WOMEN IN RICE FARMING

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The International Rice Research Institute

Rice is life itself to almost a third of the world's 4.5 billion people and a secondary staple for a further 450 million. The average annual income of rice consumers in the developing nations is less than US $200. This, combined with the continual rise in world population and the demand for more food has put an increasing burden on small-scale rice farmers.

The International Rice Research Institute (IRRI) has as its objective the improvement of the quality and quantity of rice. Established in 1960 by the Ford and Rockefeller Foundations, this non-profit organisation is adjacent to the University of the Philippines at Los Baños, 65 kilometres south east of Manila.

Today, IRRI is funded through the Consultative Group for International Agricultural Research, a group of donor agencies dedicated to the improvement of agriculture in developing nations. IRRI scientists cooperate with scientists throughout the world to develop improved rice varieties and technology.

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Foreword

Women play a major role in rice cultivation, post-harvest processing and marketing throughout the world. Rural women work long hours in domestic and agricultural production because they frequently have primary responsibility for both household subsistence and child welfare. Any technology that can increase rural women's productivity, allowing them to work less and earn more, will be beneficial to the welfare of rural households.

IRRI convened the Women in Rice Farming Systems Conference in September 1983 in order to understand better a) women's role in rice farming, b) whether women have benefited from past introduction of new rice technologies and c) how they could benefit from emerging technologies. The conference was attended by 78 participants from 27 countries. The papers in this volume reflect the variety of women's experience in Asian and African rice farming.

IRRI is grateful to several donors for supporting the conference. Generous assistance was provided by the Ford Foundation, New York, USA, and its Regional Offices; the Netherlands Ministry of Foreign Affairs; the German Agency for Technical Cooperation; and the Food and Agriculture Organization of the United Kingdom.

Thanks are due also to the Organizing Committee members Marietta Adriano, National Economic Development Authority, Philippines; Prof. Gelia Castillo, University of the Philippines at Los Baños; H. Velarde, Bureau of Agricultural Extension, Philippines; and IRRI representatives: Laurian J. Unnevehr (convenor), Ruby Castro, Glenn

Denning, Alice Flinn, Leo A. Gonzales, Richard A. Morris, Victoria M. Segovia and Lois Stanford.

This book provides new information about rural women but is by no means complete, and we hope it will stimulate further research.

M. S. Swaminathan
Director General

1 Technology and the demand for women's labor in Asian rice farming *

L. J. Unnevehr and M. L. Stanford

Women in Asia play a major role in rice cultivation. New rice technologies have had and will continue to have a substantial impact on women's income earning opportunities both within and outside the household. Women in land-operating households benefit from new rice technologies that raise the productivity of either household labor or land, but they benefit most directly when they have access to information about new technology and some control over household resources. Women in landless households, however, can only benefit from technologies that generate employment opportunities for hired labor. This paper reviews women's role in Asian rice cultivation and some evidence on the impact of past technological change on women. As many studies have considered the effect of past technological change in rice on labor demand, it is possible to draw some tentative conclusions about the benefits for landless women. Data concerning farm household women's access to technology are very scarce, and this paper only raises issues for future work. Finally, some emerging

* Paper presented at the conference on 'Women in Rice Farming Systems', IRRI, September 26-30 1983. The authors wish to thank the authors of the country papers for providing much of the information presented here and E. Marciano for able research assistance.

technologies and their potential impact on women's employment are discussed.

Women's role in Asian rice cultivation

Asian women's participation in agricultural production varies widely both among and within countries. Some generalizations about women's role in rice cultivation are possible, however. First, women's participation is much greater in rice-based cropping systems than in dryland farming. Women contributed only 9 per cent of agricultural labor in northern Chinese wheat producing regions, but 29 per cent of labor in the double cropping rice areas of southern China in the 1930s (Buck, 1937). With collectivization, women's labor input into agriculture increased in all regions, but it is still highest (33 per cent) in southern China, where rice is the dominant crop (Croll 1979). A comparison of women's participation in northern and southern India also indicates that rice systems have traditionally used more female labor, and within rice farming the more intensive irrigated systems use more female labor (Boserup, 1970; Rosenzweig and Schultz, 1982; Sen CP 1983).

Second, within Asian rice farming, women contribute most of the labor in transplanting, harvesting, and weeding (Table 1.1). One exception to this pattern is Bangladesh, where women do not participate in field work but do almost all of the post harvest processing. Elsewhere, women's contribution to total rice cultivation labor is rarely less than a third of total labor input. Their contribution is highest at one-half in Nepal and India, and is roughly a third in southeast Asian countries. Their proportional contribution does not decline with development, as it is still 30 to 40 per cent in Malaysia, Japan and South Korea.

Much of women's labor in rice cultivation is hired labor. Women in farm households sometimes exchange labor, either for cash or on a day-for-day basis. Where there are landless households as in Java or India, women without land work to exchange their labor for cash or percentages of crop harvested (Sajogyo CP1983; Mencher CP1983).

Women in small farm households supervise agricultural labor and make farm decisions in addition to work in their own fields. Throughout Asia women play an important role in rice seed selection. They are often responsible for selecting plants to provide seed, for storing seed, and for testing and germinating seed (Table 1.1). Frequently, women are involved in farm management decisions about inputs and hiring of labor (Res CP1983; Pradhan CP1983). In India, women travel to the fields to supervise labor and to check on pests and weeds (Saradamoni CP1983). In Bangladesh, women are responsible for food preparation

Table 1.1 Women's participation in rice cultivation

Country	Seed Selection	Seed-bed	Land Prep	Trans-planting	Crop Care: Weed-ing	Crop Care: Ferti-lizing	Crop Care: Insect & others	Harvest-ing	Thresh-ing	Other Post Harvest	Market-ing	Total
Nepal (Hill Systems)	X		0	64	72			52				54
India												
Andhra Pradesh			7	78	73	8	3	63	25			48
Tamil Nadu			0	69	85	39	8	64	41			55
Sri Lanka (Kandy)												
Irrigated			0	100	80	0	0		49	46		n.a.
Rainfed			0	91	80	0	0		37	67		n.a.
Bangladesh	X									X		
Thailand	X		16	29		33			73		61	n.a.
Malaysia	X	19	6	55	27	19		46	24	76	15	37
Indonesia (East Java)				X	X			X				35
Philippines (Central Luzon)			0	45	7				15			19
China		X		X		X		X				33*
Korea	33	27	2	48	23	12	24	34	34	43		36
Japan												40

Per cent of total labor in each activity, where available. X indicates that women are involved in the activity.
* Total farm labor in southern region.

Sources:

Nepal	Pradhan (CP1983)	Bangladesh	Abdullah & Zeidenstein (1983)	Philippines	Sison, et al. (CR1983)
India	Agarwal (CP1983)		Aziz (CR1983)	China	Croll (1979);
Sri Lanka	de Alwis (CR1983)	Thailand	Chandratat (CR1983)		Xue-bin (CR1983)
Malaysia	Yap (1981)	Indonesia	Collier (1982); Sajogyo (CP1983)	Korea	Lee (CR1983)
Japan	Yoshida (CR1983)				

for hired labor (Abdullah and Zeidenstein 1982); in the Philippines, women supervise hired labor (Illo CP1983); and in Indonesia, women from larger farm households are responsible for contracting, hiring and paying of farm labor (Stoler 1977). In southeast Asia, women generally market the rice crop as well (Chandratat CP1983; Watson CP1983).

How women can benefit from new technology

Contradictory statements are often made in the 'women in development' literature regarding how technological change will benefit women. On the one hand, there is a call for technologies to eliminate drudgery or to reduce women's work burden. Yet on the other hand there are warnings against introducing technologies that will reduce women's employment opportunities. All writers agree that it is beneficial to raise women's labor productivity, because this raises the returns to their labor.

The confusion arises because an increase in labor productivity is not always accompanied by an increase in labor demand. Where there is a growing supply of landless women's labor, women will only benefit from productivity increases that are accompanied by increased labor demand. Figures 1.1 and 1.2 illustrate three types of technical change

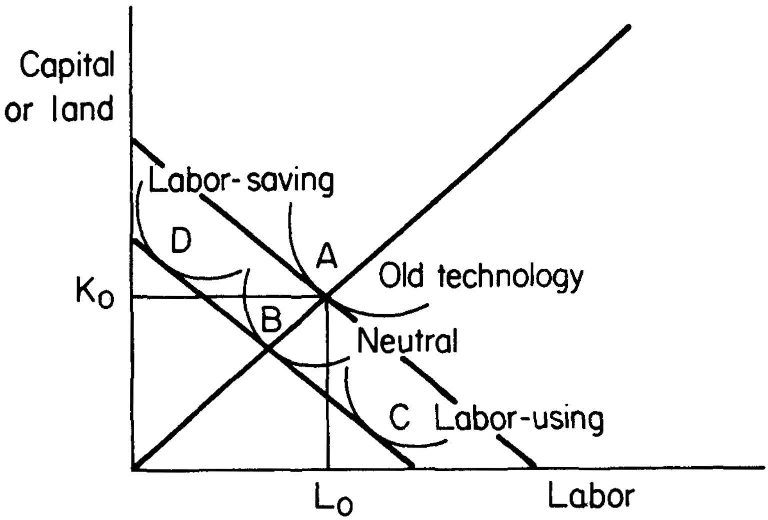

Figure 1.1 Technical change and factor proportions

and their impact on labor use. In Figure 1.1, point A is the combination of factors used with the old technology. Three new isoquants, representing labor-saving, neutral, and labor-using technologies all allow the same output to be produced with fewer inputs. In all three cases labor productivity increases because the same output can be produced with a smaller amount of labor. However, the factor proportions vary, and thus the demand for labor also varies.

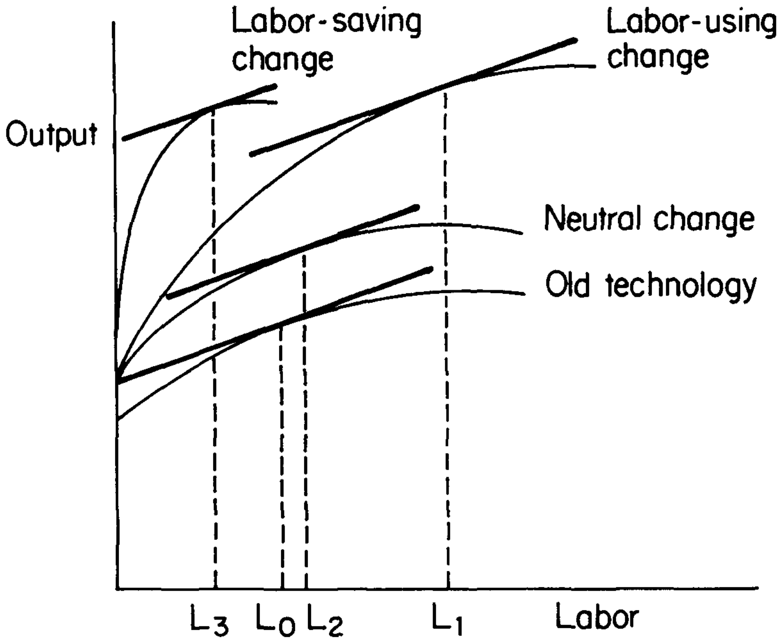

Figure 1.2 Technical change and labor use.

Figure 1.2 shows the changes in total labor use for the individual farm or household. With a given set of prices, labor amount L_0 is used under the old technology. With either a neutral or labor-using shift in the response function, it will be profitable to employ additional labor to produce more output. With a labor-saving technical change, however, the total use of labor declines. Thus any technical change will increase labor productivity, but only neutral or labor-using change will increase total labor use as well.

Whether technical change benefits women depends on their control over resources. Women in farm households who have some control over the income from land will benefit from any type of technical change in agriculture. This is because they will reap the returns from increased productivity of both household labor and land (ignoring intra-household distribution). For women in landless households whose only resource is labor, neutral or labor-using technical change in agriculture will raise demand for their labor as well as their productivity. Labor-saving technical change will reduce their employment opportunities.

The impact of past changes in rice technology on demand for women's labor

In land-scarce Asia neutral or labor-using technical change is most desirable, because growing populations and declining expansion of arable land mean that increasing numbers of rural Asian households neither own nor operate land.[2] The proportion of rural households that are landless and dependent on agricultural work is estimated at 27 per cent for India, 41 per cent for Java, and roughly 13 per cent for both the Philippines and Sri Lanka (Barker and Herdt, forthcoming). While growth in industry provides some job opportunities outside agriculture, evidence from the Philippines (Castillo et. al. 1983; Kikuchi et. al. 1983) and Indonesia (Collier et. al. 1982) indicates that children of farm households are moving into the best-paid urban sector jobs. Landless households do not have the resources to invest in education and thus remain dependent on opportunities in agriculture or the informal urban sector for their income.

Landless women have a higher labor force participation rate that farm women and contribute a higher proportion of the family's cash income. In Java (Stoler 1977), Bangladesh (Halim and McCarthy CP1983), and India (Mencher CP1983; Saradamoni CP1983), landless women contribute about half of household cash income and work longer hours in both wage labor and household production than men. Because of the need to earn a minimum subsistence level of income, wage earners in landless households continue to work even when returns to additional labor are declining (Hart 1978). Agricultural labor is often the most rewarding type of labor open to landless wage earners who are otherwise forced to work for small returns in the informal service sector.

Women in landless households would benefit from working less only if their subsistence needs can be met from other sources. As long as they are dependent on labor income, increased demand for labor will benefit them through ensuring that wages do not continue to fall with population growth. Labor in rice cultivation or processing provides a varying but always significant portion of women's income in Asia. For example, harvesting alone provides a third or more of women's income in the major rice growing states of India (Acharya and Parker CP1983). Thus labor demand growth in rice production can benefit landless women.

Past experience in East Asia suggests that the seed-fertilizer technology is neutral or labor-using (Ishikawa 1981). Increased amounts of labor can be applied per hectare and per crop, and at the same time the average amount of rice each worker produces increases. Thus development of improved varieties for the tropics was expected to provide employment in countries currently developing (Jayasuriya and Shand 1983).

Japan, Korea, and Taiwan experienced rapid technological change in the 1920s and 1930s with the introduction of fertilizer responsive rice varieties. In the mid-1960s short-statured, fertilizer responsive modern varieties (MVs) for the tropics were introduced by IRRI and national research programs. They have been widely adopted by farmers in irrigated and favorable rainfed environments, because their yield advantage is greatest where water managment is good. MVs are most widely grown in the Philippines, Indonesia, Sri Lanka, and India (Table 1.2). They are less widely adopted in the rest of South and Southeast Asia. MVs have contributed greatly to global production growth, complementing investments in irrigation and increased fertilizer use. Herdt and Capule (1983) estimate that MVs alone accounted for one-quarter of the growth in production between 1965 and 1980 in the major rice growing countries of Asia.

MVs generally require more labor than traditional varieties because they require more weeding (due to increased fertilizer use) and the increased yields require more harvest and post-harvest labor. Barker and Herdt (forthcoming) review 20 village studies of labor use both before and after MV adoption throughout Asia and find that in 13 cases labor use increased, and in another 3 cases remained unchanged. Some of these findings are presented in Table 1.3, and they show gains in labor productivity as well as labor use. Increased labor has generally been used in women’s tasks: intensification of crop establishment (transplanting in straight rows) and crop care (weeding and fertilizing), and harvesting and processing the additional yield. Furthermore, increased irrigation and shorter-duration varieties lead to increased cropping intensity and more regular demand for labor throughout the year, as demonstrated by long-run trends in Taiwan (Barker and Herdt, forthcoming). As the increase in labor demand is principally for women’s tasks, new technology has expanded their employment opportunities.

The adoption of MVs has also been accompanied by increased use of hired labor. In a review of 21 studies of hired labor use after MV adoption, Barker and Herdt found an increase in 16 cases. Not only are the seasonal demands for increased labor use met through hiring in, but family labor also declines absolutely. In particular, women in farm households shift to more lucrative marketing or sideline activities and

Table 1.2 Levels of irrigation, modern cultivars, and fertilizer used on rice in Asia, 1960s and 1970s.[a]

Location	1965–69 Irrigation (% area)	1965–69 Modern cultivars (% area)	1965–69 Fertilizer[b] on rice (kg/ha)	1975–79 Irrigation (% area)	1975–79 Modern cultivars (% area)	1975–79 Fertilizer[b] on rice (kg/ha)
South Asia						
India	38	7	13	40	37	40
Pakistan	100	10	13	100	46	43
Bangladesh	7	2	3	12	16	8
Sri Lanka	61	1[c]	36	66	56[c]	67
Southeast Asia						
Malaysia	65	3[c]	57	67	18[c]	69
Thailand	28	0	6	24	10	11
Philippines	40	22	14	42	70	36
Indonesia	65	3	11	70	55	41
Burma	15	1	3	17	12[c]	8
East Asia						
Japan	100	100	286	100	100	340
Taiwan, China	100	100	218	100	100	246
Korea, Rep. of	84	0	143	92	51[d]	216
China	89	16	24	89	66	49

[a] Sources: Modern cultivars data from Herdt and Capule, 1983. Fertilizer and irrigation data from Palacpac 1982.

[b] In nutrients (N + P + K); Chemical sources only.

[c] Narrow definition of modern cultivars.

[d] % in indica-japonica crosses.

[e] Includes all provinces except Taiwan; data are assumptions as spelled out in Barker and Herdt (forthcoming).

Table 1.3 Increase in labor, labor productivity and hired labor use with MV adoption, selected locations in Asia.

	Labor use ratio MV/TV (days/ha)	Rice/Labor ratio MV/TV (kg/day)	Hired labor ratio MV/TV (days/ha)
Indonesia			
West Java	1.6	1.2	1.4
Central Java	0.8	1.6	1.0
East Java	1.1	1.2	n.a.
Bangladesh	1.4	1.1	1.6
Philippines	1.2	1.2	1.7
Thailand	1.4	0.9	n.a.
S. Korea	1.1	1.2	n.a.
Sri Lanka	1.3	1.2	n.a.
India			
W. Godavari	0.9	n.a.	n.a.
Ferozepur	1.0	n.a.	n.a.
Kanpur	1.2	n.a.	n.a.
Palamau	1.7	n.a.	n.a.

Source: Barker and Herdt, forthcoming.

provide supervision rather than labor in farm production (Roumasset and Smith, 1981; Illo CP1983; Res CP1983). Thus, the adoption of MVs not only increases total labor demand, but increases hired labor demand, which should benefit women in landless households.

Comparisons of labor use before and after MV adoption are relatively rare, and studies that disaggregate the data into male and female labor are even more unusual. In this volume Agarwal (CP1983) compares labor use for MV farms and non-MV rice farms in three states of India. She finds that use of hired female labor is greater for MV cultivation, primarily in the weeding and harvesting tasks. Sen (CP1983) does not examine MV use directly but does find that women's participation is greatest in the more intensive irrigated paddy farming systems. Her results support the notion that female labor use increases with intensity of land use. Other results differ, however. Res (CP1983) finds a decline in female labor use with the introduction of short duration varieties in a rainfed area of the Philippines, because direct seeding and mechanical threshing were also adopted to reduce the seasonal demand for labor.

Sajogyo (CP1983) reports that hired female labor use has been declining over time in rice cultivation on Java, as access to harvesting opportunities has been limited by institutional change. Both White (CP1983) and Sajogyo (CP1983) point out that this decline is not the consequence of MV adoption, but part of a longer process of change. Thus the little evidence that is available specifically concerning women's labor and new rice varieties is mixed.

There are several reasons why the introduction of MVs may not have the expected effect on labor use and income. Rapid population growth has continued at the same time that MVs have increased demand for hired labor in rice cultivation. Acharya and Parker (CP1983) report rising numbers of agricultural workers per cropped hectare between 1964–65 and 1977–78 in India, and Mencher (CP1983) reports very high unemployment among landless women in paddy growing areas of India. White (CP1983) and Sajogyo (CP1983) find declining returns to labor also on Java. Aggregate agricultural wages confirm this trend – wages have been stagnant in most Asian countries (Table 1.4). Wages have increased only in Japan, South Korea, and Malaysia where there has been strong growth in the industrial sector. Where farm wage data are available by sex, women's wages do not show any particular change relative to men's wages (Table 1.4). Thus gains in labor demand from the new rice technology have not offset the effects of population growth and slow growth in the industrial sector on both men's and women's wages.

One reason for this is that the new rice technology is location-specific to irrigated and favorable rainfed environments (Barker and Herdt, forthcoming). As labor opportunities expand in irrigated areas, labor from upland areas migrates in (Hayami and Kikuchi 1981). Areas adopting the new rice technology must absorb considerably more labor than if the technology were broadly adopted. Potential gains in wages from the increased labor demand must be spread over many more workers.

Recent studies (Ishikawa 1981; Barker and Herdt, forthcoming; Jayasuriya and Shand 1983) have suggested that the new rice technology's ability to absorb labor is not as great now as in past East Asian experience. Labor use has not increased as much in South and Southeast Asia as it did earlier in East Asia. There also seems to be a faster shift to other technologies that are labor saving following the adoption of MVs. Barker and Herdt (forthcoming) expressed their concern over these developments: '. . . with the technological alternatives available today, labor use in rice will not reach the levels of 200 or more man days per hectare prevalent in Japan and Java for a decade or more after World War 11. On the contrary, the danger exists that in many parts of Asia today premature introduction of labor saving

Table 1.4 Index of real wages of agricultural laborers in selected Asian countries (1965 = 100).

	Japan		South Korea		Sri Lanka		Malaysia	Philippines	India	Bangladesh
	Index	Ratio Fernale/ Male[a]	Index	Ratio Female/ Male	Index	Ratio Female/ Male				
1965	100	0.80	100	0.74	100	0.82	–	100	100	–
1966	104	0.81	104	0.80	99	0.83	100	101	104	–
1967	111	0.82	112	0.83	98	0.84	95	102	103	–
1968	125	0.83	126	0.76	107	0.82	97	93	102	100
1969	132	0.84	136	0.68	100	0.82	100	84	113	99
1970	138	0.81	147	0.68	96	0.81	98	79	117	96
1971	179	0.78	155	0.68	96	0.97	93	78	86	75
1972	162	0.79	161	0.69	110	0.71	91	–	107	70
1973	170	0.79	171	0.70	93	0.91	89	–	92	67
1974	178	0.79	178	0.70	105	0.76	100	70	56	70
1975	197	0.79	182	0.71	122	0.76	90	–	84	70
1976	191	0.79	205	0.71	134	0.77	102	–	94	68
1977	195	0.78	230	0.72	146	0.77	102	–	89	70
1978	201	–	290	–	–	–	107	–	90	74
1979	202	–	372	–	–	–	119	–	90	–

[a] Ratio of female to male farm wage.

Source: Barker and Herdt (forthcoming) and World Rice Statistics, 1982.

technology such as tractors, threshers, and weedicides could keep labor input per hectare from rising significantly above the current level of around 100 man days per hectare.' Mechanization of land preparation will not affect women directly, but the mechanization of threshing and use of herbicides will affect demand for women's labor in many labor abundant Asian countries.[3]

In contrast to earlier East Asian experience, labor-saving technologies are already available from developed countries. Although these technologies may have been produced in response to differing land/ labor endowments and environmental conditions, they are often readily transferable to the tropics (Jayasuriya and Shand 1983). There is also underinvestment in research on labor-using technologies relative to research on labor-saving technologies (Anderson 1980). Because returns to development of labor-saving technologies accrue to private machinery or chemical industries, private research is undertaken by industry. Labor-using technologies, such as new varieties, are public goods. Thus research to develop these technologies must be supported by public funds. Because governments, particularly in LDCs, tend to underinvest in agricultural research (Akino and Hayami 1975), less labor-using technology is developed. The end result is that farmers' opportunities to substitute capital for labor are greater than their opportunities to substitute labor for capital.

Farmers do not substitute capital for labor without some price incentive to do so. Many governments in Asia pursue price policies that discourage the growth of labor demand in agriculture. Farmers switch to labor-saving technologies if capital becomes cheaper, even when wages are stagnant. In many Asian countries, subsidized credit is available to farmers for purchase of machines and inputs. Fuel or electricity is sometimes subsidized to encourage adoption of mechanization, and this has encouraged the switch to mechanical rice milling in Bangladesh, for example (Begum CP1983).

Furthermore, agricultural output prices are frequently reduced by direct taxation and overvalued exchange rates (World Bank 1982). This reduces the long-run incentives to produce in agriculture, and also incentives to employ labor. For example, Mencher (CP1983) finds that cultivators in India do not double crop because output prices are low, and it is in single crop rice areas that landless women's unemployment is highest. A comparison across countries suggests that in the long-run labor use declines with rising real wages (Figure 1.3). Short-run estimates of the elasticity of labor with respect to wages from India (Evenson and Binswanger 1979) and the Philippines (David and Barker 1981) are fairly small and vary from –.1 to –.4. David and Barker (1981) point out that labor use is more sensitive to the rice price than to wages, however, because a higher output price encourages use of all inputs, many of which are complementary to labor. Thus the elasticity of labor use with respect to the rice price should be somewhat greater. Negative output prices not only discourage growth in food supply, but also the long-run ability of the agricultural sector to absorb labor.

Ultimately wage-earning opportunities for landless women are affected by decisions regarding research directions and public policies for agriculture. In order to ensure expanded employment opportunities for the landless women of Asia, more agricultural research on labor-

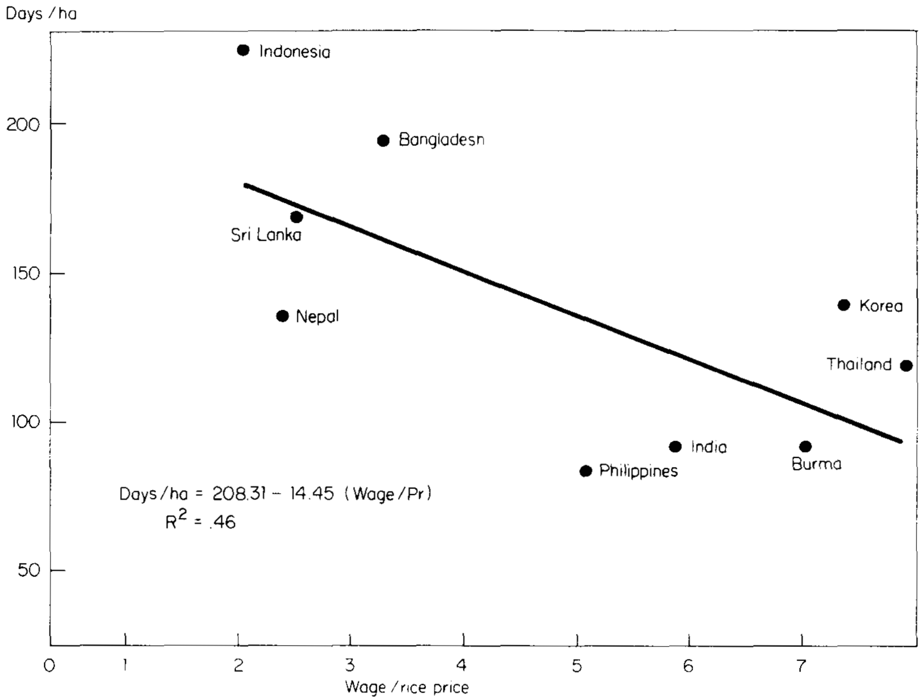

Figure 1.3 Labor use in rice and real wages in selected Asian countries.

Sources:
Data on wage/rice price:
Thailand, South Korea, Bangladesh, Sri Lanka, Indonesia, Nepal, Burma – Barker and Herdt (forthcoming)
Philippines – IRRI-Central Luzon data for 1979.
India – Agricultural Situation in India for 1971-72.

Data on days/ha:
Thailand, South Korea, Bangladesh, Sri Lanka, Indonesia – Barker and Herdt (forthcoming)
Burma – Paris, T. et. al., 1982
Nepal – Karki, B. B. 1979
Philippines – IRRI-Central Luzon data for 1979.
India – Indian Agricultural Statistics, Annual Report 1976-77.

using technologies is needed. Research institutions need to design technologies that are appropriate to the social opportunity cost of factors, rather than market prices that are frequently distorted by government policy. Technology is not the only factor affecting agricultural employment growth, however. There is also a need for public policies to provide incentives for long run growth in agriculture. These include favorable prices and investments in infrastructure such as irrigation. Intervention at the household or community level to aid landless women may be futile without accompanying changes to improve growth in the rural sector.

Women's access to resources and information

Women in farm households benefit from new agricultural technology when they have some control over the income from household land and labor. Established social institutions governing intra-household allocation of income and decision-making vary across Asia.[4] For example, women in Java can own land (Wijaya CP1983) and control household financial resources used in marketing (Stoler 1977). In contrast, women in Bangladesh devote a significant amount of time to caring for bullocks, but have little control over decisions about when to sell the bullock or how much to sell it for (Abdullah and Zeidenstein 1982).

Given the differences in women's status, the policy relevant question is whether technology transfer programs have changed or reinforced women's traditional roles. By providing women access to more productive technology, programs can enhance women's earnings in their traditional roles. By ignoring women, programs can help to push women out of traditional productive roles.

In a survey of agricultural extension programs, Ashby (1981) notes that women's contribution to crop production is frequently underestimated. Agricultural extension services are directed to men, who are perceived to be the managers of farm households. Examples of this are found in the African literature (see Staudt 1978 and Dey CP1983, for example), but there are few studies of crop extension programs in Asia. One study in Nepal confirms that women's role in farm management declines when the extension of new technology is directed to men. Pradhan (CP1983) finds that Nepalese women's role in fertilizer decisions declined after extension programs provided subsidized credit to men for use of chemical fertilizers.

Extension projects and training for women have operated from a Western concept of domestic production, focusing primarily on women's reproductive, child care and home-making activities (Ashby

Table 1.5 Women's involvement in agricultural education and extension

Country	% Women Literate	% Women enrollment in Agricultural Colleges	% Women of Extension Workers
Nepal	5	0	0
India	19	1	n.a.
Sri Lanka	68	28	33
Bangladesh	9	19	n.a.
Thailand	70	26	24
Malaysia	48	n.a.	19
Indonesia	45	20	n.a.
Philippines	81	49	58
China	n.a.	n.a.	n.a.
Korea	81	11	5
Japan	97	n.a.	17

Source: Country Reports and Population Reference Bureau.

1981). Government programs for women in the Philippines, Sri Lanka, and Korea also provide training for income-generating activities such as livestock raising, vegetable gardening and handicrafts (Sison et. al. CR1983; de Alwis CR1983; Lee CR 1983). They do not include training for rice crop cultivation, however. Sideline and home-making activities can be important sources of household income, but women's substantial role in crop cultivation suggests that crop extension programs should also try to reach them.

Some private programs have focused directly on women's income and employment needs. Women in south India have organized to gain better employment opportunities and control over household income (Arunachalam CP1983). Women's cooperatives in Bangladesh have invested in post-harvest rice processing, so that groups of women can control the gains from the improved productivity of rice mills (Abdullah CP1983).

Emerging technologies

Emerging technologies will have an impact on the demand for women's labor and management skills in the future. The pessimism cited above concerning the future capacity of rice agriculture to absorb labor may be premature. There are several yield-increasing, labor-using rice technologies under development: new MVs, hybrid rice, fertilizer deep placement, and bio-fertilizers. The latest MV releases are super-short duration and will allow further increases in cropping intensity. Other MVs are being developed to provide higher yields in less favorable environments and these could raise yields in a much larger part of Asia (Khush CP1983). Another source of higher yields is use of hybrid seed. Both traditional and modern varieties are pure varieties, and farmers can use seed from their own production. Hybrid seed is the result of cross-pollination between two varieties and new seed must be produced every year. Preliminary evidence indicates that use of hybrids could increase yields by 20 to 30 per cent (Virmani and Te CP1983). A third yield-increasing technology is the use of simple deep-placement machines for fertilizer application. These can double the efficiency of inorganic fertilizer through reducing the loss of nitrogen in water. Thus yields can be increased without any increase in fertilizer cost (Khan CP1983). Another labor-using technology is the use of bio-fertilizers, such as azolla, to fix nitrogen in the soil (Ladha et al. CP1983). Use of this technology substitutes labor for purchased inorganic fertilizer. All of these technologies are likely to benefit women in labor abundant countries through raising demand for labor.

Any changes in crop establishment will clearly affect women as they are responsible for transplanting throughout Asia. Farmers in many parts of Asia traditionally direct seeded their fields and substantial portions of the rice crop are still direct seeded in Thailand and Sri Lanka. A shift to transplanting or intensification through transplanting in straight rows to allow easier weeding is sometimes considered part of the Green Revolution package. Rising labor costs in some countries have led to adoption of direct seeding and herbicides to replace transplanting and weeding labor (Moody and Cordova CP1983). This technology would be appropriate in areas where crop establishment and weeding are carried out by female household labor, and its suitability where transplanters are hired female labor requires study. Price policies with respect to herbicides should be carefully considered in order not to encourage premature adoption.

More complex strategies to control rice pests will require the management skills of women in farm households, Integrated pest management is a package of cultural techniques, including the use of pesticide only in response to monitored pest levels (Litsinger CP1983). This technology is ‘management-using’, as it requires greater understanding of the pest life-cycle in order to make complex decisions about pest control. Women’s involvement in crop care suggests that they are the natural target group for training.

Machine milling of rice is not an ‘emerging’ technology, as it has been already widely adopted in Asia with growth in marketed rice supply (Barker and Herdt, forthcoming, Sen CP1983). The shift from handpounding to machine milling of rice is currently an important issue in Bangladesh, however (Begum CP1983: Abdullah CP1983: Halim and McCarthy CP1983).[5] Some alternative designs for intermediate-scale milling technology are suggested in Srivastava (CP1983).

Concluding remarks

This paper has looked at some broad indicators of the benefits of past technological change in rice for women. Past adoption of MVs has raised demand for hired labor in women's tasks and should therefore have provided expanded employment opportunities for landless women. There is danger, however, that these gains will be eroded by continued population growth, government policies that encourage adoption of labor-saving techniques, and underinvestment in research on labor-using technologies.

Women in farm households do not seem to have direct access to new rice technologies. The effect of this on their productivity and ability to gain from technological change is largely unknown. However, women's substantial role in rice cultivation in many countries suggests that crop extension could be more successful if also directed to women.

Many of the authors in this volume have emphasized that rice production is only one part of women's income earning activities and that more opportunities for remunerative employment outside agriculture are needed. (Wijaya CP1983; Sajogyo CP1983;Illo CP1983; Res CP1983; Mencher CP1983). It is therefore important to realize that new agricultural technology can have broader effects than those considered here. Sometimes an analysis of labor use by activity fails to consider how increased income from new technology can generate employment outside agriculture. Where small farmers spend income from new technology on labor-intensive goods and services, substantial gains in rural employment can be obtained (Mellor 1976; Ahammed and Herdt 1983). Studies of the alternative employment opportunities available to displaced women workers would help us to understand whether and how these forward linkage effects work in practice.

Notes

1. If many farms adopt the new technology, the increased demand for labor will cause wages to rise and eventually less labor will be used.
2. This problem is not unique in Asia. See Dey CP1983.

3. Generally, the first activities to be mechanized in rice production are land preparation, threshing and milling. Transplanting and harvesting, women's traditional tasks, are mechanized at a much later stage of development. As wages in the industrial sector rose in Japan, farm household men and children shifted to off-farm employment, leaving older women to cultivate rice (Kada CP1983). Complete mechanization of Japanese rice farming came about only in the 1970s, and women were then able to spend more time in off-farm employment.
4. Intra-household bargaining in an African country for control over labor and income is analyzed by Jones CP 1983.
5. The past impact of the introduction of milling on women in Java and India is discussed in Acharya and Parker CP1983, Sajogyo CP1983, and White CP1983.

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2 Observations on institutions, infrastructure technology and women in rice farming

R. E. Evenson

Our understanding of the relationships between the welfare of women (and their families) and the institutional and technological settings in which they live and work is still rudimentary in most respects. However, a number of case studies and time allocation studies, some of them reported at this conference, are providing a basis for substantial improvements. We are accumulating a rich mosaic of 'micro' studies showing wide diversity in the activities of women and their relationships to other members of their families. Many different types of contractual arrangements regarding control over income are being reported. Women's activities in rice farming are observed to range from complete management and production of the crop in some societies to very limited roles in others.

This diversity of activities and roles of women certainly suggests that we should be very careful about generalizing from any particular study and drawing conclusions about other rice farming communities. On the other hand, the diversity and detail provided by micro studies can be useful in suggesting the types of abstractions or theorizing that are plausible and can guide us toward improving these theories. In economics there are three bodies of theory that bear on the proceedings of this conference. The first is the 'economics of the family', formerly the new household economics. The second is the more recent 'economics of institutions'. The third is the 'economics of technology'. My objective in this note is to juxtapose the abstractions of each of these bodies of theory against the emerging data on women's activities. I hope in the process both to draw out some interpretations of the data from the theory and to point out some of the inadequacies of the theories.

Perspectives from the economics of the family

The body of economic studies now generally called the economics of the family or the economics of the household is primarily concerned with the nuclear family. In much of this literature it is assumed that family or household members have a high degree of 'caring' for each other. That is, each member derives satisfaction from events that cause an improvement in the welfare of another member. Becker and others have shown that in this type of family consumption goods, including leisure, will be shared relatively equally among family members. This does not mean that everyone will consume the same goods or engage in the same activities. It simply means that each member will have an equitable share of the total family resources (or income). In this type of family, conflicts between men and women or parents and children tend to be dominated by the concern each member has for the larger welfare of the entire family.[1]

This conference has produced a number of papers stressing conflict between men and women in many societies. It seems that the model of the caring family is inappropriate to many societies and situations. This is particularly true in societies where the conventional monogamous family does not exist. Economists do have an alternative model of the 'bargaining household' for such situations. It is somewhat less well developed than the standard model. Before turning to it, however, I want to draw out further implications of the caring family model because I believe that this model does apply to the vast majority of the rice farming communities of the world.

The model implies that family members will specialize, according to comparative advantage, in their time allocation. Members facing the highest wage offers and employment opportunities will naturally specialize in market work. Rural households engage in many types of economic activities that are often considered non-economic. For example, food processing and meal preparation are often not considered to be productive when undertaken in the household. Yet when they are industrialized (e.g., rice milling, vegetable canning, meat packing) the same activities are accorded economic status.

The economics of specialization explains why women engage in more housework and household production than men when men have better employment opportunities than women. Economics does not explain why household production generally confers less status or standing than does work on wage jobs or on the farm. This is a long standing bias (and is present in this conference) in spite of the fact that the economic model tells us that the real value of women's time in the household is at least as great as, and probably greater than, the value of time spent in the market.[2] Table 2.1, drawn from a Philippine study, illustrates the nature of proper income accounting.[3]

Table 2.1 Value of market production, home production and full income based on Laguna Intensive Data (regression estimate method)

	Pesos per year
Market income	
Father	3334
Mother	1148
Children	1301
Total	5783
Value of home production	
Father	668
Mother	3287
Children (excluding school time)	2061
Total	6016
Children (including school time)	3599
Total (including school time)	7554
Full income	
Father	4002
Mother	4435
Children (excluding school time)	3362
Total	11799
Children (including school time)	4900
Total	13337

Source: King (1977).

It simply shows that when a proper accounting of the economic value of all work is undertaken, women contribute more to family income than men because they work more. Whether they work harder and endure more drudgery is difficult to say. Drudgery like beauty tends to be in the eye of the beholder. When the beholder is a member of another class or group, and particularly a member of another culture, I would not be very comfortable with the beholder's definition of drudgery. There is considerable danger that policies motivated by a desire to reduce drudgery can reduce employment opportunities for women and have serious welfare implications.

Let me now turn to the bargaining model of the household to see whether it can offer insight into those cases where conflict between men and women is observed. This model essentially says that the bargaining power of a woman or man depends on the alternatives outside their present arrangements. This explains why property rights of women and property rights of men are important. In societies where women have power they have property rights.

A study of rural Philippine households (Laguna Province) by Raul Fabella (1982) supports this contention. Fabella found that for the higher income households in the Laguna sample, the data did not enable him to reject the hypothesis of equal sharing in consumption of food among household members. He did find that for the lower income households in the sample there was unequal sharing. Income earning members of the household consumed relatively high shares of the food budget and women and female children consumed inequitably low shares. The higher consumption of food by income earners is consistent with the caring family model.

The paper by Christine Jones (this conference) illustrates the applicability of a bargaining model to North Cameroon.

Perspectives of institutional economics

Institutions, as the term is used here, encompass legal property rights, contract forms and community conventions as well as administrative processes, communication media, etc. These institutions quite clearly impinge on household behavior and on the sharing of income by members of the household. The focus of the new institutional economics is on understanding the factors that change institutions. These include changes in laws, choice of contracts and the invention of new institutions. Much of this literature deals with problems that emerge because of inherent limitations in contract forms and related market failures.

The major conceptual themes underlying this literature are 'minimizing excess burden' as applied to micro household decisions and a somewhat more general 'induced institutional change' applicable to public decisions.

The excess burden analysis can be illustrated by the choice between paying hired laborers by the hour or day versus paying by a piece rate. Either contract has its costs. The hourly wage rate contract is subject to 'shirking' by workers and the farm manager must provide supervision to hold down these shirking costs. The piece rate contract is also subject to shirking and monitoring of the task is required. Presumably the farmer will choose those contracts that minimize the total excess burden, i.e., the sum of shirking, supervision and monitoring costs. In societies where these costs are generally high, there is a strong incentive to avoid some of these costs by relying on family type enterprises. Typically the family obligation and ties are strong enough to reduce shirking costs.

In rice farming in Asia we do observe the predominance of family farms in rice production, and in part of the region the extended family is important. This tends to be associated with high densities of population to land.

When markets become more efficient in the sense that the costs of recruiting labor and the costs of searching for work fall, the advantage of the family enterprise declines. We then observe specialization emerging in some sectors of the economy and much economic growth is produced from these gains.

David Feeny, among others, has argued that societies change institutions by developing or adapting new institutions consistent with the interests of the politically powerful groups.[4] In Thailand, for example, the rising value of land led to a clarification and strengthening of property rights in land. He also argued that falling real wages in Thailand were a factor in the decline of the 'Corvee' system in Thailand. The argument basically is that governments respond to the interests of the most powerful groups in the society.

It is not obvious that this line of analysis can actually explain the existence of the marriage arrangements and property rights in the different societies reflected in the conference papers. It is suggestive, however, that most of the societies with high ratios of population to land have highly regularized systems of land rights, tenancy contracts, and related wage contracts. Many societies with low ratios of population to land, on the other hand, have land rights characterized by the absence of strong legal systems.

The micro-economics of the family, modified to some degree by institutional factors, has been used primarily in the context of analyzing the determinants of change in demographic behavior, investment in schooling and work by children. Table 2.2 reports regression analysis results of this type based on a sample of households from Laguna province.[5]

The table is designed to show the integrated nature of household

Table 2.2 Regressions: FHDO 1963 data

	Dep Variable Pregnancies 72–77	USEFAMPLAN	Children Days worked	Expenditures on schooling
Child wage	.0342**	.0030	32.21**	–10.676*
Mother's wage	–.1122**	–.0061	–48.92*	–23.11
Father's wage	–0.153	.0072	–25.59**	7.469
Mother's education	.0054	.0129**	–.577	2.899
Father's education	.0034	–.0028	4.198	7.355*
Mother's age	.0054	.0056**	1.439	.226
Father's age	.0105**	.001	–.646	2.344
Home capital	–.722(05)**	.826(07)	.0004	.0052**
Farm capital	.354(05)	.179(06)	.0004	.00004
Home Tech Adoption 1968	–.0020	–.005	–1.561	1.589
Farm Tech Adoption 1968	–.0190*	–.0007	–16.364**	–7.373
LAND	.0563*	.0039	–26.053	55.97**
Price Wedge	–.1521	–.0243	227.12*	108.09
LAND X Price Wedge	–.0018*	–.00018	.4431	–1.8816**
Distance F.P. Center	+.0229*	.0026	6.772	–1.093
R^2	.319	.224	.115	.167
F	6.80	3.89	1.90	2.90

** "t" > 2.0
* 2.0 > "t" > 1.5

decision making. Four dependent variables reflecting choices by families are included in the household model. Each is regressed on a common set of exogenous variables that are not under the control of an individual household in the short run. The four choice outcomes, fertility, contraception, work by children and expenditures on schooling per child, are thus jointly determined by the set of exogenous variables.

The independent determinants or exogenous variables include the wages offered in the labor market in each barrio. This variable was itself estimated by a regression procedure in which observed wages were regressed on schooling, distance from work and barrio dummy variables. It is thus a predicted wage corrected for schooling differences and distances from work. Parental schooling and age were included. Two capital variables and two technology use variables are also included. The farm capital variable along with the land farmed variable are picking up wealth effects and employment opportunity effects. The technology adoption variables (measured as the number of recommended practices actually adopted as of 1968) are designed to measure differences in household and farm management skills between households.

A price wedge variable is included as a crude measure of institutional or transactions costs. It is the ratio of prices paid by consumers for rice to prices received for rice by producers at the barrio level. Finally a variable, distance to the nearest family planning center, is included as a measure of the provision or supply of family planning services.

The results are generally consistent with a *priori* reasoning and with results obtained in other studies. High child wages have a positive impact on pregnancies and child work and a negative impact on schooling investment. High mother's wages, on the other hand, impact negatively on pregnancies and on child work. High wages for fathers have a non-significant effect on pregnancies but do have a significant negative effect on child work. On the whole this is consistent with expectations. We expect the value of mother's time to be most important as a determinant of pregnancies because of her specialization in child care activities.

Interestingly, when wage effects are taken into account, parental schooling affects only contraception and schooling expenditures.

Farm capital and land have positive effects on both pregnancies and schooling expenditures. This appears to be the result of a combined wealth – earning opportunities effect. The technical skill variables and the home capital variable generally have negative impacts on pregnancies and child work reinforcing the view that skills are important in the home. Note that the distance from a family planning center is also affecting pregnancies. The price wedge variable has a negative effect on pregnancies as expected because it reflects lower net farm earnings and lower net contributions of children.

These results indicate that Philippine families do respond to economic conditions in ways that are important to women and their welfare. The finding that wage levels and employment opportunities for women affect behavior is important. We should not ignore the labor markets in which women work. It appears that policies designed to reduce discrimination against women in labor markets as well as programs directed toward skill development in farm and home production will have desirable consequences for children.

Technology and its economic implications for women

I now turn to my third topic, the effect of technical change on welfare. I am not aware of any studies addressing the effect that new technology has for women directly. We do, however, have some evidence of the effects of technology on producer behavior in North India and on the welfare of certain groups in the population. I will provide only a summary of these results here. Evenson (1982), Evenson (1983) and Quizon and Binswanger (1983) provide details.

The primary results on which the estimated effects are based are obtained from econometric estimates of farm level response to changes in prices, technology and infrastructure. The underlying economic model presumes that farmers maximize variable profits subject to the prices they face for outputs and factors and to fixed factors over which they individually have no control. This model yields an eight equation system in which each variable output supplied (wheat, rice, coarse cereals, other crops) and each variable input demanded (fertilizer, bullock labor, tractors and labor) is related to the prices farmers face and the technology and infrastructure available to them.

The data used for these estimates are from North Indian Districts. These district data are aggregated into 22 homogenous regions based on crop production data. Table 2.3 provides means and variable definitions for two major regions, a wheat producing region encompassing the districts of Punjab, Haryana and Western Uttar Pradesh, and a rice producing region encompassing Eastern Uttar Pradesh and Bihar. The table shows the relative importance of the different crops and inputs in the two regions.

Table 2.4 reports the basic estimates in elasticities form. The ‘t’ ratios apply only to the estimated parameters. These equations are estimated as a system and the symmetry restrictions across equations implied by profit maximizing behavior have been imposed.[6] The table can be read by reading down a column to see how the several exogenous variables impact on one of the endogenous output supply or input demand variables. For example, column 1 shows that a 10 per cent increase in the price of wheat will cause a 3.7 per cent increase in the supply of wheat. A 10 per cent increase in the price of rice, however, will cause farmers to shift production out of wheat and into rice. Wheat supply will fall by 1.28 per cent. We may note that irrigation investment increases wheat supply as does an increase in the availability of high yielding varieties and an expansion in investment in the Indian public research system.

The table can also be read by row enabling us to see how a particular exogenous variable shifts the entire system. This is particularly illuminating for the technology variables. The HYV variable is designed to measure the short term direct impact of high yielding varieties on farms. The HYV variable measures the availability of modern varieties of wheat, rice and maize. In the case of wheat and rice these varieties were initially introduced by CIMMYT and IRRI. However, the Indian research system quickly responded to the availability of the new germplasm by introducing these varieties into local breeding programs. Locally produced HYVs had largely replaced imported HYVs by the early 1970s.

By reading across the HYV row we can see that the availability of

Table 2.3 Variables dictionary: North Indian data set observations on 22 regions, 1959–74

Variable definitions	Means Wheat Region	Rice Region	All
1. Variable Farm Outputs			
Wheat	20678.19	10124.76	16360.88
Rice	4319.35	22083.35	11586.44
Cereal Grains	5660.20	4467.06	5172.10
Other Crops	25833.99	16114.35	21857.78
2. Variable Farm Inputs			
Labor	22006.25	41818.24	30111.16
Animal Power	21841.10	50139.95	33417.90
Tractor Services	1038.04	256.74	718.42
Fertilizer	4155.17	2641.76	3536.05
3. Prices			
Wheat	2.215	2.291	2.246
Rice	2.058	1.879	1.984
Cereal Grains	2.174	2.390	2.262
Other Crops	2.898	3.288	3.058
Labor	2.041	2.111	2.070
Animal Power	1.790	1.371	1.619
Tractor Services	1.577	1.577	1.577
Fertilizer	1.278	1.307	1.290
4. Structure Variables			
Rural Electrification (percentage of villages electrified)	38.99	15.25	29.28
Roads (km of roads per 10 km^2)	2.08	1.11	1.68
Research Expenditures (cumulative expenditures, 1955 to t−2)	9.56	4.61	7.54
Research Intensity (current expenditures/ net cropped area)	1.49	.865	1.23
High Yield Varieties (percentage of gross cropped area under high yielding varieties of rice, wheat and maize)	10.79	7.09	9.27
Irrigation Intensity (percentage of gross cropped area irrigated)	40.97	25.31	34.57
Net Cropped Area (000 hectares)	1299.03	1711.52	1467.78
Farm Size (net cropped area/number of cultivators)	.0017	.0012	.00
Agricultural laborers/Cultivators	.265	.430	.33
Literacy (percentage of rural males who are literate)	25.80	21.13	26.34

Source: Evenson (1982)

HYVs shifts the wheat and rice supply function to the right, i.e., it causes an increase in wheat and rice production holding all other exogenous factors constant. It is also important to note that these HYVs cause a reduction in the supply of coarse cereals and other crops. This last point is generally overlooked in studies of green revolution effects. The fact is that farmers reduce their plantings of these crops in order to increase acreage in the higher yielding crops.

Table 2.4 Elasticity estimates: North Indian District Data Set 1959–75

Elasticity with respect to:	Elasticities of output supply				Elasticities of input demand			
	Wheat	Rice	Coarse Cereals	Other Crops	Fertilizer	Bullock Labor	Tractors	Labor
Wheat Price	.370**	–.207**	.224*	–.031	–.007	.016	.010	.001
Rice Price	–.128**	.392**	–.076	–.030	–.198*	.008	–.051	–.060**
Coarse Cereal Prices	.073*	–.040	.040	–.040*	–.155	–.005	.112	.093**
Other Crops Price	–.058	–.090	–.227*	.176**	.348**	.006	–.016	.011
Fertilizer Price	.001	.042*	.062	–.024**	.195*	–.038**	.160	.122**
Bullock Price	–.025	–.019	.025	.005	–.440**	–.010	–.010	.048**
Tractor Price	.001	.003	–.011	.001	.038	–.001	–.084	–.155**
Labor Price	–.232**	–.079	–.038	–.046	.217**	.023**	–.103	–.061**
Electrification	–.025	.011	.057*	.084**	.245**	.006**	.034	–.026**
Roads	–.110	–.465**	.373**	–.362**	–.325**	–.086**	.291*	.029
Rainfall	.161**	.407**	–.173*	.019	.456	.012*	.208*	.055**
Irrigation Int.	1.123**	.271*	.919**	.276**	1.203**	.056**	1.851**	.117**
Net Cropped Area	–.139	1.485**	1.048**	.609**	.289	–.022	–1.266**	.042
Farm Size	.224*	.379**	–.027	–.210**	–.744**	.060**	.693**	–.285**
HYVs	.278**	.l09**	–.074**	–.128**	.259**	.012*	–.122**	.030*
Indian Research	.023	–.085**	–.102**	.176**	.249**	–.002	.537**	–.084**

* Asympotic ‘t’ < 2.0. >> 1.5
** Asympotic ‘t’ > 2.0
Source: Evenson (1982)

We can also see how HYVs shift input demand functions by reading further along the row. We note that HYVs cause an increase in the demand for fertilizer (i.e., they are fertilizer using) and an actual decrease in the demand for tractors. In total, a 10 per cent increase in HYVs availability causes a 0.48 per cent increase in total outputs, and a 0.23 per cent increase in total inputs resulting in a 0.25 per cent increase in total variable factor productivity. This may seem small, but in value terms it is very high. The productivity effect in North India alone is more than sufficient to justify the research investments made in India and in all of the International Agricultural Research Centers directed toward the production of HYVs.

The non-HYV components of the Indian research system have also been important and even more productive than HYV research. A 10 per cent increase in the India research stock causes a shifting of supply in favor of other crops and a net 0.49 per cent increase in total output. It causes an increase in fertilizer and tractor use and a decrease in labor employed. This produces a net decrease in inputs used of 0.2 per cent. Thus, a 0.69 per cent increase in total variable factor productivity is realized.

The North India region is actually itself one of the major regions of the world (with a population in 1981 of more than 200 million people). It includes some of India's most progressive districts (Punjab — Haryana) and some of its least progressive districts (Bihar and Eastern Uttar Pradesh). This analysis, then, is not simply based on the most successful regions of India. The willingness to invest in agriculture differs greatly among the districts in the analysis and these differences have enabled us to identify with a fair degree of precision the importance of growth factors in North India.

This analysis implied very large returns to investment in Indian research. Since I do not have an extension variable in this analysis, it is probably reasonable to suppose that the research variable is picking up both a research and an extension effect. Spending on research and extension combined represented approximately 0.7 per cent of the value of agricultural product in the early 1960s. A 50 per cent increase of this spending is estimated to produce a 3.45 per cent increment to output (9.5 per cent if HYVs are included). This can be converted to a rate of return.

With an average 5 year time lag between expenditure and economic effect, this implies an internal rate of return to this investment of 55 per cent (75 per cent if the average lag is 4 years).

These results can be further extended by specifying the demand side of the 4 product markets and the supply side of the 4 factor market. This will enable us to endogenize prices. We have sufficient data from Dhar, Bardhan and Rosenzweig to do this. This provides us with an eight equation system which can be expressed in rate of change form as

$$G\,U^1 = K^*$$

where G is a matrix of elasticities, U^1 is a vector of equilibrium rates of change in prices and quantities and K* a vector of shifter variables. We can solve for the effects of research and extension variables on equilibrium prices and quantities as

$$U^1 = G^{-1} K^*$$

These effects in turn can be translated into real income changes for 5 representative groups in the Indian economy if we know the consumption and income weights of these groups. We do have such data for landless workers, small, medium and large farms, and the urban population for India.

Table 2.5 shows the effects of a 10 per cent increase in the technology base (investment in research and extension), a 10 per cent increase in the irrigation base of the economy, and a 10 per cent decrease in population growth on the real income of these 5 groups. In each case the changes in prices affect each group as consumers and as producers. Landless laborers are affected by changes in wages. Farmers are affected by changes in wages and by residual land rents. Urban consumers are affected primarily by changes in food prices.[7]

Table 2.5 Computed effects of population reduction, technology and irrigation

	Effect of 10% Reduction				Effect of
	All Population Groups	Landless Population Only	Urban Population Only	Effect of 10% Increase in Technology	10% Increase in Irrigation Intensities
Real Income Effects					
All Groups	7.74	2.18	–83	.52	1.64
Landless	14.72	7.68	–1.74	1.61	6.29
Small Farm	11.82	3.31	.55	–1.10	–1.33
Medium Farm	6.78	.73	1.77	–1.98	–4.80
Large Farm	.69	–1.93	4.10	–5.28	–13.71
Urban	7.06	1.06	–5.28	5.52	13.12
Employment Effects	–4.80	–1.95	–.82	–.93	– .55
Land Rent Effects	–25.18	–3.97	–17.87	–49.75	–60.18
Wage Effects	15.94	7.33	–7.47	–10.32	–30.73
Price Effects	–3.03	1.46	–6.18	–8.08	–18.74

Source: Evenson (1982)

It is perhaps surprising that all three effects show strong progressive distributional effects. This may seem counter to some of the development literature, but much of that literature is based on micro data sets and some is subject to serious bias. Since women often have limited property rights, the results for landless laborers and small farmers are of particular interest. Note that the major reason for lower incomes of farmers is the fact that both new technology and irrigation effectively increase land stocks and hence lower land rents.

Relevance to women in rice farming

The three bodies of studies under review in this paper originated with concerns for a better understanding of the way households and institutions, as well as farms, respond to changes. The studies did not initially concern themselves with women *per se.* Yet they have, I think, directed our attention as research scholars and as policy makers to women. The literature addressing the economics of the family has naturally considered the specialization process that is central to understanding women's activities. When women specialize in certain activities, particularly home production including child production activities, we generally find that this specialization makes economic sense to the household in question. If women in poor households were to change their roles without changing their behavior toward children and the goods produced by the household, there is reason to believe that a loss in family welfare would ensue.

Part of the role structure that women live with is governed by community institutions. In communities where transactions costs are high and where some markets may not function effectively because of this, the family enterprise has an economic advantage over other forms of economic organization. Women in those communities will then have roles dictated by family economics and a number of institutions will tend to reinforce these roles. As long as the basic economic and institutional structure remains unchanged, these family and community systems will dominate the lives and activities of women.

This conference has reported, however, that in many of the rice farming communities of the world, change is under way. New rice technology has, as noted in one study reviewed in this paper, altered production strategies, and traditional production practices have changed. This technology has had important welfare consequences for the poor rural worker. Perhaps of more importance is the institutional change being observed in much of the rice farming world. Most communities now provide better schooling, better health and family planning services, and supply lower cost credit. These changes are likely to have quite profound effects on the traditional household. Women will bear the brunt of such changes.

It is possible, I think, to speculate to some degree as to the likely nature of this change. First, it seems likely that the advantages of the family enterprise over other forms of enterprises will decline. This means that many smaller farms will tend to be consolidated into larger, more commercial units. The proportion of the labor force working for wages will increase as more and more small tenant farm families find it in their interest to become full time laborers.

This will have two effects on women. First, the expansion of employment opportunities will afford them stronger bargaining positions in households and provide increased incentives for investing in skills. Second, and possibly of more importance in rice farming communities, women will tend to expand their specialization from the home to the farm. We are likely to see many households where men take advantage of high wage employment (often non-agricultural) and women take over the management and operation of rice farms. These trends will be strengthened by the continued provision of family planning services and health and schooling services in rural communities. They will be further strengthened by the development of markets for more of the rice farming tasks such as land preparation.

It seems clear that the lives of women are changing and will continue to change in much of the rice farming world. Institutions such as IRRI, but perhaps more importantly institutions extending technical and economic advice, will find it productive to respond to these changes with more direct attention to women.

Notes

1. In fact, Becker (1965) argues that one altruistic individual in a family will arrange a bargain with non-altruistic family members such that they will act in an altruistic fashion.
2. See Gronau (1980) for the development of this argument.
3. See Evenson, Popkin and Quizon (1980).
4. See Feeny (1982).
5. The sample of 244 households was originally drawn in 1963, resurveyed in 1968 and in 1977. See Evenson and Roumasset (1983) for a fuller discussion.
6. See Evenson (1982) for details and for the functional form specification.
7. The elasticity of labor supply is presumed to be quite low in this simulation. See Evenson (1983).

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3 The changing role of women in Japanese agriculture: the impact of new rice technology on women's employment

Ryohei Kada and Yukiko Kada

Introduction

Women's role in Japanese agriculture can be best expressed by a well-known Japanese phrase — 'San-chan nōgyō' (three persons' farming) — to characterize farms worked mainly by the mother, grandmother, and grandfather of a family. As employment opportunities off the farm were expanded, more and more of the young, and especially male, labor force has been employed in non-agricultural sectors, even if they continue to live there. Thus a modern Japanese farm household has both a dual source of income and pattern of labor allocation.

Historically, too, women have for generations played an important role in rice cultivation; among the most laborious works, transplanting, weeding, and harvesting were considered to be women's tasks. Although a complete set of farm mechanization in rice cultivation has relieved to a considerable extent the heavy burden of women's drudgery, Japanese rural women still take a significant part in farm labor input. In addition, many of them work off-farm at the same time. Today, nearly 50 per cent of rural women are engaged in agriculture and an increasing percentage of them are working off the farm at the same time. Many contemporary women's health and family issues are closely associated with this heavy commitment of women in dual employment.

The main purpose of this paper is to outline the role of women by examining their employment situations and labor allocation patterns, and to analyze various impacts of new rice technology (biological-chemical and mechanical) on women's employment patterns. The final section summarizes the argument and discusses some policy implications of the changing role of women.

Structural transformation and the changing role of women in Japanese agricultural development

Let us first examine the nature of structural changes of Japanese agriculture in the overall economic development in the post-World War II period and how they are related to a continued important role played by rural women. For this aim a statistical examination is attempted here to outline the characteristics of changing employment patterns of women in the farm household.

Basic characteristics of long-term Japanese agricultural development

The experience of agricultural development in modern Japanese history has been analyzed by various economists.' The long-term performance of Japanese agricultural development, especially before World War II, can be summarized as follows:

(a) Agricultural output was increased within the framework of continued small-scale family farming;
(b) Increase in yield and factor productivity was based on wide diffusion of high-yielding fertilizer-responsive varieties, and relatively simple improvement in cultivation techniques evolved by experimentally-minded farmers and later by public experimental stations; and
(c) Agricultural and industrial development went forward together in a process of concurrent growth, with various interactions between the two sectors in terms of intersectoral capital and labor flows.

These features are still applicable to the post-war period in Japan except that the rapid economic growth since the early 1960s has brought about increased part-time farming and heavier capital investment in mechanical technology and land infrastructure. The mid-to late-1950s were a significant turning point in Japanese economic history.[2] It was a period which was marked by a structural transformation in which the rapid decline in the absolute size of the agricultural labor force started. But it was also marked by an upward shift in the marginal productivity of labor and of real wages in agriculture. Furthermore, rapid economic growth since around 1960 has provided expanding opportunities for the rural population, both males and females, to take up modem off-farm employment.

Income expansion through part-time family farming

In Japan, improved income and living standards of farm households were achieved partly by the development and diffusion of labor-saving agricultural technology, but more importantly by the concomittant expansion of off-farm employment taken by various members of the farm household.

Table 3.1 shows the number of full-time and part-time farm households in the post-war period. The number of full-time households decreased quite drastically from about 3 million in 1950 to only 0.5 million in 1980. At the same time, the absolute number and ratio of part-time farm households Type II (where off-farm income is greater than farm income) increased from 1.3 million in 1950 to 3.0 million in 1980.[3]

Table 3.1 Japan: Number of full and part-time farm households, selected years.

Year	Total Number of Farm Households	Number of Full-time Farm Households	Number of Part-time Farm Households	1,000 /(%) of which Type I	Type II
1950	6,176	3,086	3,090	1,753	1,337
	(100)	(50.0)	(50.0)	(28.4)	(21.6)
1960	6,057	2,078	3,979	2,036	1,942
	(100)	(34.3)	(65.7)	(33.6)	(32.1)
1970	5,402	845	4,557	1,814	2,743
	(100)	(15.6)	(84.4)	(33.7)	(50.7)
1980	4,661	623	4,038	1,002	3,036
	(100)	(13.4)	(86.6)	(21.5)	(65.1)

Source: *Census of Agriculture* (Ministry of Agriculture and Forestry, Japan) Various issues.

The ratio of off-farm income to total family income has accordingly increased from 32.5 per cent in 1950 to 78.9 per cent in 1980, with an especially remarkable increase after 1960 (see Table 3.2). The share of off-farm income exceeded that of farm income in 1963 for the first time. Moreover, it should be noted that the per capita disposal income

Table 3.2 Japan: Annual farm and off-farm income per farm household, selected years

Year	Total Farm Household Income (1,000 yen[1])	Farm Income (1,000 yen)	Off-Farm Income (1,000 yen)	Share of Off-farm Income (%)
1960	409.5	225.2	184.3	45.0
1970	1,393.2	508.2	885.2	63.5
1975	3,414.4	1,146.0	2,268.4	66.4
1980	4,515.2	952.3	3,562.9	78.9

[1] US $ = ¥360 in 1960 and 1970; ¥260 in 1975; ¥227 in 1980.

Source: *Farm Household Economy Survey* (Ministry of Agriculture and Forestry, Japan)

of the farm population exceeded that of the non-farm population in 1972 for the first time in Japanese history. The trend thereafter has been a further widening of the gap between the two, as more and more farm household members took up off-farm employment. This increase in off-farm income, in turn, has enabled farmers to invest in farm machinery and equipment.

The variety of off-farm jobs in the post-war period has widened from rural or agricultural-related employment to include urban manufacturing or service-related jobs. This widening of modern off-farm job opportunities was made possible through decentralization of industry and development of transportation methods, and now off-farm jobs are available not only for youngsters but also for middle-aged, female and elderly members of the farm family. In addition, the nature of off-farm jobs has gradually changed from casual and part-time to permanent (or at least long-term).

Role of women in rice farming and other activities

Traditionally, in rural Japan, the tasks involving most drudgery in rice cultivation, namely, transplanting, weeding and harvesting, were considered to be women's major tasks. In fact, until recently when a program of farm mechanization was fully introduced and diffused among rice-producing farm households, women had to play a substantial role in these laborious works in addition to ordinary household chores. As we will see later, even today Japanese rural women contribute substantially in most tasks of rice cultivation (about 40 per cent of the total labor input). At least in the case of Japan, rice production can never be accomplished without the heavy participation of women. To show this let us next examine briefly the role of women in the agricultural labor force and labor input, using various official agricultural statistics.

In the past few decades, the percentage of women in the total agricultural labor force has been great but relatively stable, i.e., 59 per cent in 1960, 61 per cent in both 1970 and 1980. In addition, as shown in Table 3.3, the percentage of female labor to the total labor force engaged only in agriculture has even increased from 63 per cent in 1960 to 66 per cent in 1980.

Table 3.3 Changes in the labor force in the farm household by sex and work pattern: 1960–80

(1,000/%)

Category and Year		Work Pattern: Only in Agr.	Both Agr. and Non-agr.: Mainly in Agr.	Both Agr. and Non-agr.: Mainly in Non-agr.	Only in Non-agr.	Not Employed	Total
Total:	1960	13,046	1,446	3,114	1,806	3,024	22,486
Male &	1970	8,519	1,833	5,266	1,564	2,631	19,813
Female	1980	6,036	937	5,566	1,670	2.877	17,087
	1960	8,209	337	501	622	1,981	11,750
Female	1970	5,649	688	1,612	695	1,731	10,375
	1980	3,968	332	1,817	804	1,937	8,858
Share	1960	62.7	23.3	19.3	34.4	65.5	52.1
of	1970	66.3	37.5	30.6	44.4	65.8	52.4
Female*	1980	65.7	35.4	32.6	48.1	67.3	51.9

* This item shows the percentage of the female labor force to the total labor force in the respective category of employment type.

Source: Ministry of Agriculture, Forestry and Fisheries: *Agricultural Census Survey,* respective years.

Particularly, in the 1950s and 1960s women's participation and contribution to farm labor input became more and more important, since an increasing number of the able young males became absorbed into non-agricultural sectors. Increased off-farm employment by such family members meant a reduction in the working population in agriculture: the agricultural labor force almost halved from 1950 to 1975. Accordingly, the composition of the agricultural labor force has gradually changed to include a heavier representation of aged and female members of the farm family.

In recent years, however, not only men but also women have increasingly taken up off-farm employment as opportunities to work off-farm were opened and expanded even for female members in the family. Today, nearly half of rural women work in non-agricultural activities, while the majority of them are still engaged in agriculture. The burden of income-earning activities upon women's shoulders appears to be very strong.

The factor of women's age also appears to influence the pattern of their employment. Table 3.4 indicates that younger women tend to be either working only in non-agriculture or not employed. The highest

Table 3.4 Work pattern of the female labor force in the farm household by age group: 1980

(Unit: %)

Age Group	Work Pattern: Only in Agr.	Both Agr. & Non-agr.: Mainly in Agr.	Both Agr. & Non-agr.: Mainly in Non-agr.	Only in Non-agr.	Not Employed	Total
16–19	14.4	0	3.9	9.7	71.8	100
20–24	11.6	0.3	24.0	47.0	17.1	100
25–29	31.7	1.3	25.1	24.8	16.4	100
30–34	41.3	3.5	29.6	13.0	12.2	100
35–39	42.7	6.4	36.8	7.8	5.8	100
40–44	43.7	8.6	39.2	4.8	3.5	100
45–49	49.8	8.2	35.2	3.5	3.1	100
50–54	59.7	6.6	26.4	2.7	4.3	100
55–59	66.6	4.8	18.9	2.3	7.2	100
60–64	70.4	2.9	10.8	1.7	13.7	100
65 and over	45.4	0.7	2.5	0.8	50.3	100
Total	44.8	3.7	20.5	9.1	21.9	100

Source: Ministry of Agriculture, Forestry and Fisheries: *Agricultural Census,* 1980

percentage of not employed for the age group 16–19 (72 per cent) is simply a reflection that more and more young girls are enrolled in high school and college educations. In contrast, the older female members of the family (aged 50 and older) tend to be engaged only in agriculture. The middle age group has a higher percentage that is working in both agriculture and non-agriculture. In other words, rural women clearly possess a kind of life cycle pattern of employment, which is influenced by family structure and income needs at various stages of family development.

Finally, Table 3.5 is provided in order to examine whether labor input pattern is influenced by the factor of farm size. The required size of agricultural labor force naturally increases as farm size becomes

Table 3.5 Labor force and labor input in rice production by farm size class: 1980

(persons; hours)

Farm Size class	– 0.3 ha	0.3 – .05 ha	0.5 – 1.0 ha	1.0 – 1.5 ha	1.5 – 2.0 ha	2.0 – 3.0 ha	Over 3.0 ha	Average (all size) groups
Agr. Labor Force per Farm Household:			no. of persons per farm household					
Total	1.4	1.6	1.9	2.1	2.3	2.6	3.0	1.9
Male	0.7	0.8	1.0	1.1	1.3	1.4	1.6	1.0
Female	0.7	0.8	0.9	1.0	1.0	1.2	1.4	0.9
Labor Input			no. of hours per 0.10 hectare of paddy					
Total	84.7	79.2	68.3	61.0	53.2	51.3	43.5	62.7
Male	50.1	46.4	40.6	37.2	33.0	31.4	26.8	37.9
Female	34.6	32.8	27.7	23.8	20.2	19.9	16.7	24.8

Source: MAF: *Rice Production Cost Survey for 1980* bigger. But the proportion of women in the total labor force stays almost equal for all farm size classes. In terms of labor input, which is measured by the number of hours employed per 0.10 hectare of rice cultivation, women's share is smaller but again remains almost the same proportion to the total, i.e., about two-thirds of that of men. Note that the required labor inputs become smaller as farm size gets bigger mainly because economies of size operate. From this table we may be allowed to suggest that women's contribution in labor input is equally important irrespective of different farm sizes, although the absolute labor input by women is greater for large farm size groups.

Labor allocation patterns at the farm household level

As we have seen in the previous section, changes in Japanese rural employment patterns in the post-war period can be characterized by an increasing trend of part-time farming and continued high labor input of women in both agricultural and non-agricultural activities. In order to investigate further this changing employment pattern, especially of rural women, this section tries to analyze the internal structure of labor supply behavior of farm family members and to examine the inter-relationship of their labor allocation decisions at the farm household level. Here, primary data, collected by Ryohei Kada in 1977 in Shiga Prefecture (a total sample of 239 part-time farm households), serve as the main source of analysis[4].

The measurement of farm and off-farm labor input index must first be clarified. For any member of the family, the extent of work contribution, either on the farm or off-farm, is classified into the following five indexes in terms of the number of days worked per year:

(0) no work at all;
(1) works 1 to 29 days;
(2) works 30 through 99 days;
(3) works 100 through 199 days; and
(4) works 200 days or more.

Since this index of labor input is not cardinal but ordinal in nature, interpretation of computed values of these indexes should be at most made in the ordinal sense.

Figure 3.1 shows the average values of on-farm and off-farm labor input indexes by the respective member of the farm family, computed by the Shiga data. For each member, the left semi-circle is drawn to represent the arithmetic mean value of the farm labor input index as defined above, while the right semi-circle represents that of the off-farm

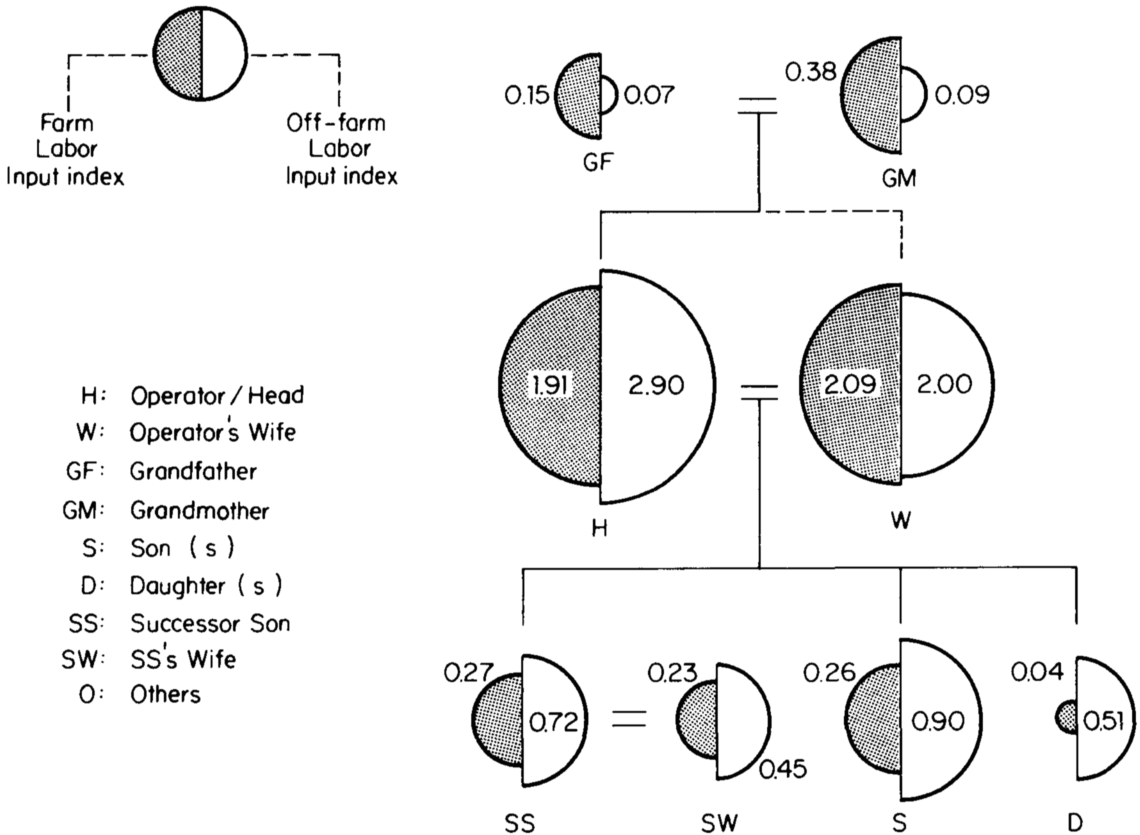

Figure 3.1 Average on-farm and off-farm labor input by individual members of the farm family: Shiga Data

Source: Kada, R. (1980)

labor input index; the area of each semi-circle is illustrated to show the respective relative magnitude of labor input. Two points are noted here. First, the contribution in gainful employment is greatest by the household head and his wife, while the wife tends to work almost equally between farm and off-farm. The younger generation members certainly work more heavily in off-farm employment. In contrast, the older generation members are working more on their own farms.

As the second step, labor allocation patterns are compared by three different farm size classes in Figure 3.2: the upper three box diagrams are for the family head, and the lower ones, for the head's wife. Clearly, the head of a large-sized farm household shows an appreciable negative correlation between the on-farm and off-farm labor input indexes, i.e., the more he works on the farm, the smaller is the off-farm work load he undertakes. To a lesser extent, this negative correlation can be observed for housewives of Shiga part-time farm households. Another feature to be pointed out in this figure is that for the small farm size group, the

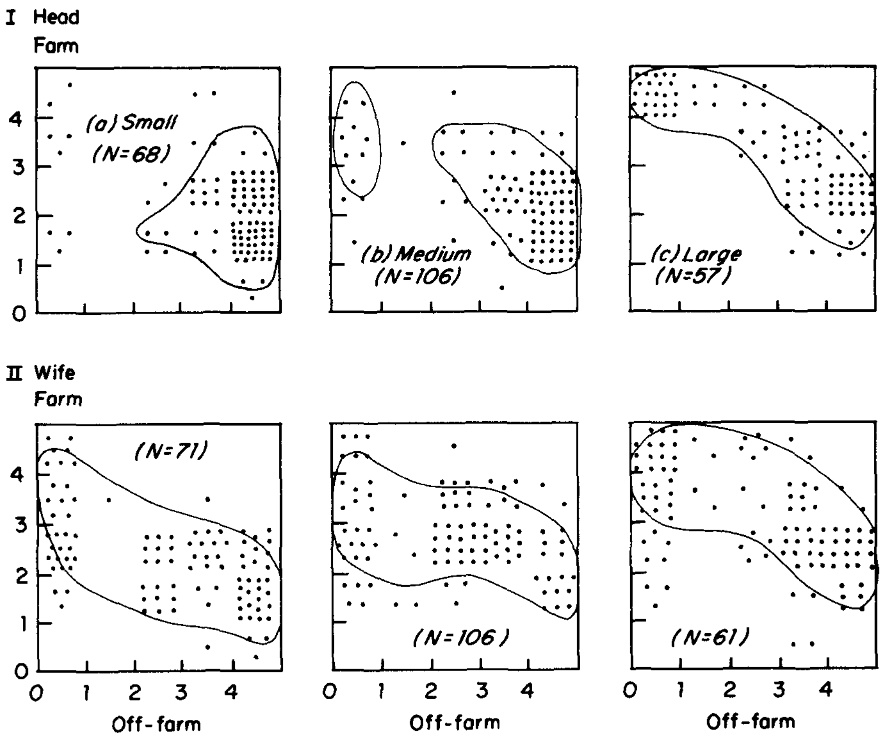

Figure 3.2 Labor allocation pattern of family head and wife by three farm size groups (. = 1%): Shiga Data
Source: Kada, R. (1980)

family head takes up a heavy off-farm work load, while their wives are taking responsibility in farm tasks to varying extents. Clearly in Shiga, the larger the farm size, the more the wives tend to work on the farm: their total labor inputs appear to be greater than in the other two groups.

It is quite conceivable that farm family members are interdependent on each other to varying degrees when they decide where (i.e., farm versus off-farm) and to what extent they work. For example, the labor allocation pattern of the family head may be influenced by that of the wife or even by that of the successor son. The next task, therefore, will be to analyze such interdependency of family members in their labor allocation decisions. For this purpose, the concept of rank-order correlation coefficient is next measured, again using the Shiga Data, as is shown in Table 3.6. (Statistically speaking, the higher the value of this coefficient, the closer relations — positive or negative — are considered to exist.) The following are some of the findings from this examination.

First, for any particular family member, the coefficient value shows negative in sign, e.g., –0.303 for the family head and –0.189 for the wife. This means that for all core members of the family, working on-farm and off-farm at the same time brings some conflict and hardship. Second, although the family head's farm labor input has a highly significant positive correlation with his wife's, it has almost no significant correlation with the successor son's farm or off-farm labor input patterns. Third, although the labor allocation decisions for the head and successor son are relatively independently made, that of the head's wife appears to be somewhat influenced by other member's labor allocation patterns (especially of the family head's and of the successor son's wife). Finally, we can point out that no significant correlations exist between members of the two generations. This probably occurs because farm size expansion can hardly be made in the Japanese land market; instead, surplus labor over required farm labor input is mostly employed off-farm.

Technological change in rice cultivation and its impact on women's employment

Technological changes have been a remarkable feature in post-war Japanese agricultural development. Just after the war, the pressing need to increase food supply was achieved mainly by the development and dissemination of yield-increasing techniques and intensification of labor inputs, such as new rice bedding systems, introduction of high-yielding varieties, and increased amounts of fertilizer and chemical

Table 3.6 Correlation coefficients of on-farm and off-farm labor input between core members of part-time farm family: Shiga Data (N = 46)

Variable	On-farm labor input index				Off-farm labor input index			
	Head (X_1)	H’s wife (X_2)	Suc. son (X_3)	S.S’s wife (X_4)	Head (X_5)	H’s wife (X_6)	Suc. son (X_7)	S.S’s wife (X_8)
X_1	(1.000)	0.337***	0.117	0.170*	–0.303***	–0.245**	0.041	0.206**
X_2		(1.000)	0.186*	0.100	–0.137	–0.189*	0.068	–0.044
X_3			(1.000)	0.358***	0.001	0.203*	–0.220*	0.002
X_4				(1.000)	0.070	–0.242**	–0.071	–0.292**
X_5					(1.000)	0.062	0.043	–0.205*
X_6						(1.000)	–0.174*	0.025
X_7							(1.000)	0.155
X_8								(1.000)

Notes: 1) Figures shown are rank-order correlation coefficients (Kendall’s Tau b values) between each pair of labor input indexes.

2) Asterisk marks on each Kendall’s Tau b value (***), (**), and (*) show that those coefficients are statistically significant at 1%, 5% and 10% respectively.

Source: Kada, R. (1980)

inputs. After Japan entered a labor scarce economy in the late 1950s, farm labor was increasingly substituted by machinery in the work of tillage, and later, in the 1960s and 1970s, the substitution was further intensified by machines doing the work of harvesting and transplanting of rice, as is shown in Table 3.7. Farm mechanization has been disseminated even among part-time farmers where the labor shortage was keenly felt. In other words, the part-time farming phenomenon has been sustained and strengthened by the development of labor-saving, mechanical technology.

Table 3.7 Trend of farm mechanization in Japan: 1955-81.
(no. in 1000's)

Year	Power Tiller	Tractor	Power Transplanter	Sprayer	Power Binder	Combine
1955	89	–	–	76	–	–
1960	514	–	–	232	–	–
1965	2,508	–	–	600	–	–
1971	3,201	267	46	1,149	465	84
1976	3,183	721	1,046	1,325	1,498	428
1981	2,812	1,413	1,887	1,569	1,683	916

Source: Ministry of Agriculture, Forestry and Fisheries: *Agricultural Statistics,* various issues, Tokyo.

Clearly, the relative decline in the price of machines and other capital equipment above the farm wage rates has been a major force which stimulated a rapid diffusion of farm machinery (Hayami). It should also be noted that this trend was made possible by the enhancement of purchasing power of farm households, which in turn is the result of intensified part-time farming with unchanged farm size structure in the post-land reform period.

The early development and diffusion of biological-chemical technology did certainly work to increase land productivity, but its impact on the reduction of required labor input was relatively weak. Labor productivity was substantially increased only after a set of small- to medium-sized farm machinery was introduced and diffused, which took place mostly in the 1960s and 70s. Related to this, the quality of those farm machines was greatly improved: hence, as can be seen in Table 3.8, almost the same hours of machine operation to do the same farm tasks reduced the total hours of labor input substantially.

Table 3.8 also shows how farm machines have affected the reduction of required labor input, especially for women, in the last 15 years. The reduction of labor input was most acute in rice transplanting, threshing

Table 3.8 Labor input and women's participation in rice cultivation: 1965 and 1980.

					Crop Care						
Type of work	(1) Seed Selection	(2) Seedbed	(3) Land prep.	(4) Trans-planting	(5) Ferti-lizing	(6) Weeding	(7) Insect Control	(8) Water Control	(9) Threshing & Harvesting	(10) Drying & Husking	(11) Total
Labor Input: (hours per. 10 ha)											
1965	0.6	7.8	14.4	24.5	6.7	17.4	3.4	12.0	47.9	6.5	141.2
1980	0.6	6.7	8.1	8.7	4.1	6.0	2.3	9.7	15.1	3.9	65.2
Hours spent on machine operation:											
1965	0.0	0.4	4.3	0.1	0.5	0.1	0.6	1.1	4.4	3.0	14.6
1980	0.0	0.3	3.7	0.5	0.5	0.3	0.9	1.8	3.7	1.3	14.4
Women's share in labor input (%):											
1965	34	43	29	65	45	56	30	37	52	47	49
1980	33	45	25	51	39	50	35	33	44	41	41

Source: Ministry of Agriculture, Forestry and Fisheries: *Rice Production Cost Survey,* 1965 & 1980.

and harvesting, partly because agricultural (regional) cooperatives also provided those services for those who could not purchase such equipment on an individual basis. In a sense, these farm mechanization processes helped to relieve heavy burdens attached to women's work.

It should be noted, however, that the reduction of farm labor input by women did never result in increased (free) time for rest and/or leisure. Rather, rural women selected an alternative path of diversifying work activities, as shown in Table 3.3. There, the desire to increase further the income and welfare levels of farm households (such as the purchase of modern farm and household equipment and expenses for children's higher education) was among the most important reasons.

Concluding remarks

The Japanese experience outlined here indicates that new technology, especially modern mechanical technology, has substantially reduced the women's labor input, but that its impact has resulted in the diversification of their work activities, both on-farm and off-farm, rather than the simple reduction of their hours worked in rice cutlivation. Compared with urban women in general, the average total labor hours worked by rural women are still much longer. This implies that the reduction of farm labor input was more than offset by increased work hours in off-farm employment.

In other words, there has been a shift in the role of rural women in post-war Japan, according to the changes in the economic conditions such as the availability of new technology and changing factor price ratios. More specifically, as off-farm employment opportunities were expanded and men began to work in non-agricultural industries, work burdens on the farm fell more heavily on women. Then at the later stage when farm mechanization (especially in the transplanting and harvesting of rice) relieved women from heavy drudgery tasks, women's work pattern has gradually shifted from mainly in agriculture to both in agriculture and in off-farm employment.

Taking into account this changing employment pattern of rural women, policies must provide multi-dimensional services specifically for women as their activities continue to expand. Some examples of such policies should include pension programs for working rural women, construction of nursery schools and day-care centers, and special extension services of farm management and machine operation for those women whose husbands are fully engaged in non-agricultural occupations.

Finally, we might pose a question: what will be the future role of rural women in Japan? A most likely situation would be, at least in the foreseeable future, that women continue to play major roles in multi-dimensional places, namely, not only in agriculture and the household but in off-farm and community activities. This, however, certainly depends upon many unpredictable factors such as the general economy in the future, farm size structure and policy measures to be taken, and value judgements of women themselves regarding work (or income needs) and leisure.

Notes

1. Among the vast literature on this topic are: K. Ohkawa and Henry Rosovsky, *Japanese Economic Growth: Trend Acceleration in the Twentieth Century* (Stanford, Calif.: Stanford University Press, 1973); A.C. Kelly, J.C. Williamson, and R.J. Chetham, *Dualistic Economic Development: Theory and History* (Chicago: University of Chicago Press, 1972); K. Ohkawa, B.F. Johnston, and K. Kaneda, eds., *Agriculture and Economic Growth: Japan's Experience* (Princeton, N.J,: Princeton University Press, 1970), Y. Hayami and V.W. Ruttan, *Agricultural Development: An International Perspective* (Baltimore: Johns Hopkins University Press, 1971).
2. R. Minami, 'The Study of Farm Labor and the "Turning Point" in the Japanese Economy,' *Quarterly Journal of Economics* 82:3 (1968).
3. According to the census definitions, *a full-time farm household* is defined as one in which no family member (including sons and daughters) is engaged in any off-farm work for more than 30 days in the census year. If any family member, including the operator himself, does any off-farm work, the household is classified as a *part-time farm household.* Part-time farm households are then divided by Japanese statistics into two categories: *Type I,* households in which net farm income exceeds off-farm earnings; *Type II,* households in which total off-farm earnings exceed net farm income. This classification is therefore made on the basis of the dependency on net agricultural income of the total household income, irrespective of the number of days worked off-farm or who was engaged in off-farm employment.
4. For a detailed description and analysis of the Shiga Survey Data, see Kada, R. (1980).

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4 Women's labor and the technological development of rice cultivation in Japan

Reiko Ohki

Japan is a highly industrialized country and great strides have been made in farm mechanization as well as technological development. However, the situation of women in agriculture in Japan is very similar to that of farm women in other Asian countries. This report will deal with the position of Japanese farm women.

Rice production in Japan

The history of Japanese agriculture after World War II started with the agrarian reforms carried out from 1947 to 1948. New agricultural technology was developed and promoted under the farming modernization policy of the Fundamental Law for Agriculture which was put into force in 1961. The development was founded on the progress of the heavy chemical industry resulting from the rapid growth of the Japanese economy after 1955.

Japan is part of the Asian monsoon region, and its agriculture has developed along with rice cultivation since ancient times. Rice cultivation has always been the nucleus of Japanese agriculture and this fact will never change. Today, annual rice production amounts to 10

Megatons and its share of total agricultural production is about 32 per cent (1981). Sixty-two per cent of the rice crop is produced by small farmers with under 150 acres who constitute 85 per cent of the total farm population.

The development of agricultural technology after 1960

The development of agricultural technology with priority being given to mechanization can be roughly classified into two periods, the first in which mechanization was introduced and partially established (1960-1970) and the second in which mechanization became well established, taking over a major part of the labor process (1971 onwards).

During the first period, great strides were made in the improvement of rice species with the aim of increasing rice production, an attempt which had begun in the 1950s. Also, chemicals such as pesticides and herbicides were extensively introduced which led to a decrease in manual labor. It is significant that chemicals, especially herbicides, liberated women from harsh work under the hot sun; weeding had always been one of the hardest types of work done by women. As Figure 4.1 shows, the greatest gains in the reduction of manual labor were realized in this area.

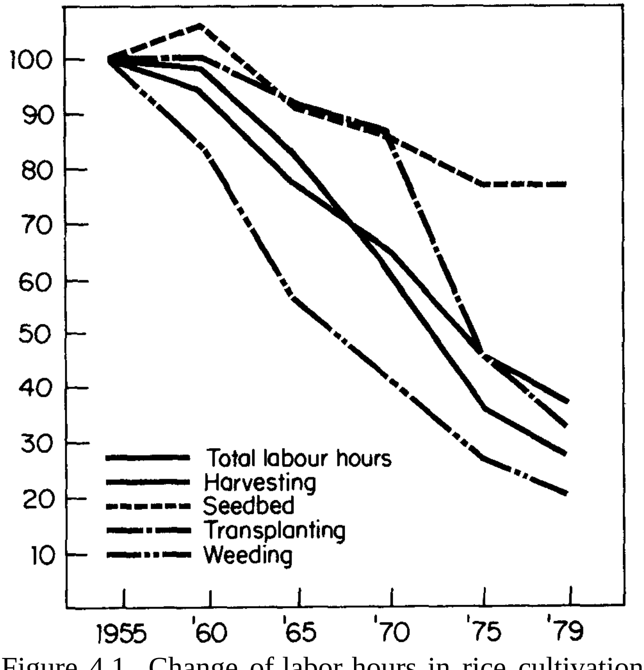

Figure 4.1 Change of labor hours in rice cultivation.

Increasing use was also made of power tillers. The mechanization of the tilling process in the 1960s was the first fundamental stage in the process of mechanization (Figure 4.2). However, mechanization of the harvesting process was only initiated in the late 1960s, and even then, planting continued to rely on manual labor. Thus, it can be seen that the process of mechanization was uneven, and this imbalance affected labor during the busiest farming season and made women's work harder.

In the latter half of the 1970s, rice seedling planters were put into use and a fully mechanized system of rice cultivation was finally achieved. Machinery and chemicals greatly contributed to the reduction of manual labor. As Table 4.1 indicates, annual work hours per 10 ares declined by about 62 per cent from 173 hours to 65 hours between 1960 and 1980. Particularly, three major types of work done by women, weeding (–80%), planting (–75%) and harvesting (–50%), decreased remarkably.

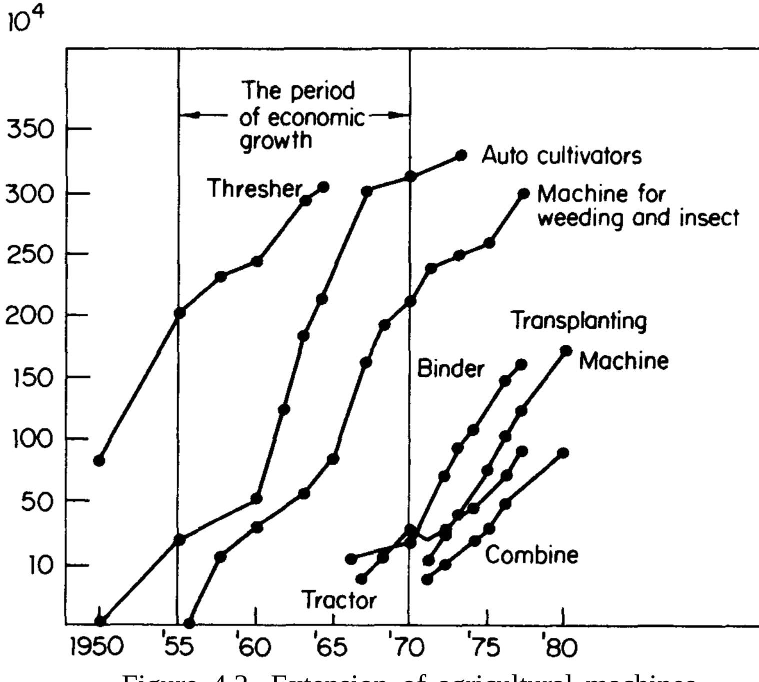

Figure 4.2 Extension of agricultural machines.

The role of women's labor

Judging from the same table, it seems as if women's labor should eventually be eliminated from rice cultivation. However, this is not the actual situation. It is no exaggeration to say that the role of women is becoming even greater. The reasons are as follows:

Table 4.1 Change of labor hours in rice cultivation between male and female

	labor hours						(%)						decreasing rate (%)			
	M			F			M			F			M		F	
	1960	1970	1980	1960	1970	1980	1960	1970	1980	1960	1970	1980	1970/1960	1980/1960	1970/1960	1980/1960
1. Seed Selection	0.5	0.4	0.4	0.2	0.3	0.2	0.6	0.7	1.0	0.2	0.5	0.7	80.0	80.0	150.0	100.0
2. Seedbed	5.3	4.0	3.4	3.8	3.4	2.9	5.9	7.0	9.6	4.6	5.8	10.9	75.5	69.8	89.5	76.3
3. Ploughing and Land Prep.	12.4	8.2	6.1	4.4	3.2	2.0	13.8	13.9	18.3	5.3	5.5	7.5	66.1	49.2	72.7	45.5
4. Basic Fertilizing	3.6	2.7	1.6	3.2	2.5	1.1	4.0	4.6	4.1	3.9	4.3	4.5	75.0	44.4	78.1	37.5
5. Trans-Planting	9.4	7.8	4.2	16.9	15.4	4.2	10.5	13.2	10.9	20.4	26.2	15.8	83.0	44.7	91.1	24.9
6. Add.–Fertilizing	1.2	1.0	0.9	0.5	0.4	0.4	1.3	1.7	2.3	0.6	0.7	1.5	83.3	75.0	80.0	80.0
7. Weeding	12.1	5.7	3.0	14.4	7.3	2.9	13.5	9.6	7.8	17.4	12.4	11.3	47.1	24.8	50.7	20.1
8. Irrigation care	14.8	6.7	6.5	7.7	4.1	3.1	16.5	11.3	16.8	8.5	7.0	11.7	45.3	43.9	53.2	41.6
9. Insect	2.3*	1.9	1.5	1.0*	1.1	0.8		3.2	3.9		1.9	3.0	82.6*	65.2*	110.0*	80.0*
10. Harvesting	27.4	17.3	8.4	29.9	18.2	6.5	30.5	29.3	21.7	36.1	31.0	24.5	63.1	30.7	60.9	32.1
11. Other Post Harvest	3.1	3.3	2.3	3.4	2.7	1.7	3.5	5.9	5.9	4.1	4.6	6.0	106.5	74.2	106.5	50.0
12. Total	89.8	59.1	37.9	82.8	58.7	26.5	100.0	100.0	100.0	100.0	100.0	100.0	65.8	43.0	50.0	32.0

Source: Ministry of Agriculture, Forestry and Fishery, Examination of the Cost of Rice Production (except direct seed)
* 1965

Aggravation of agricultural management: an increase in operational costs due to necessary investment in mechanization, low farm prices and the rising cost of living have put increasing pressure on management. As Table 4.2 shows, the expense share of farm implements of total material expenses has increased, whereas the income rate

$$\frac{\text{total income minus material expenses}}{\text{total income}} \times 100$$

went down from 72 per cent in 1960 to 46 per cent in 1981.

Table 4.2 Change in expenses and agricultural income of farm households

(per 10a, %)

	rate of machines in agr. materials cost [a] (%)	rate of agricultural income [b] (%)
1960	18.3	72.3
61	22.7	70.8
62	24.8	73.0
63	27.1	73.0
64	30.5	73.8
65	31.3	74.2
66		
67	25.7	76.6
68	34.6	74.8
69	37.6	69.6
1970	40.3	67.5
71	43.0	64.2
72	45.5	65.1
73	49.0	69.3
74	41.0	67.7
75	40.3	67.6
76	41.7	61.9
77	43.4	61.9
78	45.4	59.5
79	46.8	54.9
1980	47.9	49.8
81	47.2	45.6

[a] Machine costs as per cent of total material expenses.
[b] Total income minus material expenses as a per cent of total income.

Source: Examination of the Cost of Rice Production, Ministry of Agriculture, Forestry and Fishery.

Decrease of farm labor and dependence on women's labor: in the course of the rapid gains of Japanese capitalism in the 1960s, the demand for labor increased leading to a great outflow of labor, mainly men, from rural areas to urban areas. Combined with the aggravation of management, this outflow of labor made farm women more dependent on outside income and forced them to assume the principal burden of agricultural work. As shown by Tables 4.3 and 4.4, 62 per cent of the agricultural population is female and the percentage of the agricultural population over 60 years of age has increased (32.6 per cent, 1980).

Labor in rice cultivation: at the present stage of mechanized rice cultivation, manual labor is still necessary in the care of crops (fertilization, irrigation, pest control and weeding), plays an important role in stabilizing rice cultivation and harvesting, and constitutes about 32 per cent of the total work hours devoted to rice cultivation (1980). Not only physical or quantitative labor but also qualitative skilled labor calling for systematic, careful observation, judgement and decision making is required. Although small lower class farmers have necessary mechanized work done by others, they usually handle the manual labor themselves. This manual work is in many cases assumed by women. Reflecting the factors stated so far, labor hours of women exceed those of men in the case of farmers with under 150 ares; in the case of farmers with under 50 ares, women's share of the work load is 55.8 per cent. For farmers with 50-100 ares, the share of women is 51.0 per cent and for those with 100-150 ares, it is 50.2 per cent (1980).

Paralleling the increase in labor productivity, land productivity has also risen (Figure 4.3). Crop yield per 10 ares rose from 445 kg to 538 kg between 1960 and 1978. (There was damage caused by cold weather in 1980.) This increase in agricultural productivity stemming from mechanization and the concomitant standardization of skills has helped justify the increasing role of women in agriculture. The greater the role of women has become, the more women have come to operate machinery. The number of women who have access to machinery amounts to about 50 per cent (Table 4.5). This implies that women are no longer merely laborers subordinate to patriarchs but are independent workers capable of using their own judgement. In the case of small farmers dependent upon the labor of family members, labor, management and possession of land cannot be separated. Women who take the initiative in labor have naturally become involved in management. This tendency is remarkable among lower class farmers. However, since an overwhelming majority of women do not own land, participation in management tends to be limited. This is a fundamental issue for women.

On the other hand, expansion of the role of women has also caused problems. The biggest problem is one of health. The increase of

Table 4.3 Women's percentage of agriculture labor force. (1,000, %)

	workers mainly engaged in agriculture				core workers in agriculture			
	total	M	F	F (%)	total	M	F	F(%)
1970	10,352	4,015	6,337	61.2	7,109	3,252	3,857	54.3
75	7,907	2,975	4,932	62.4	4,889	2,298	2,591	53.0
80	6,974	2,674	4,300	61.7	4,128	2,036	2,092	50.7
70–75	2,445	1,040	1,405	57.5	2,220	954	1,266	57.0
75–80	933	301	632	67.7	761	262	499	65.6

Source: The Census of Agriculture

Table 4.4 Number of women based on age and days engaged in agricultural labor

(1,000,%)

		amount	age				days			
			16–29	30–59	60–64	65 +	0–59	60–99	100–149	150+
	1970	6,337	917	3,953	1,467		2,042	1,347		2,947
number	75	4,933	575	3,000	520	839	1,684	604	681	1,963
	80	4,300	390	2,553	482	875	1,624	563	545	1,565
	1970	100.0	14.5	62.4	23.2		32.2	21.3		46.5
per cent	75	100.0	11.7	60.8	10.5	17.0	34.1	12.2	13.8	39.8
	80	100.0	9.1	59.4	11.2	20.4	37.8	13.1	12.7	36.4

Source: As Table 4.3.

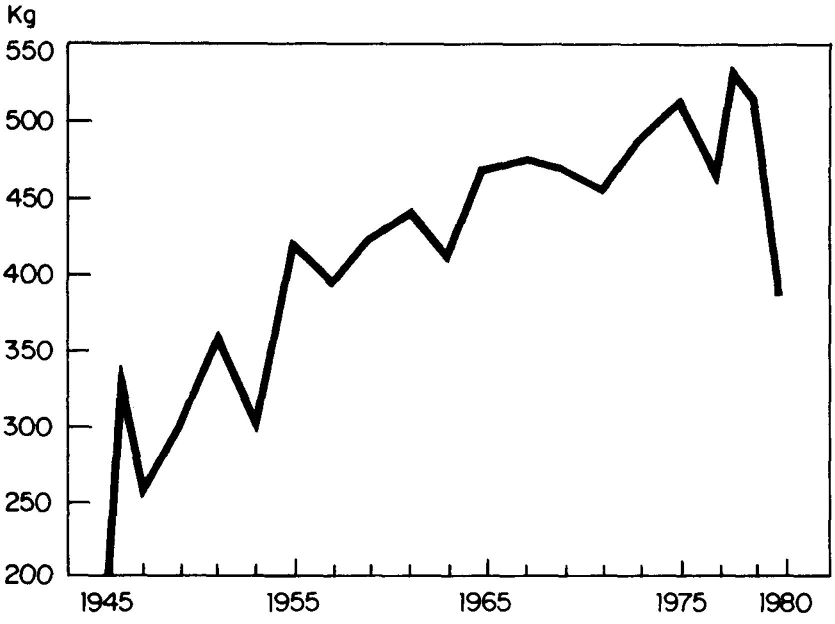

Figure 4.3 Change in rice production

Table 4.5 Percentage of women operating agricultural machinery.

	number	%
tractor	336	7.3
cultivator	773	16.7
truck	907	19.6
transplanting mach.	639	13.8
binder	761	16.4
combine	286	6.2
speed sprayer	36	0.8
milker	365	7.9
others	607	13.1
no operation	2,117	45.7
no answer	73	1.6
total of sample	4,628	100.0

Research by Zenkoku Nogyokaigisho, 1977.

women's labor hours off the farm has not meant a decrease in total hours of labor. The number of hours devoted to agricultural work by women per household per year is 2000 hours, a figure which has remained unchanged since 1965 (Figure 4.4). As a result, accidents caused by machinery and chemicals have frequently occurred, and health problems caused by the increase in stress due to the rapid change of technology and life style have appeared. Furthermore, this has had an ill effect on the children of these women in the form of mental and physical disorders. This problem has been discussed in detail by the well-known researcher of rural medicine, Dr. Shunichi Wakatsuki.

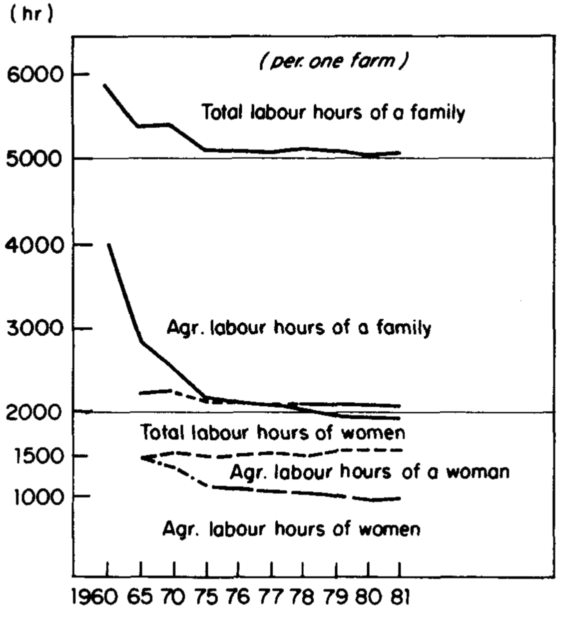

Figure 4.4 Change in women's labor hours in farm households.

The demands of farm women and problems to be solved

Farm women have three urgent demands which should be given serious consideration: more chances to acquire knowledge and skills, guarantees of individual free time, and security in old age. In order to meet these demands and solve the related problems, it is necesssary to stabilize farm income and improve the quality of life on the basis of respect for fundamental human rights. Also, it is essential that all women join agricultural cooperatives in order to promote their interests and welfare. Currently in Japan, women constitute only 8.3 per cent of the total membership. Although a women's department exists, it is only an affiliate of the agricultural cooperative and does not have a say in the management of the cooperative.

The United Nations' Decade for Women was initiated in 1975. In its 'Program of Action for the Second Half' (1980–1985), proposals were made to solve problems related to women's labor, women's right to own and use land and social participation by women, in an attempt to elevate the position of farm women.

Agricultural development is closely tied to the betterment of the position of farm women. Farm women in Japan, in this regard, have the same problems as women in other Asian countries.

5 'Half-sky'* role of China's women in rice farming systems

Li Chen-Quan, Feng Rui-Yin and Xu Xue-Bin

Rice plays a very important role in the national economy of China. Nearly one fourth of the total area devoted to grain crops is grown with rice and its yield accounts for almost half that of the total grain production in the country (Table 5.1). At present, almost 50 per cent of the two hundred million farm laborers are women (Table 5.2). In rice production, Chinese women join the men in doing all kinds of jobs particularly in sowing seeds, raising rice seedlings, transplanting, inter-

Table 5.1 Total cropping area and production of grains in People's Republic of China in 1980.

Crop	Area (x 10^6 ha)	Production (x 10^6 t)	Production (kg/ha/crop)
Total grains	116.47	318.2	2730
Rice	33.75	140.0	4125

Source: Agricultural Yearbook of People's Republic of China 1981.

* In ancient China, people thought that the sky was a whole and was held up by people, 50 per cent of whom were women.

Table 5.2 Percentage of women laborers in South China rice growing areas in 1980.

Province	Total laborers (x 10^6)	Women laborers (x 10^6)	Percentage
Shanghai	2.82	1.56	55
Jiangsu	22.64	11.49	51
Zhekiang	14.96	5.54	37
Anhwei	16.70	7.74	46
Fujien	7.29	2.97	41
Jiangxi	9.29	4.24	46
Hubei	15.01	7.15	48
Hun am	19.98	8.83	44
Guangdong	19.62	9.73	52
Guangxi	13.00	6.33	49
Sichuan	37.28	18.15	49
Guizhou	9.29	4.61	50
Yunnam	11.99	5.84	49
Total	199.89	94.18	47

Source: Agricultural Yearbook of the People's Republic of China 1981.

tillage, spraying chemicals to control pests, weeding, applying fertilizers, seed selection, harvesting, and threshing. They are also engaged in household sideline occupations, doing housework, and looking after their children and parents. Thus, women play a very important role in rice production, which is the most important grain crop in China. In addition, they also play a special part in building socialist spiritual civilization in China.

The role of Chinese women in rice production

In old China, most of the countryside was backward and very poor. Very few farmers had their own farmland. Since the farmers were exploited and oppressed, they lived in poverty. The women were in a worse position than men: they were looked down on both politically and economically.

After liberation, a campaign of land reform was launched. The rice farmers got their own farmland for the first time. This has raised the farmers' initiative in production. Since 1949, the founding of the New China, the government has adopted a series of measures to protect equal rights between men and women. Women now, like men, are the masters in China. They have been active in participating in all sorts of agricultural activities and have shown their special ability in rice production.

For example, in order to increase the previous yield of only 750 kg/ha, Ms. Ai He-Xiang, a woman committee member of Kong Zhuang Production Brigade, Hunan Commune, Lin Chuan County, Jiang Xi Province, had led the farmers to change the wasted ponds and shady hills for eight years since 1960. They leveled the land, inaugurated a system of irrigation, improved the low yield fields and finally won a bumper harvest with an output of over 7.5 t/ha.

Since early 1979 the Chinese Government has implemented the production responsibility system and has encouraged economic diversification in the countryside. Under the production responsibility system both men and women commune members sign contracts to accomplish a particular output or output value. Their contracts stipulate that they are free to utilize the portion in excess of the production target. This makes the peasants work with greater enthusiasm and gives them more initiative than before. Women, like men, have accepted responsibility for fields, taken part in rice production management and also used their spare time to raise pigs, domestic fowls, and aquatic resources, and engage in food processing, embroidery, sewing, and other sorts of sideline occupations. Women have become a very important workforce in the countryside.

For example, in one production brigade in Bao Shan Country, Shanghai Municipality, there are twenty-nine households with altogether twenty-five workforces who are all women. They worked in 6.2 ha of arable land and have achieved three crops of wheat and double rice. With this system, the annual grain yield surpassed 15 t/ha. Ms. Li You-Zhen, a young woman farmer from Ji Yun Eighth Brigade, Long Hu Commune, Tao Yuan County, Hunan Province, together with her mother, organized all the five members in the family to contract 0.45 ha of paddy fields. In 1982, they harvested 5.3 t of paddy rice and got Y 11,000 (2 Yuan = US $1) of income by selling pigs, cattle, rabbits, and chickens raised by themselves in their spare time. Women like Ms. Li are far from being few in China now. They are in an independent position and have become organizers and attenders of agricultural production.

The role of Chinese women in rice scientific research

Since the founding of the New China, women have also become masters in the fields of education and scientific research. In 1982, among the students in agricultural universities and colleges, 18.6 per cent of under-graduates and 12.7 per cent of graduates are females. In agricultural scienstific research institutions about 14 per cent of the scientists are women. In rice scientific research, 20 per cent of the research workers are women. They are engaged in the research programs of rice breeding, cultivation, plant protection, germplasm resources, genetics, physiology, etc. and they have achieved very good progress. Ms. Ke Wei, from Guangdong Academy of Agricultural Sciences has taken part in research of breeding rice varieties for about thirty years. She also participated in selecting and breeding about a dozen elite semi-dwarf varieties of rice such as Guang Lu Ai 4, Zhen Zhu Ai, Guang Jie 9, and others; all these new varieties were recommended for production in more than 7.2 million ha. Ms. Xing Zu-Yi, from the Chinese Academy of Agricultural Sciences has spent thirty years in the indica-japonica cross breeding and bred more than 10 varieties like Jing Yue 1 and others. The area planted to these improved varieties has already reached several hundred thousand hectares in the northern rice producing areas. Ms. Zheng Zu Ling from Shanghai Academy of Agricultural Sciences and Ms. Li Mei-Fen, together with men, have bred varieties which are high yielding and disease resistant by the method of pollen culture. These varieties were also recommended for production.

The role of Chinese women and the Women's Federation in training and technology transfer

Raising agricultural output depends not only on the correct policy but also on science. Over the past thirty years rice production in China has undergone a series of reforms and adopted many new techniques. For example, we have extended the planting area of double crop of rice, bred and utilized on a large scale the short-stalked variety of rice, grown more hybrid rice, adopted the techniques of close planting and applying more fertilizers. Women play a very important part in disseminating and applying these new techniques.

In growing hybrid rice, producing seeds is a new technique which requires special skill and much labor. Many women and educated youths have worked hard to master this complicated technique and have borne the task of producing hybrid rice seeds. This not only promoted the spreading of the hybrid rice, but also achieved higher yield and increased the farmers' income. Ms. Chen Lili, a woman farmer who is also experienced in plant breeding, from Tian Nih Country, Fujian Province, has consecutively undertaken the breeding for 10.3 ha and bred 10.11 t hybrid rice seeds for the brigade since 1980; by this she has acquired an income of Y 12,700. The Women's Federation, an organization of women, in order to teach women the techniques for achieving high yields in rice, has laid an emphasis on education in agricultural technique for the women farmers. In some areas the Women's Federation had held technical training classes and given lectures for the women. Among the 64,000 people attending the lectures, women account for about 60 per cent in the 2,280 rice technical lectures in Yu Lin Prefecture, Guang Xi Autonomous Region in 1982. Among the 53,606 trainees taking technical training in An Hui province in 1981, 32,188 or sixty per cent are women.

Solutions to some special problems of Chinese women in rice production

The Constitution of the People's Republic of China stipulates: 'Women in the People's Republic of China enjoy equal rights with men in all spheres of life, political, economic, cultural and social, including family life'. Because of the long-term influence of traditional feudal ideas and because of old habits, discrimination against and maltreatment of women still exist in China's rural areas.

In order to control population growth, the state has in recent years encouraged each couple to have only one child. But the concept of men being superior to women has not been fully wiped out. Some men have tormented their wives who gave birth to girls or drowned the infant girls in some rural areas. The government is quite concerned about this serious problem. Opposition to these practices is one of the important educational campaigns of the women's federations in various localities.

Marriage at mature age and having only one child for each couple have also been strongly encouraged for years. This will not only benefit the construction of the country's socialist modernization but will also help the women minimize their household work and have more time to learn culture, science and technology. The government will promote maternal and child hygiene, develop health care for children and popularize primary school voluntary service to give a better opportunity for the women to take part in agricultural production. At present China has been taking a series of measures for improving production technology and people's lives such as using lower toxicity pesticides to guarantee the people's health and easing the intensity of labor and developing countryside sideline occupations to increase the women's income.

In improving our national economy, raising the yield from each crop of rice and building up the country's spiritual and material civilization are essential: and women are surely going to play a very important part.

6 Wives at work: patterns of labor force participation in two rice-farming villages in the Philippines

Jeanne Frances I. Illo

Introduction

The evolution of farming systems from shifting agriculture to plow cultivation, which characterizes rice-farming areas in Southeast Asia, has been associated with the defemalization of agriculture (Boserup 1970). While shifting agriculture in African villages and in some tribal communities in Asia leaves nearly all tasks of food production to women, the entry of the plow and draft animals has brought about a shift in the major producer role to men. Under plow cultivation men have increasingly taken over farm operations although women can continue to engage, alongside men, in hand operations like transplanting, weeding, and harvesting and threshing. As some of these manual activities are mechanized, women are expected to be further marginalized in agricultural production.

This paper seeks to investigate the question of female participation in the production of food and other marketable goods in two Philippine villages, one of which has experienced widespread mechanization of key rice-farming operations. Although men are generally considered as the family's breadwinner, wives are often compelled to supplement male earnings to ensure the survival of the family. They accomplish this in various ways which fit into their housewifely chores, thereby disguising the degree of women's involvement in the village and family economy. Because of the pressures which are brought to bear on married women, the paper focuses on this group's labor supply decisions and how these are influenced by their family's access to mechanized rice-farming technology.

This paper consists of three parts. A brief exposition of the assumptions and the thrust of the analysis, and a description of the data used for this paper constitute the first section. This is followed by a description of the nature of married women's participation in market production and the principles which seemed to govern their market involvement. The last section discusses the patterns of married female labor force participation resulting from the access which women's families have to a rice farm and other productive resources, particularly farm machines.

Analytical thrusts and data source

The effect of farm mechanization on female workers has been studied in the context of changes in labor utilization of rice farms, with female labor lost in the general categories of 'hire', 'family', or 'total' labor (Cordova 1980). The present analysis departs from this labor-demand perspective and, instead, explores the relationship which access to farm machines bears on labor supply decisions of married women.

Thrusts of the analysis

Married female labor supply can be assumed to be determined along with that of other family members in an effort to maximize household welfare (Mincer 1962, Gronau 1980). The model expects the supply of labor to increase with a rise in wage rate, unless the income effect of the wage change outweighs its substitution effect.

In view of peasants' concern to ensure the survival of the family (Scott 1976, Hart 1978), the labor supply behavior of married women may be interpreted as geared toward fulfilling the survival requirements of their respective families (Tilly and Scott 1978 used the same argument for women in pre-industrialized Europe). Thus, married women would supply more or less of their labor according to how far their family diverges from its subsistence requirements. Moreover, their labor supply response to a change in the wage rate and family income (or earnings) could deviate from the expectations of the household labor supply model because of their foremost desire to help the family attain some (subsistence) standard of living.

A change in production technology like mechanizing certain operations is assumed to affect labor supply of married women through its influence on the chances of survival of these women's families. Farm mechanization is further assumed to operate at two levels. The first is through the family's direct access to resources like land (and irrigation); the other is through the demand for female labor in the village rice farms, which has already been found to be modified with the use of farm machines. While the former refers primarily to a push effect, the latter operates mainly as a pull effect. If other factors are constant, the more resources the women's family has, the lower is the likelihood for her to be found in the labor force; or if found in the market, the shorter are the hours she is bound to observe. Similarly, women in villages where mechanized rice-farming technology dominates are expected to have lower labor force participation and shorter hours worked than otherwise.

Data base used

In 1979, two rice-farming villages in Camarines Sur were chosen for a study of market participation and time allocation of married women. These communities provided two farming systems with rice as main crop. One village (Ayugan) was a community where the majority of rice farms were found to be irrigated and operated using power tillers during land preparation and the crop threshed by machine. The other village (Gatbo) had rice farms where land preparation was generally accomplished with the use of plow and carabao, and threshing was undertaken either through the *hampasan* (literally, flailing or whipping the palay stalks against a threshing board) or the *ginik* (treading on the palay stalks) method. Although a number of farms were irrigated by diverting water from nearby springs, the irrigated area contracted by about half during the dry season.

A sample of 100 households with currently married women in residence was selected for each village using simple random method. The combined sample was associated with a sampling error of 6 per cent, with level of confidence set at 95 per cent. In each sample household, the married women served as the respondent. Table 6.1 presents the distribution of the sample.

The research data were generated by visiting the same panel of respondents three times during the 8-month survey period. The survey rounds were timed to coincide with significantly different periods of the agricultural cycle. The first visit was accomplished in late March until the middle of April with the intent of capturing the relatively slack rice-farming period in the two villages. Gathered during this survey round was background information on the respondents and

Table 6.1 Distribution of sample families by irrigation and farm-mechanization status of the rice farms they cultivated: Ayugan and Gatbo (1979)

Irrigation and farm-mechanization status	Ayugan 1978/79 dry season	Ayugan 1979/80 wet season	Gatbo 1978/79 dry season	Gatbo 1979/80 wet season
Irrigated farms operated				
with machines	55 (80)[a]	59 (88)	8 (12)	6 (9)
without machines	4 (6)	3 (4)	29 (43)	40 (59)
Non-irrigated farms operated				
with machines	8 (12)	3 (4)	11 (16)	5 (7)
without machines	2 (3)	2 (3)	20 (29)	17 (25)
Total no. of rice-farming families in the sample	69	67	68	68
Total no. of non-farming families in the sample	31	29	32	28
Total no. of sample families	100	96[b]	100	96[b]

[a] The figures in parentheses pertain to the percentage of sample families belonging to an irrigation and farm-mechanization status to the total number of rice-farming families included in the sample.

[b] By the third survey round, the sample size has been reduced to 96 per village for any of the following reasons: death of the married female respondent, out-migration of the family after the first survey round, or death of the woman's spouse which thus rendered her a widow and was therefore considered not qualified to belong to the currently-married female sample.

their respective families, and labor force participation and time allocation data for the week immediately preceding the interview date. The second interview was conducted in June; this coincided with the land preparation, transplanting, or weeding phases in a number of farms in the two areas. The last survey round took place in late September through mid-October; this captured the harvesting and/or threshing of the bulk of the rice crop planted during the 1979/80 wet season. The last two survey rounds generated information on the respondents' labor market activities and time allocation during the week previous to the interview date.

A comprehensive analysis of the research results is contained in Illo (1983). Only the data which are directly relevant to the discussion of married women's market participation and farm mechanization are presented in this paper.

Village women: wives and workers

The married women studied in 1979 were between the ages of 18 and 68 years, with the average female respondents in their mid-thirties when interviewed during the first survey round. Formal years of education ranged from nil to 14 years, and average education was estimated at about 5 years or a year short of the complete elementary education. These women had been married for an average of 15 to 16 years to men who were of about the same age and educational attainment.

The modal sample family in the two villages was composed of the couple and 5 to 6 children; the number of living children, however, ranged from nil to 11 (in Gatbo) and 13 (in Ayugan). Of the children in the average family, at least 2 were aged 6 years or younger, and about 4 would live with their parents until they themselves marry and form their own families. The age composition of the majority of the sample families in the two areas implies that while there were children to care for, there were also older children who could either relieve the woman of part of child care responsibilities or engage in market production to help increase family income.

Despite the presence of adult children, the women often undertook production of home goods and services alone. They prepared meals, washed the household laundry, cared for the younger children (particularly the infants), and kept the house and yard clean. Moreover, they sometimes produced the vegetables they cooked, and the poultry which they might serve once in a while. When necessary, they gathered firewood and fetched water from the nearest spring (in the case of women in Gatbo) or well or pump (in Ayugan). On the whole, married women spent between 37 and 44 hours a week in home production; those with preschool-aged children, from 52 to 63 hours a week.

At the same time that village wives continuously kept house for their families and looked after the welfare of their spouses and children, they also engaged in an array of activities which would either produce marketable commodities or earn them some income. The percentage of women with non-zero market production time varied from one period of the year to another, but never did the figure fall below 64 per cent in Ayugan and 86 per cent in Gatbo. In at least 5 per cent of the sample families, the wife was in the labor force while the man was either ill or could not find work in the village. The more common arrangement, however, had both the woman and her spouse involved in market production. This was particularly true in Gatbo where at least 8 of every 10 sample families had a working man and wife team, in Ayugan, the proportion was about 6 of every 10 sample cases.

The preponderance of working-wife cases in Gatbo appears to be associated with the generally lower family earnings in the area. The average annualized earnings of Gatbo families stood at ₱5,951, which was but 61 per cent of that estimated for Ayugan familes (₱9,683). With annual minimum food requirements in 1979 valued at about ₱8,000 for a family of six, about 81 per cent of Gatbo families, as compared with 57 per cent in Ayugan, may be considered 'absolutely' poor (Illo 1983).

The variation in average family earnings between the two villages and among families within each community may be partly traced to the access which families have to productive resources. In Ayugan, farming families generally had irrigated land where crop turnaround could be facilitated with the use of farm machines. Consequently, the divergence between the earnings of farming families and those of landless households had been dramatic; the latter's average earnings were only about half of the former's (see Table 6.2). In contrast, a majority of farming

Table 6.2 Average annual family earnings, by family's access to productive resources: Ayugan and Gatbo (1979)

Category of family by access to resources	Ayugan		Gatbo		Overall	
Access to riceland[a]						
Farming	₱ 11,394	(69)[b]	₱ 6,655	(68)	₱ 9,042	(137)
Non-farming	5,875	(31)	4,454	(32)	5,153	(63)
Access to other productive resources (for farming families)[c]						
Irrigated, mechanized farm	12,348	(55)	10,593	(8)	12,125	(63)
Non-irrigated but mechanized farm	8,182	(8)	8,521	(11)	8,379	(19)
Irrigated but non-mechanized farm	7,604	(4)	5,231	(29)	5,520	(13)
Non-irrigated, non-mechanized farm	5,590	(2)	6,118	(20)	6,070	(22)
Overall	₱ 9,683	(100)	₱ 5.951	(100)	₱ 7,817	(200)

[a] Using one-way analysis of variance, average annual family earnings in Gatbo and for the two villages combined did not vary significantly with the family's access to riceland. In Ayugan, however, annual family earnings varied according to access to riceland at 0.05 level of significance.

[b] The figures in parenthesis refer to the number of sample families belonging to the particular access category.

[c] Annual family earnings varied significantly (at 0.001 level) by the family's access to productive resources other than riceland in Ayugan, Gatbo, and in the two villages combined.

families in Gatbo were either operating non-irrigated land or cultivating irrigated farms without sufficient resources (as roughly indicated by the low incidence of mechanization) to maximize the returns to rice farming. Probably because of the minimal advantage which farming households enjoyed over landless families in this village, annual earnings did not vary significantly with families' access to riceland. In Gatbo more than in Ayugan, therefore, families seemed to differ in economic status very minimally: most were poor, or few were a little less poor.

Market production activities

What constitute market production activities? These may be broadly interpreted as pertaining to activities which generate income for the worker and her family as well as to those which produce marketable (though not necessarily marketed) goods. These market activities then cover wage work along with tasks related to growing of rice and other crops, livestock and poultry raising, backyard gardening, and running a *sari-sari* (variety) store and other economic enterprises. Crop production operations include work in the field (e.g. planting or transplanting, weeding, and harvesting and threshing, and supervision of hired farm labor), and auxiliary tasks like tending work animals and preparing and bringing food to workers in the family farm.

Of the possible market activities, unpaid work in agricultural enterprises of the household other than rice farming accounted for the largest proportion of married female workers in Ayugan and Gatbo (see Table 6.3). Probably because of the low time requirement of these activities, working wives had sometimes combined their backyard gardening and livestock or poultry raising with wage employment. At other times, married women from farming households actively engaged in rice-farming activities while keeping their gardens and a brood of chickens or one pig.

Meanwhile, the 20 or so wives who worked for wages during the research period were found to be involved in different tasks in rice farms, stripping of abaca, or harvesting sugarcane. However, there tended to be a concentration of female workers in harvesting and threshing of rice crops in March and April, and again in September and October (see Table 6.4); in June, a number of working wives joined transplanting teams. A comparison of the wage employment of married women in Ayugan and Gatbo underscored two points. Firstly, overlaps in rice-farming activities seemed to occur in a community like Ayugan where farms have access to irrigation facilities, realize at least two crops in a year, and planting schedules are staggered rather than uniform for all. Secondly, shortfalls in labor demand from rice farms could be covered by other crop farms' demand. This would tend to obtain when

Table 6.3 Distribution of married female workers by type of activity: Ayugan and Gatbo (1979)

Type of activity	Ayugan April	Ayugan June	Ayugan Oct.	Gatbo April	Gatbo June	Gatbo Oct.
Wage employment	28	21	27	24	20	20
	(44)[a]	(36)	(34)	(28)	(22)	(23)
Unpaid work in own rice farm	8	19	11	17	19	14
	(12)	(33)	(14)	(20)	(21)	(16)
Unpaid work in own business	6	9	9	16	11	7
	(9)	(16)	(11)	(19)	(12)	(8)
Unpaid work in other agricultural enterprises of the household	39	36	61	77	90	87
	(61)	(62)	(77)	(90)	(99)	(99)
No. of sample married women working during the survey week[b]	64	58	79	86	91	88
	(64)[c]	(59)	(82)	(86)	(94)	(92)
No. of sample non-working married women	36	40	17	14	6	8

[a] The figures in parenthesis pertain to the percentages of women in a particular activity to total married women working during the survey week.
[b] The figures in the table need not total to the data given at the foot of the table owing to women holding different types of employment.
[c] The percentage figures in parenthesis pertain to the labor force participation at the particular survey period.

a semi-upland village like Gatbo had a diversified cropping system, thus wage employment opportunities particularly for landless workers would not depend exclusively on low-cropping intensity rice farms.

Although the village economy might dictate the degree of involvement of women in the formal labor market, family circumstances like poverty appear to unveil strategies and mechanisms through which women could help support their family, Production activities which are commonly referred to as petty gainful occupations provide the meat of such strategies. The higher participation of women from a poorer village like Gatbo in growing vegetables and fruit trees, and in tending pigs which could be sold later presents itself as a refutable evidence of informal market work as a response to poverty.

Hours worked and return to labor

On the whole, working wives spent between 23 and 28 hours per week in market production (see Table 6.5). Because female wage workers

Table 6.4 Distribution of married female wage workers by activity: Ayugan and Gatbo (1979)

Activity	Ayugan April	Ayugan June	Ayugan Oct.	Gatbo April	Gatbo June	Gatbo Oct.
Non-farming	4	4	5	1	–	–
Teaching	3	3	3	–	–	–
Dressmaking	–	–	–	1	–	–
Paid laundrywoman	1	1	2	–	–	–
Farming	24	17	22	23	20	20
Transplanting	3	8	3	2	11	–
Weeding	1	2	–	–	2	–
Harvesting and threshing	11	4	17	13	–	19
Other rice-farming tasks	6	–	–	–	1	–
Stripping of abaca	–	–	–	5	4	1
Harvest of sugarcane crop	–	2	1	3	2	–
Other agricultural activities	3	1	–	–	–	–
No. of sample married female wage workers	28	21	27	24	20	20

were also involved in other unpaid productive activities, their total weekly market time consistently exceeded that reported for women who never worked for wages, regardless of village and survey round. Moreover, a comparison of working hours only in wage employment (Table 6.6) and the cumulative workperiod of non-wage earners (Table 6.5) indicated that indeed women, on the average, were bound to work longer hours when working for wages than otherwise. The additional hours from non-wage activities spent by female wage workers were about 4 to 6 hours per week in Ayugan; but in Gatbo, the added market time ranged from 12 to 18 hours per week.

The hourly wage rate slightly fluctuated between survey rounds. Averaging for the two villages, wage rates were about ₱ 1.40 per hour during the first and third survey periods and ₱ 1.08 in June. Meanwhile, mean hourly returns to labor ranged between ₱ 1.36 in June to ₱ 1.64 during the other two survey periods (see Table 6.5). At least three things, however, can be pointed out in connection with the average hourly payments to female labor estimated for Ayugan and Gatbo. First, wage rates in Ayugan appeared to consistently exceed those paid in Gatbo regardless of task. For instance, transplanters seemed to be paid about twice as much in Ayugan as in Gatbo while harvesters (working in September or October) were estimated to have received almost ₱ 0.60 more than their peers in Gatbo for every hour worked. Second, working wives in Gatbo who never worked for wages in a particular survey round consistently reported (average) hourly returns

Table 6.5 Estimated average market production time (in hours per week) and hourly payment (actual and/or imputed) to female labor, by women's wage employment status: Ayugan and Gatbo (1979)[a]

Survey round and village	Working for wages			Non-wage workers		All workers		
	Hours	RWPH[b]	RHWR[c]	Hours	RHWR	Hours	RWPH	RHWR
March–April								
Ayugan	26	₱1.59	₱1.59	12	₱2.03	18	₱0.68	₱1.84
Gatbo	44	1.12	1.27	24	1.58	30	0.31	1.49
Overall	35	₱1.37	₱1.44	20	₱1.74	25	₱0.46	₱1.64
June								
Ayugan	40	₱1.46	₱1.35	27	₱1.24	32	₱0.51	₱1.28
Gatbo	41	0.70	0.91	24	1.57	28	0.16	1.42
Overall	41	₱1.08	₱1.13	25	₱1.45	28	₱0.30	₱1.36
September–October								
Ayugan	35	₱1.67	₱1.66	15	₱1.52	22	₱0.59	₱1.57
Gatbo	41	1.10	1.16	20	1.83	25	0.25	1.68
Overall	37	₱1.43	₱1.45	18	₱1.73	23	₱0.41	₱1.64

[a] Included here were women workers who were covered by the three survey rounds. However, 3 female workers who were employed as public schoolteachers during the research period were excluded.

[b] RHWR was estimated by dividing the total labor payment (wages plus replacement costs in own enterprise) for the reference week by the number of hours worked during that period.

[c] RWPH was derived by dividing total wages (cash and non-cash) which female workers received during the reference week by the number of hours spent in wage employment for that period.

Table 6.6 Estimated average time (in hours per week) spent by married female workers in particular market activities: Ayugan and Gatbo (1979)

Type of activity	Ayugan			Gatbo		
	March–April	June	Sept.–Oct.	March–April	June	Sept.–Oct.
Wage employment	22 (28)[a]	34 (21)	29 (27)	27 (24)	24 (20)	28 (20)
Unpaid work in own rice farm	10 (8)	28 (19)	29 (11)	18 (17)	22 (19)	25 (14)
Unpaid work in own business	29 (6)	46 (9)	25 (9)	21 (16)	30 (11)	28 (7)
Unpaid work in other agricultural enterprises	7 (39)	6 (36)	5 (61)	16 (77)	12 (90)	11 (87)
No. of sample female workers during the round	64	58	79	86	91	88

[a] The figures in parentheses pertain to the number of nomen engaged in the particular market activity.

to their labor compared with those who fitted in wage work with their other production tasks. In contrast, there was little variation in the mean overall payment to working wives by wage employment status. Lastly, lower average returns to labor seemed to be associated with longer workweek. This pattern was observed particularly in Gatbo and, to a limited extent, in Ayugan. In the latter, the negative wage-hours relationship was apparent only in March and April.

Wives' contribution to family earnings

The lengthening of the workperiod when returns to labor had declined could be interpreted as an attempt to guarantee that only the most minimal deterioration in the family's level of living would result when a relative downturn occurred in the village economy. The goal of working wives seemed modest – to help the family secure its present economic gains. And on the average, the women appeared to have succeeded. In Gatbo, total family weekly earnings averaged between ₱145 and ₱147; in Ayugan, ₱230 to ₱240 (see Table 6.7).

The estimates of the contribution of working wives to family earnings suggest the following points. Women from poorer families (in Gatbo) tended to affect family earnings more dramatically than those from less poor households (in Ayugan). The contribution of Gatbo working wives, for instance, accounted for 26 to 31 per cent of family earnings. In comparison, the labor earnings of Ayugan married female workers were but 14 to 18 per cent of the total earnings of their respective families. Although working wives realized about the same

Table 6.7 Estimates of working wives' contribution to weekly family earnings: Ayugan and Gatbo (1979)

Survey round and village	Ave. hours worked	RHWR[a]	RTLPAY[b]	FWEARNRB[c]	TFWE[d]	% of RTLPAY to TFWE
March–April						
Ayugan	18	₱ 1.84	₱ 33	₱ 207	₱ 240	14
Gatbo	30	1.49	45	102	147	31
Overall	25	₱ 1.64	₱ 41	₱ 146	₱ 187	22
June						
Ayugan	32	₱ 1.28	₱ 41	₱ 189	₱ 230	18
Gatbo	27	1.42	38	107	145	26
Overall	28	₱ 1.36	₱ 38	₱ 139	₱ 177	21
September–October						
Ayugan	22	₱ 1.57	₱ 34	₱ 198	₱ 232	15
Gatbo	25	1.68	42	105	147	29
Overall	23	₱ 1.64	₱ 38	₱ 148	₱ 186	20

[a] RHWR pertains to the estimated hourly returns to labor. This was derived by dividing the total labor payment (wages plus replacement costs in own enterprises) for the reference week by the number of hours worked during that period.

[b] RTLPAY refers to the total labor payment during the reference week.

[c] FWEARNRB pertains to the weekly family earnings net of the woman's contribution.

[d] TFWE refers to the total weekly family earnings inclusive of the working wives' labor earnings for the week.

level of earnings (as in June), the significance of their added income to family welfare was asymmetrical. To a poor family, the woman's contribution could have spelled the second or third full meal for the members; to a less poor household, the wives' earnings might have allowed an additional viand per day if not for each of the three meals during the day.

An examination of female labor earnings, taken in conjunction with hours worked and the earnings of their families net of their contribution, offers an explanation to the seemingly perverse negative hours-wage relationship observed in the previous section. Based on estimates of averages, the extension in workperiod recorded when hourly returns to labor declined tended to transpire when the latter was accompanied by a fall in family earnings exclusive of the wives' income. Otherwise (as in Gatbo between the March-April and June survey rounds), a reduction in hourly returns to labor was associated with shorter (not longer) hours worked. Controlling for the effects of family earnings, age composition of the family, village of residence, and other factors, working wives' market production time consistently declined with a rise in hourly returns to labor throughout the three survey rounds (Illo 1983). These data lend support to the contention that indeed village women take on economic roles with the welfare of their family in mind. And what is an apparently perverse labor supply behavior of married women could in fact be rational when viewed in the context of family needs and poverty.

Women's work and access to resources

The shift in production technology which takes the form of substituting machines for labor connotes the presence of prior changes in the traditional production mode. In Ayugan, for instance, farm mechanization was observed to have occurred in rice farms which had been using high-yielding, early-maturing rice varieties, applying fertilizers, and warding off weeds by spraying the crop with herbicides. Moreover, the probability of adoption of farm machines has been shown to be higher where the farms already have access to irrigation facilities. With irrigation, second and third crops are possible, and mechanization has been rationalized as facilitating crop turnaround by mitigating the effects of labor supply shortfalls during critical stages of the production process.

The input package which precedes or accompanies mechanization of certain farming operations is theoretically geared toward increasing rice yields; accumulation of resources may result among families which have already been more progressive and more affluent than the rest. In view of these, village families are differentiated along the most recent of a line of yield-increasing inputs — machines. With access to machines (and irrigation) interpreted as access to future higher earnings, the effect on economic decisions of the family and its members need not be limited to production and labor demand issues. Rather, it could be viewed as influencing labor supply behavior, with variations expected to occur along the dimension of access to productive resources. The questions which can be posed at this point are: have access to (irrigation and) farm machines so polarized resource classes that the patterns which were noted to be grounded on poverty concerns would only hold among women from lower resource-access groups, or are there principles other than poverty which could explain labor force participation patterns among different groups of women?

Working from the poverty hypothesis, it is first assumed that categories reflecting access to productive resources based on farm mechanization and irrigation embody relative poverty positions of families. Five resource classes are then created; these may be simplified into three types of households based solely on access of families to farm machines. Using either classification, landless families constitute a separate category.

Combining the two schemes, families may then be classified as follows.

Resources of family	Scheme A	Scheme B
Irrigated and mechanized rice farm	Class 1	Type A
Non-irrigated but mechanized rice farm	Class 2	Type A
Irrigated but non-mechanized rice farm	Class 3	Type B
Non-irrigated and non-mechanized rice farm	Class 4	Type B
No rice farm (landless)	Class 5	Type C

These classes roughly reflect gradations of poverty levels with Class 1 or Type A families as the least poor and Class 5 or Type C families as the poorest. Among the rice-farming families, Class 4 or Type B represent the poorest. Some support for these schemes is evident from the average family earnings figures summarized in Table 6.2.

Translating the poverty argument in terms of resource classes, the labor force participation of married women would be expected to decline as one moves from Class 5 (or Type C) to Class 1 (or Type A). The contention is that families with less resources would be more vulnerable to (product and labor) market fluctuations. To cushion the effect of market forces on the survival of the family, the participation of married women in market production is bound to be higher the lower is the resource status of their respective families.

Some empirical evidence

An examination of the labor force participation data summarized in Tables 6.8 and 6.9 suggests that women from Type A families did tend to join the labor force less often than those from Types B and C, except in September and October when participation rates varied very little according to access to resources. Between the two lower classes, however, slightly fewer landless women (from Type C families) were working relative to less poor women. But while it is true that landless women had lower participation rates than those belonging to Type B families, they nonetheless enter the wage labor market in greater number and worked slightly longer (by about 4) hours during the reference week (see Table 6.9). Not having any land to till, landless workers are forced to seek gainful employment to live. Rice, the staple food, has to be bought; crop sharing during harvest time appears to be a preferred arrangement and the activity has been shown to attract (and employ) a larger number of married female workers from landless

Table 6.8 Labor force participation rates of married women, by the irrigation and farm mechanization status of their family farm: Ayugan and Gatbo combined (1979)

Irrigation and farm mechanization status	March–April	June	September–October
Mechanized farms (Type A)[a]			
with irrigation	63	63	87
without irrigation	89	90	94
All mechanized farms	68	67	88
Non-mechanized farms (Type B)			
with irrigation	88	88	92
without irrigation	70	90	83
all non-mechanized farms	81	89	90
All farms	73	76	89
Non-farming (Type C)	80	75	83
Overall	75	76	87

[a] The information in parentheses refers to the access-to-resource category to which the women's families belong.

Table 6.9 Selected market participation data on working wives, by survey round and resource-access category: Ayugan and Gatbo combined (1979)

Survey round and selected market participation data	Farming families Type A	Type B	Total	Nonfarming families (Type C)
March—April				
% with wage job	25	21	23	54
Mean hours worked for the week	17.1	28.8	22.2	30.0
Mean RHWR[a] (₱)	1.76	1.54	1.65	1.60
Mean RTLPAY[b] (₱)	30	44	37	48
June				
% with wage job	30	15	22	40
Mean hours worked for the week	34.8	24.9	29.6	27.9
Mean RHWR (₱)	1.32	1.49	1.41	1.26
Mean RTLPAY (₱)	46	37	42	35
September—October				
% with wage job	19	26	21	47
Mean hours worked for the week	21.8	23.0	22.3	24.7
Mean RHWR (₱)	2.03	1.79	1.94	1.92
Mean RTLPAY (₱)	44	41	43	47

[a] RHWR pertains to the hourly returns (wage plus replacement cost) for the woman's labor.
[b] RTLPAY refers to the woman's total labor earnings for the reference week.

families than transplanting or weeding. Apart from providing the female workers with rough paddy as payment, harvesting also yielded the workers higher earnings per hour worked than other activities. In the two villages studied, landless women could secure weekly labor earnings of about ₱48 during harvest time even when they kept relatively shorter work periods in times (like September and October) of higher returns to labor.

Women from farming families, in contrast, are assured that at least some part of their household's rice requirement need not be purchased, and that work in the family farm could keep them away from the wage labor market. Working wives from farming families could then opt to work in the family farm, raise crops other than rice, or engage in trading as an alternative to wage employment. A curious pattern, however, seemed to emerge in the involvement of these women in the formal market. Like the landless women, those from families with non-mechanized farms (Type B) held wage jobs in greater number during the harvest months than during the transplanting and weeding period. Working wives from the highest resource class, on the other hand, tended to withdraw from the wage labor market when the wet season rice crops had to be harvested. A probable explanation of this phenomenon seemed to lie in what these landholding women did when they were not holding wage jobs.

The withdrawal of female workers from Type B households from wage activities in June could be partly explained by their involvement in planting (by broadcast method) or weeding in the family farm. The decision not to work for pay in other farms could then be rationalized by a desire to minimize cash costs in their own farm. But come harvest time, the change of supplementing the rice harvest from the family farm by share harvesting in other rice farms seemed to provide the primary attraction for women from Type B households. And because these women were more likely residing in Gatbo than in Ayugan, the opportunities for earning larger shares in the harvest (by contracting the harvesting *and* threshing of the rice crop) were definitely greater. During this period, women from Type B families were able to earn, on the average, between ₱41 and ₱44 per week; this level of earnings was secured despite the shorter hours they kept in September and October than in March and April. Like landless women, they generally tended to supply fewer hours in the wage labor market when hourly returns to labor (hired for harvesting) rose.

Working women from Type A households joined the labor force in September and October in greater number but the percentage of wage workers was lower at this time than in previous survey rounds. Several factors could account for the observed pattern. With the harvesting of the wet season rice crop, a number of the families mustered enough resources to invest in livestock which got more women involved in tending one or two pigs. Some women helped supervise the harvesters in their family farm while others engaged in trading activities. More than other groups of women, working wives from the highest resource class had the capital for trading ventures. Most of the female traders were running variety stores; a few engaged in buying and selling of rice and other food products. Returns from trading, farm supervision, and livestock raising were evaluated by working wives to be at least 25 per cent higher than what they could earn for each hour worked in the harvesting of rice crops. Assured of their farms' meeting the rice requirements of the family, women from Type A families had little incentive for share harvesting. In contrast, when payment for hired labor was in cash (as in June), relatively more working women engaged in wage jobs *and* worked longer hours in spite of the lower hourly rates.

Conclusion

The analysis of labor supply behavior of working women from families with differing resources underscores two related points. First, the concern to prevent a further deterioration in their family's standard of living when returns to labor are falling pervades among the village women. The persistence of the general tendency of women, regardless of resource status, to work longer hours when labor rates are falling leads to the second point. In villages like Ayugan and Gatbo, families are rarely distinguished as 'rich' or 'poor', but as being in different states of need (or poverty). The classification of families based on access to productive resources need not therefore be correlated with variations in the basic response of married female workers to changes in the hourly returns to labor. However, differential access to resources, particularly as it indicates the family's chances of fulfilling its rice consumption requirements, offers an explanation for some observed patterns in women's participation in the labor market.

Taking the involvement of working women in wage activities, the following principle seems to be suggested. Where the family is not likely to meet its rice needs either because of the family farm's suboptimal production or because the family has no land to till, married women are wont to hire out their services for the harvesting of rice crops; sharing in the harvested paddy provides the main attraction of this activity. In contrast, women from families whose farm could supply the household with its rice needs (as in the case of Type A families) rarely join paid harvesting teams; instead, they engage in what they view as more profitable, self-employed work. The few working wives from Type A families who seek paid agricultural employment desire to earn cash which can be used to meet non-food needs of the household.

The preceding discussions stress the use of family's access to farm machines — and, by assumption, all previously introduced yield-increasing production inputs — to set alternative family scenarios so as to delineate differences, if any, in married women's labor supply decisions. Nonetheless, the research results suggest that mechanising certain rice-farming operations would affect village women differentially. Landless (female and male) workers are the most vulnerable group; the less poor farming women, the least vulnerable. Where threshing has been mechanized (as in Ayugan), the workers' share in the harvested paddy declines but their total take-home pay could increase relative to other (non-mechanized) communities. Because threshing is accomplished by a smaller (all-male) team, the harvesters can opt to cover more farms; the limit to such strategy is the degree of competition the workers face in their own and in adjoining villages. And because working wives from landless households need at least the customary total amount of paddy which they had taken home even before the advent of portable threshers, they understandably tend to work longer (and in more farms) for lower hourly (cash-equivalent) wage rates. As the study of the two Philippine villages reveals, the focus of married women's energies is the family; their constant worry, providing the children with the basic needs. Their pre-occupation cannot confine them to purely homemaker's functions; such is not their way.

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7 Changing labor patterns of women in rice farm households: a rainfed rice village, Iloilo Province, Philippines *

Lyda Res

Summary

The purpose of this study is to provide an insight into women's changing roles in a rainfed rice production system, as population, technology and outside opportunities change. The farm household is considered the major unit of analysis.

In the past and at present women in the village under study have contributed much to household's income by taking any lucrative opportunity open to them. Particularly in the later phases of the household's developmental cycle, when children take over a large part of the domestic activities, women are able to engage in income-generating activities. Farm wage labor is only done by women of poor households, while women in higher-income households have better opportunities for pig raising.

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In rice production women contribute on the average about 11 per cent of the total family labor. Especially in low-income and in older households women participate in rice production. In all households women's part is particularly important in financial management and in disposal of the outputs of rice production.

As a consequence of change in harvesting practices and crop establishment method, and of the introduction of the mechanical rice thresher, relatively more female than male labor was displaced. However, women of low-income households are still forced to work in rice production on their own and others' farms. Because of their limited access to large rice fields with high yields and to new technology, women's work in rice production is still performed at a relatively low productivity level.

More attention by agricultural services to this group of women could be directed to raise their productivity level and increase other income-earning opportunities.

Introduction

In the area under study rice is the basic food crop. For households which produce more rice than they consume it is both an exchange crop and a cash crop. As such it represents the main trading and survival commodity in the economy of the area.

As in most rice growing areas many changes in rice production have taken place in the village. These changes are often found to have stimulated processes of either polarization or stratification of households in rural societies (Griffin, 1979; Palmer, 1975; Hayami and Kikuchi, 1981; Ledesma, 1982), especially where capital intensive, labor saving technology is involved (Rogers, 1983). The effects of these processes on women's position and relations within households have not received much attention until recently.

The effects of change processes on the position of women can be a decline in own income-earning opportunities, overburdening in production and reproduction activities, and decreasing control over inputs and outputs (Boserup, 1970; Presvelou, 1973; Tinker, 1975; Fresco, 1979).

For Java it was shown that both the change of rice harvesting tools and the introduction of rice hullers resulted in a loss of women's productive tasks and their income-earing capacity (Stoler, 1975; Sinaga and Collier, 1975; Dauber and Cain, 1981).

For the Philippines where women's role in rice farming is considered important (Illo, 1977; Castillo, 1976; Santiago, 1980; Ancheta, 1982), only few studies related agricultural change or new rice technology to women's labor. Santiago (1980) found that household female work share in the farm was higher in rainfed areas than in irrigated. Guino (1980) suggests that increasing cropping intensity increases female labor contribution in the farm. Gonzales and Guino (1982) conclude for one region next to the area of this study that female labor participation decreased over time, because total labor in general decreased as a consequence of the adoption of the direct-seeding technology.

The question remains what happens to women's work in and outside agriculture and to their working conditions as compared to those of men in the overall process of change. While this paper will mainly focus on female labor in rice production, these questions will also be explored.

The village study is an example of a situation where new technology at first created some new employment, while subsequent changes show a decreasing capacity to absorb labor in rice production. This is a more general feature of the food crop sector in Asia during this decade (Jayasuriya and Shand, 1983).

The purpose of this paper is to describe women's role in rice production in a rainfed area and to analyze the effects of new technology on women's role. After presenting the framework and village setting, the general division of labor in households is described. Women's role in rice production is highlighted. The relationship between changing labor allocation patterns and new technology are assessed and evaluated as to their consequences for women and women's role in the farm household and the village.

Analytical framework

In this study the household is taken as major unit of analysis. However, in order to analyze women's work and their situation within the household and the village, the household cannot be viewed as one entity. This would obscure intra-household relations (Cain, Kharam and Nahar, 1978; White, 1980) and with it women's position within the household. The household is defined here on the basis of the activities it performs, as a unit of production and reproduction.

The household activities comprise the entire set of activities aimed at the satisfaction of material needs of its members and at creating the material conditions for the satisfaction of immaterial needs (Spijkers-Zwart, 1980). The activities are grouped in direct productive activities which are income generating (1 to 5 below), and indirect productive activities which are aimed at the reproduction and nurturance of human labor and at the maintenance of animal power (6 and7).[1]

1. Rice production
2. Non-rice production
3. Farm wage labor
4. Pig raising
5. Other economic activities
6. Carabao maintenance
7. Home production

Activities 1–5 are direct production activities and 6 and 7 are indirect production activities.

The activities listed above are considered the basis of the internal organization of the household. Allocation of household resources, which are inputs into these activities, as well as relations within and between households related to these activities are crucial variables in the household analysis and in the study of male-female relations. Not only labor as input is important, more so are the control relations to productive resources (Stoler, 1976; Deere and de Janvry, 1979; Sharma, 1980; Beneria, 1979).

Women's working conditions will be evaluated on the basis of a number of variables. Through these variables change processes affect households and their members. These are:

The division of tasks within the household;
The workload, associated with these tasks;
The productivity of the work, which relates to the level of technology used;
The control over inputs and outputs of own and others' work.

New rice technology has a direct impact on these variables. It is an impact however, which is made in interaction with other exogenous variables such as population and alternative job opportunities.

In addition variables endogenous to the household have to be considered. Wealth status and developmental cycle of the household are expected to affect the allocation and availability of labor and other household resources, and hence the organization of labor within and between households (Chayanov, 1966; de Vries, 1977; Castillo, 1979). Therefore, these two characteristics may explain differences in working conditions between women, and how these conditions are affected by technological change.

The wealth status of a household in this study was determined on the basis of the household's amount of land, whether owned or tenanted, the household's ownership of productive resources (thresher/sewing machine) and of consumption goods (furniture/radio) and the number of household members which make use of them. Two categories of households, hereafter called low income and high income group, were distinguished.

For the purpose of this study the phases of the developmental cycle of a household are: child-bearing (all children 10 years or younger), child-rearing (children in the household younger than 5 years and children 10 years and over) and child-launching (all children older than 5 years, in which households one or more children have left the house). Underlying criteria for the classification were the degree of freedom of movement of a woman and the labor needs of a household, as this is largely determined by the age of the children. The number of years the household finds itself in a certain phase of the developmental cycle and the number of years of marriage, are additional criteria which have been used to rank the households on a life cycle continuum, and create categories with equal numbers per cell.

Data collection and village setting

The village has been intensively studied from March 1979 to March 1982. Basic information on all village households was collected through yearly surveys for three consecutive years. Twenty-five farm households were selected for obtaining data on all farm household activities performed. Farm activities were continuously monitored, while for the other household activities a recall method was used with different recall periods. The case-study households were studied in depth through interviewing and participant observation.. Women's life histories were recorded. The village history was assessed gradually in the course of the research through formal and informal interviews.

The village is located in Iloilo Province, one of the four provinces on Panay Island, at about 500 km from Manila, and about 24 km from Iloilo City.

There are 125 households in the village with an average of 5.1 persons per household. Twenty-five of these households do not cultivate their own farm of which only 9 are landless households in the sense that they depend for their living mainly on farm wage labor. There are 10 female-headed households in the village. Most households are nuclear; only 15 per cent of the households are extended which usually means here a nuclear family plus father or mother of the wife or the husband. The average level of education is 5.8 years for wives and 5.7 for husbands.

Half of the households are residing along an unpaved municipal road, while the other half are scattered over ten *sitios* (neighborhoods). The distance to the nearest market is about 2.5 km. A regular jeepney service started in 1976 provides a direct link with the markets in Iloilo City two times a day.

The village itself has a cooperative store which provides some immediate household necessities. Other facilities available in the village are a rice mill, a water tank, a piped water system along the road, and one primary school. Electricity was installed during the time of the research.

Households cultivate on the average about 1.5 ha. Thirty-three per cent cultivate an area less than 1 ha, 43 per cent between 1-2 ha, 15 per cent between 2-3 ha and 9 per cent cultivate more than 3 ha. Around 90 per cent of the total farm land is tenanted.

Owing to the topography of the area, the land resource base in the village is highly diverse in character. It ranges from well-watered landscape positions where double-cropping of rice is possible in most years, to higher areas where a single rice crop can barely be grown in the dry years. Due to rainfall dependency the area under double rice crop varies from year to year, but remains limited to about one-third of the area in a favorable year.

Other crops grown include corn, cassava, banana, gabi and numerous other vegetables. They are grown in the upland areas during the wet season (June to October) and in the lowland areas before and after the rice crop.

The village is predominantly an agricultural community. More than 90 per cent of the active male population is engaged in self-employed farming. From the female labor force more than 50 per cent mentions farming as occupations, besides housekeeping.

Before the Second World War women were engaged in a handicraft weaving industry. During peak periods women participated in transplanting and harvesting rice. Rice production was very extensive, handweeding was not a common practice. Harvesting was mainly done with a finger knife *(kayog)*.

Housekeeping was the responsibility of women and included more activities than today. Rice for own consumption was still pounded by hand. Fetching water also took more time because the water tanks were not installed yet. Domestic work was done with the help of all household members.

For women pig raising was already a potential source of income. For men carabao raising was a more important activity than it is at present. Hill-sides, hardly used for crop cultivation, provided sufficient grazing areas for the cattle herds.

After the Second World War farmers gradually started to cultivate the vacant upland areas. There was an increase in seasonal migration of young women to rice areas in the northern province of Panay, Capiz, where they participated in the harvesting operation.

The weaving industry, which had disappeared during the war, was replaced by a sewing industry. Both industries were home-based and controlled by Chinese businessmen. The sewing industry offered employment to a large number of women in the village. As one woman said, ‘in almost every house you could hear the sound of a sewing machine’. Working conditions, however, were hard, but it was one of the few opportunities to earn money.

In the sixties women in the village stopped sewing because the textile industry declined and the earnings became too small for the work they had to do. From the sewing industry women turned to agriculture. While the demand for agricultural products increased, women gradually started to grow and market vegetables. Despite the fact that sewing opportunities are still available, at present, women prefer farm activities, because the sewing work is hard and bad for their health, and the returns are low (Table 7.1). Beginning in the 1960s, a steady increase in intensification of both rice and upland crop cultivation, and in land use, through multiple cropping, took place.

In the seventies, the trend of intensification in agriculture continued. Change in harvesting practices for women, the introduction of new varieties, chemical inputs and direct seeding method, and the adoption of the mechanical thresher intensified rice production. The consequences of these changes for women will be elaborated later in this paper.

Division of labor of households

At present basically the same division of tasks exists as previously. Women are responsible for home production (housekeeping and child care) and usually have one pig to raise. Men spent little time on these activities; they are mainly occupied with carabao grazing and farming (Figure 7.1). They spent about three times as much time on farm work and farm wage labor as their wives.

Although a clear division of tasks exists, generally the sexual division of labor is not very rigid. Women can handle a plow if necessary, and a man will do the cooking if his wife is off marketing her products, and does the laundry if his wife has just delivered a child.

Both wife and husband spend about the same time on other economic activities, which for men implies mainly carpentry, basket weaving and buying and selling cattle and for women market activities and the making and selling of cassava delicacies.

Vegetables grown by women are mostly marketed by themselves. Selling vegetables is typically a women’s job, and the petty markets are women’s domain. In the wholesale market many men also operate.

Table 7.1 Daily earnings per activity in the Iloilo village.*

Activity	Average net daily earnings in US $
Making and selling cassava delicacies	0.90
Sewing	0.65
Buying and selling	1.65
Pig breeding (own pig)	1.35
Raising pigs (own piglet)	1.00
Raising pigs (in sagod**)	0.55
Carpentry	2.20
Wage labor:	
Land preparation	2.30/2.70
Transplanting/weeding	1.20/0.95
Harvesting and foot threshing	
(Pakyaw = group)	2.45
(Pasapar = open)	1.80
Pulling seedlings (maximum)	2.00
Harvesting gabi (minimum)	1.45
Hauling rice***	2.45
Harvesting ratoon	1.10
Own crop production	±3.45

* 1979 figures. One working day is 8 hours, except for plowing 6 hours. The value of food and drinks offered during a working day are included in the net earnings.

** Caretaker receives half of the returns if the pig is sold.

*** Based on the average of 5 sacks of paddy per day on 30 minutes distance.

Women's role in the economy, at least in terms of total labor input, is as important as that of men. Figure 7.1 shows that on the average women contribute about as much time as their husbands to direct productive, income-earning, activities.

The developmental cycle of the household has a distinct effect on this pattern of labor allocation. In households which are in the later phases of the developmental cycle, women spend even more time in directly productive activities than their husbands (Figure 7.2). Children assist only very little in pig raising and in other economic activities. They do take over half of the indirectly productive activities (home production and carabao grazing. Girls usually do home production activities such as cooking, washing, laundry and cleaning the house; boys are mainly grazing the carabao. Since most children go to school their contribution takes place mainly during weekends and vacations.

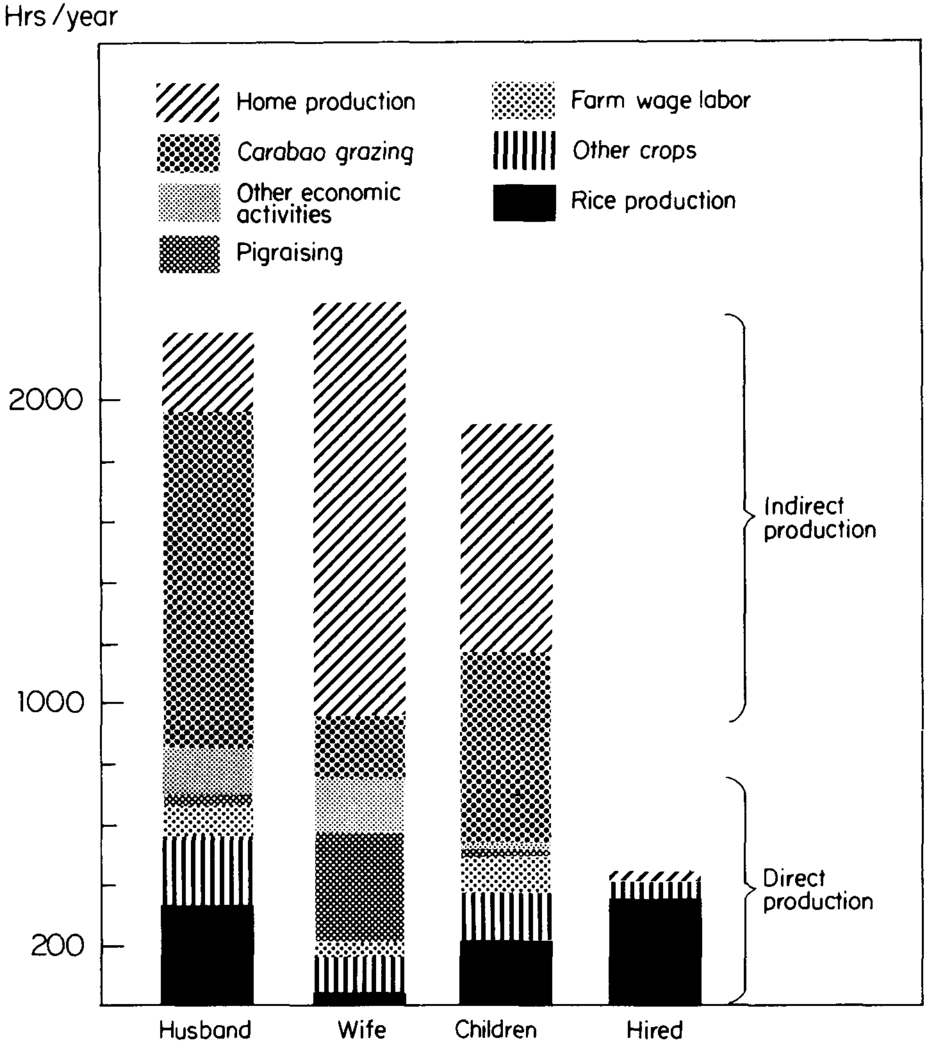

Figure 7.1 Division of tasks between wife and husband, children and hired labor. Average number of hours per year spent on 7 different groups of activities.

Information is based on a sample of 25 households in 1978/79 and 24 in 1979/80 (walking distances are included).

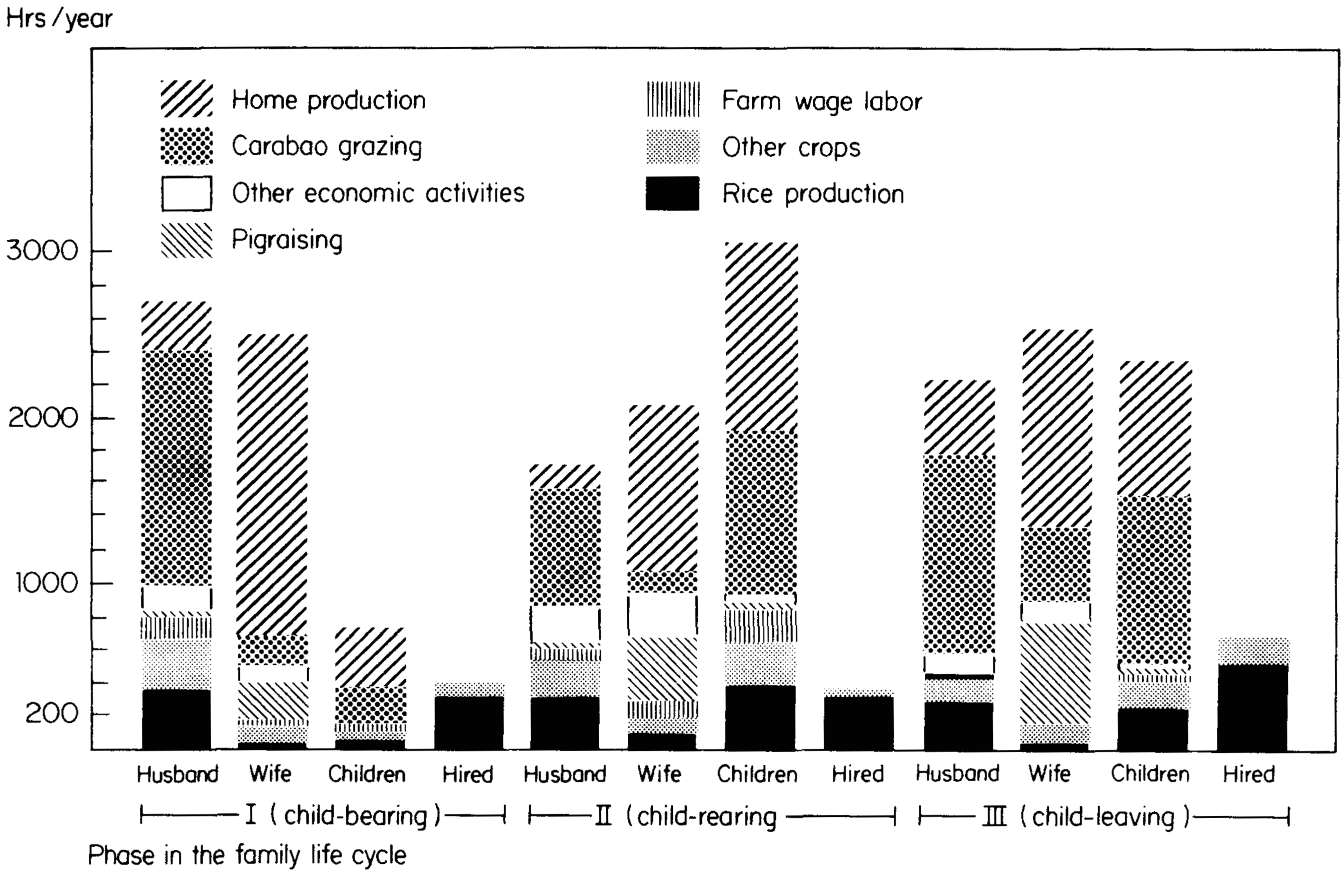

Figure 7.2 Labor allocation between husband, wife, children and hired labor, *per family life cycle.* Average number of hours spent per year per household over 3 years 1978–81.

In households with older children, women can move freely without children so that long distances from home to fields and markets do not restrain them from performing farm and market activities. In these households therefore, women can spend more time in direct productive activities (farm production, pig raising, farm wage labor, etc.) (Figure 7.2). Husbands' production time decreases if children assist them in the farm. The direct production time of their wives increases absolutely and relatively, because their child rearing activities are for a large part taken over by the children so that they can spend more time to earn the additional income needed in a household with children growing up.

The influence of the household's wealth status on the labor allocation of its members is also significant. In households with more wealth women devote somewhat more time to directly productive activities than women of poorer households (Figure 7.3), particularly in pig raising. They can afford the initial investment for pig ownership more easily thus avoiding the acquisition of a pig in *sagod,* whereby the returns of the grown pig are divided equally between the owner and the caretaker. Lower income households have longer intervals between selling one pig and obtaining another, they have to sell or consume their pig after shorter raising period, and they cannot afford to do pig breeding. Therefore, they spend less time in pig raising. In poorer households, both wife and husband need to work for other farmers to earn an additional income. Although daily earnings in farm wage labor are often higher than raising a pig, especially if in *sagod* (Table 7.l), women prefer to raise a pig. One reason for this preference is that employment is always open to them once there is a pig. Furthermore the workload is less: the type of work is easier, more convenient, and flexible in the sense that it can be combined with other activities: the status of the activity of pig raising is higher than that of farm wage labor.

Division of labor in farm production, particularly in rice production

In the pattern of total household labor allocation agricultural production in the household's own farm takes a relatively limited place in terms of working hours. It takes 26 per cent of the husband's time (15 per cent for rice production and 11 per cent for other crop), and 7 per cent of the wife's time (2 per cent for rice production and 5 per cent for other crops (Figure 7.1)). However, farm work uses considerable energy and cannot be combined with other activities, so it makes up a considerable part of the total workload.

Men engage in non-rice crop growing, especially in the first phase of the household's life cycle, possibly because it is a relatively new and

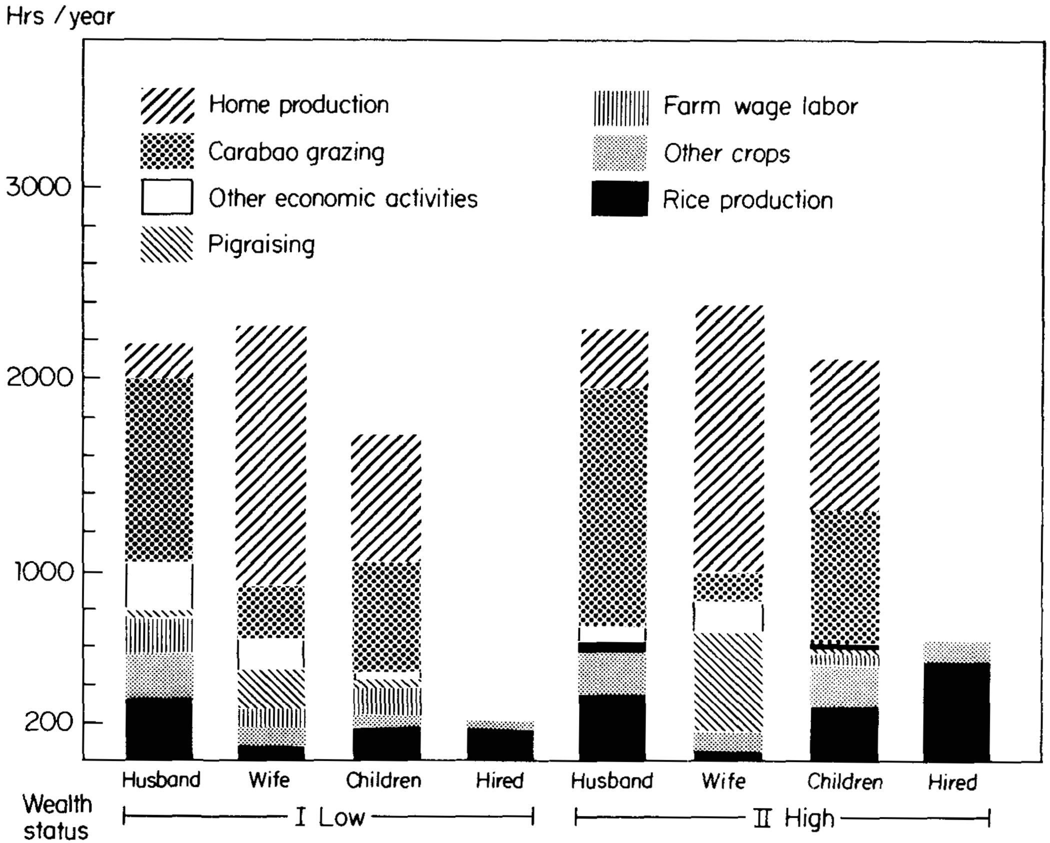

Figure 7.3 Labor allocation between husband, wife, children and hired labor per wealth status. Average number of hours spent per year per household over 3 years, 1978–81.

still expanding opportunity open to young men. Women, however, grow vegetables at any phase of the life cycle and at any income level. Their labor input in non-rice crops is spread throughout the year. Small areas of vegetables are grown under continuous care for a few hours per week, allowing a steady market income.

Women's participation in rice production occurs mainly during peak periods. They contribute on the average about 11 per cent of the total family labor in rice production, against 20 per cent in other crop production (Table 7.2).

Female contribution to hired farm labor, which is mainly for rice production, is about 23 per cent. Only in the low income households do women engage in wage labor. In addition, those women also contribute more labor to rice production in their own farm, because they

Table 7.2 Average use of family labor and % female labor per operation in rice production, for non-rice crops and work for other farmers and total labor use (family labor + hired labor) of 24 households in the Iloilo village.

	1979–80			1980–81		
	family labor hrs/yr.	% female labor	total labor hrs/yr.	family labor hrs/yr.	% female labor	total labor hrs/yr.
Rice						
Land preparation Seedbed preparation Seeding	265	–	309	228	–	250
Transplanting	39	33%	72	22	36%	81
Weeding/Replanting	150	23%	175	75	28%	87
Harvesting/Threshing	89	17%	301	89	16%	324
Other crop care pesticide/fertilizer/ herbicide water control	28	4%	32	49	4%	54
TOTAL RICE	571	11%	889	463	10%	796
Work for other farmers	273	25%	273	223	20%	223
TOTAL RICE in own and other farms	844	16%	1162	686	13%	1019
TOTAL NON-RICE	549	21%	589	401	35%	482
TOTAL FARM WORK (excluding ratoon)	1393	18%	1751	1087	21%	1501
Ratoon harvesting	–	–	–	40	98%	40
TOTAL FARM WORK (including ratoon)	1393	18%	1751	1127	24%	1541

cannot afford to hire labor. Furthermore, during the second phase of the household's developmental cycle, when children are growing up, women increase their contribution to rice production, because they are freed from housework and child care and because of the necessity to meet increased family needs.

Besides harvesting and threshing, women's major tasks in rice production are transplanting, weeding and replanting, and some rice drying (Figure 7.4). Wives usually harvest a portion of the first rice crop for ceremonial purposes and for own consumption *(ariring),* and they do the harvesting of seeds with the small harvesting knife *(kayog).* Land preparation, seedbed preparation and seeding, and crop care such as fertilizing, spraying, pesticides, herbicides and water control is nearly exclusively a male job.

Participation in rice production for boys as well as girls starts after the age of 10 years. It is striking that in the age-category 10–15 years a girl spent more time in rice production than a boy. This is mainly because of their large contribution to weeding and replanting in 1979, which was a relatively dry year for rice production (Figure 7.4). The ratoon rice,[2] which is harvested only by women, caused harvesting time for adult women to increase in 1980. Figures indicate that in a less favorable year when more time is needed by a household for weeding and replanting, mainly the daughters between 10 and 15 years of age and sons between 15 and 20 are recruited to do the job. Above 15 years of age, female share in rice production decreases considerably.

Women's involvement in decision making

Women's role in control and decision making regarding rice production is not very obvious from formal interviews. When asked who makes the decisions about rice production such as the acquisition of new seeds, choice of pesticide, establishment method, and hiring harvesting labor, most women answer that their husbands decide, sometimes together with them, and sometimes with their sons. Even in cases where the wife contributes substantially to decision making with respect to rice farming, to the outside world it will always appear that the man has taken the decisions.

In general, the influence a woman has on the decisions depends on the wife's and husband's personality traits and the relationship between them. Furthermore, informal talks and the occurrence of several incidents made it clear that in decisions which have consequences for the labor input of women as well as in those related to the household budget, women are always involved.

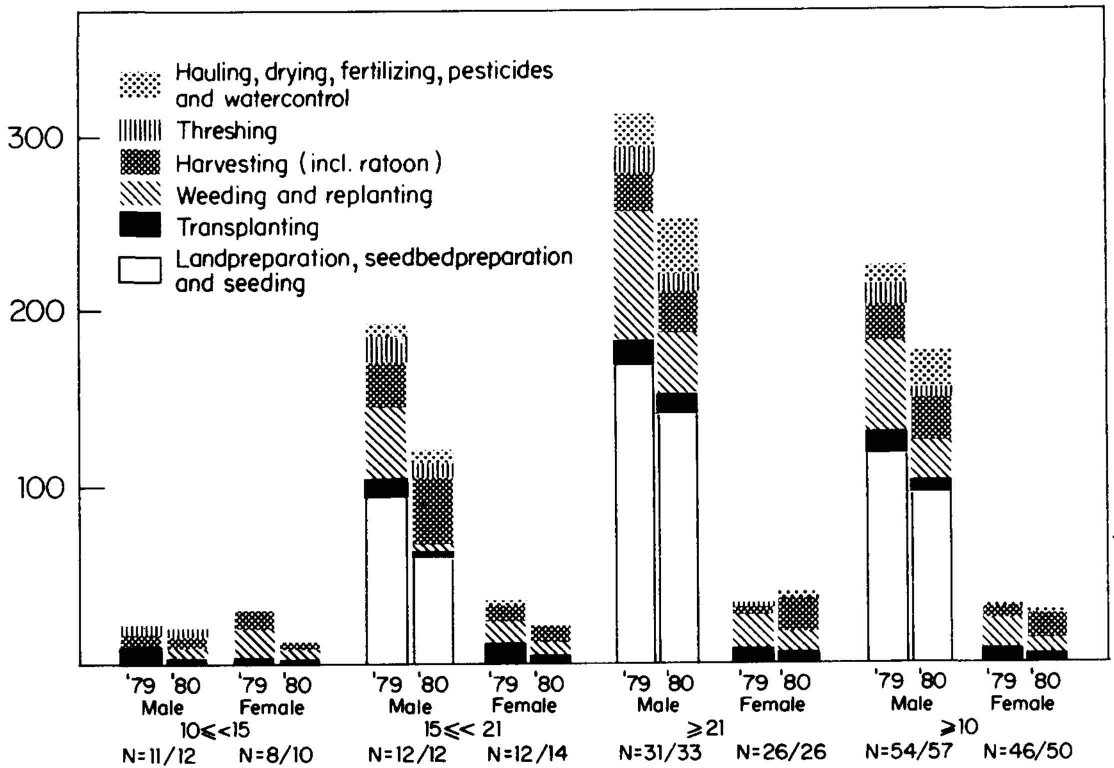

Figure 7.4: Average hours spent per operation in rice production in own farm per person in each age and sex category in 1979–80.

One example of how women influence rice farm decisions because of their labor input is given by a couple that disagreed during the interview on the method of crop establishment in a certain parcel. The husband wanted to broadcast the seeds in the dry soil (dry-seeding), in order to have more chance to grow two rice crops. The wife expected that this parcel, which had some degree of weed infestation in previous years, would give her much work in weeding. She preferred wet-seeding, so that the water would suppress the weeds, and would hardly need any weeding thereafter. Finally the crop was established the way the wife wished, since the husband knew that his wife, who was also engaged in other activities, might be too busy to do the weeding.

With respect to the decisions to buy farm inputs, such as fertilizer, husband and wife discuss how and whether they can finance these inputs. Particularly in case of competing needs in the household, for example expenses for the children's education, women will be involved in the decisions. Women's role in this decision process is defined as that of a person who, as keeper of the purse, takes care of the financial management of the household, obtains loans, and manages the household's debt balance.

The control over the output of rice production from the own farm is in the hands of both wife and husband. The husband may well spend some of the produce for personal expenses, such as drinks, without his wife knowing it. As soon as the rice has been hauled to the house the wife keeps an eye on the amount of rice in stocks. The wife has an important role in decisions on the allocation of the produce for own consumption, paying off debts, and others.

Changes of female labor use in rice production[3]

In the village under study rice production has undergone a number of major changes in the last 15 years.

First the replacement of the *kayog* (small harvesting knife) by the sickle as a harvesting tool for women, caused by the introduction of the relatively short-statured variety (BE-3), started in the 1960s; in 1974 the sickle, which is a labor-saving device, was used by all female harvesters (Res, 1980).

Since 1970 the modern varieties have been gradually introduced in the village. Direct seeding of pre-germinated seeds on puddled fields (wet-seeding) became a viable establishment technique with these varieties. By skipping the laborious transplanting operation much hired labor was saved.

Through the introduction of the non-photo sensitive varieties also double-rice cropping was made possible. At the same time this meant an expansion of the harvesting period from 13 to 21 weeks, leveling off harvesting labor peaks. Extra labor was needed, but demand was spread over a longer time span.

The use of the dry-seeding method at the end of the 1970s did not change much in the quantity of labor required for crop establishment, since it mainly replaced wet-seeding.

In 1977 the portable mechanical thresher was introduced. Since that time threshing labor use has started to decline. Almost all the village rice harvest could be threshed by three new mechanical threshers with blowers which came into the village in 1979.

As a consequence of the above mentioned changes in rice production, the decade 1970–1980 shows a decrease of 9 per cent in total labor use, even though the crop area increased by 36 per cent during the same period. This decrease in labor use was mainly due to the direct seeding method and in a lesser degree to the introduction of the mechanical thresher (Table 7.3).

In the first period, from 1970 to 1978, the decreases in labor use are well counter-balanced by the increasing crop area. However, the population, which increased by 13 per cent during this period (Table 7.3) could not be absorbed.

In the later part of the decade, 1978 to 1980, total labor use did decrease, not withstanding the increase in crop area, because of the decline in transplanting labor and the further introduction of the thresher. During these three years labor use decreased by 12 per cent while the population decreased by 2 per cent owing to out-migration. Therefore, the decline of labor absorption in these years may have stimulated increased out-migration.

In order to determine whether more male or more female labor was displaced and under which circumstances, the different operations in which women are involved were considered.

Crop establishment, weeding and replanting

At present women perform about one-third of the family labor in transplanting (Table 7.2). In hired labor the female share is somewhat more, up to 50 per cent. Since transplanting is traditionally considered as an activity which is shared equally between men and women, both male and female labor was displaced with the increased use of direct seeding. The preparation of the seeds and the broadcasting of the seeds by men may have made up for the loss of male labor in seedbed preparation. It is estimated that in crop establishment at least as much female as male labor was displaced.

Table 7.3 Change in work days in total village labor use for rice production tasks and change in crop area and population in the Iloilo village.

	1970–78[a]			1978–80			1970–80		
Land preparation	518	+18%	(– 2)[b]	461	+ 14%	(+ 1)	979	+34%	(– 1)
Crop establishment	–867	–32%	(– 43)	– 750	–40%	(– 46)	– 1617	–41%	(– 70)
Weeding/replanting	188	+21%	(–)	255	+25%	(+ 10)	443	+50%	(+ 10)
Other crop care	114	+ 54%	(+ 26)	41	+11%	(–)	155	+71%	(+ 26)
Harvesting (sickle) (including threshing)	436	+ 10%	(– 9)	– 1368	–30%	(– 37)	– 932	– 23%	(–43)
Total	389	+ 3%	(– 15)	–1361	–12%	(– 22)	– 972	– 9%	(–33)
Crop Area		+21%			+12%			+36%	
Total Population		+ 13%			– 2%			+11%	
Male Population		+ 17%			– 3%			+12%	
Female Population		+ 8%			– 1%			+ 7%	

[a] 1970 labor use data are estimated, based on the usual labor input profile for transplanted and direct-seeded BE-3 crops.

[b] Figures inside parentheses are % change per hectare

Source: Kikuchi, Huysman, Res, 1982.

In weeding and replanting one fourth of family labor is female (Table 7.2). For hired labor in these activities the female share was nearly the same as that of men. The use of the direct seeding, especially the dry-seeding method was expected to create more labor in weeding and re-planting. However no increase in weeding per ha. was found between 1970 and 1978 possibly because of the use of herbicides. In the period 1978–1980, however, when the dry-seeding method was introduced, weeding and replanting time per ha. increased by 10 per cent (Table 7.3). Owing to the increase in crop area in the village total weeding and replanting labor use further increased. This increase is absorbed by both male and female labor.

In total both male and female labor for transplanting, weeding and replanting decreased. It cannot be ascertained whether more male or more female labor was displaced. Village residents assert that both males and females decreased their total labor input in these operations, as family laborers and as hired laborers. Relatively more women and men of low income households remain involved in these activities.

Harvesting and threshing

With the gradual abolition of the *kayog* in the first part of the 1970s, the attendant harvesting arrangement also disappeared. In former days harvesting for other farmers would take place according to the *pulo-pulo* arrangement (10 per cent of the harvester's share), which was a typically female arrangement, and the *pakyaw* arrangement (contract), which is exclusively male.

Nearly all women in the village participated in harvesting for other farmers and in their own fatm. In addition to this women from outside assisted in harvesting, and female village residents went harvesting else-where, where other varieties and other climatic conditions caused different harvesting dates. With the change from the *kayog* to the sickle the *pulo-pulo* was replaced by the *pasapar* arrangement, which is also an open harvesting arrangement in which both men and women can participate. At the most 50 per cent of the harvest under this arrange-ment is performed by women. Table 7.4 gives an overview of arrange-ments.

Women who could afford it stopped harvesting for other farmers. The reason mentioned is that harvesting with a sickle is too difficult for them. Sickle harvesting is a more back-breaking activity, whereas *kayog* harvesting has a more skilled character, which was therefore considered more appropriate for women.

Women harvesting with the *kayog* under the *pulo-pulo* arrangement earned less than half per day of what men earned in contract group

Table 7.4 Earnings per day for harvesting and threshing per harvesting arrangement for foot threshing and mechanical threshing[1] in US $, in the Iloilo village.

	Pulo-pulo	Pasapar	Pakyaw	80 cavans* harvested by 5 persons[2] Pasapar	Pakyaw
Harvesting arrangement	Female/kayog (until 1974)	Male and female (from 1970)	Male contract (since a long time)	Male & female	Male contract
Threshing method	No threshing	Foot-threshing	Foot-threshing	Mechanical	Mechanical
Harvester's share	1/10 of harvested	1/6 of the harvested & threshed indivi-dually	1/6 of the harvested & threshed*** for the group	2/3 of the 1/6 harvesters share***	
Hours cutting per cavan*	6	1.5		1.5	
Hours threshing and cleaning per cavan	(2)	3		0.08	
Average hours Transportation thresher				2	
Cavans harvested and threshed per 8 hours workday	1.33**	1.8		n.a.	
Total hrs worked per harvester				30.5	
Total earnings per harvester (including meals)				10.80	13.00
Earnings per 8 hrs working day (including meals)	0.80	1.80	2.45	2.85	3.40

* 1 cavan = 1 sack unmilled rice = 44 kg = 6 US $

** Number of cavans, only harvested, not threshed, per 8-hours workday.

*** Under pakyaw arrangement the harvesters get one mea1 during cutting, 3 meals during threshing. 1 meal during cutting is .50, 3 meals during threshing is 0.85, half day threshing is 0.70 US $.

1 Figures are mainly based on estimates of informants. 1₱ = US $0.1 35.

2 Earnings from harvesting and threshing while using mechanical thresher depend on the amount harvested and number of harvesters, because of transportation time of mechanical thresher and "waiting" time. Therefore, if 160 cavans are harvested by 10 persons total working hours/harvester is 34.5 and daily earnings are 2.50 if under pasapar and 3.20 under pakyaw.

(*pakyaw*) harvesting (Table 7.4). With the change to the sickle, which is nearly twice as fast as harvesting with the *kayog,* and to the *pasapar,* daily earnings for women increased; but harvesting in the exclusively male contract group remains the most profitable.

In the second half of the 1970s, the thresher brought about major changes in harvesting and threshing labor use and arrangements. A close look at harvesting labor use in 1979/80 and 1980/81 (Table 7.2) reveals that while the rice harvest in 1980 was nearly twice as much as in 1979, mainly due to the different weather conditions in the two years, time spent by household members in harvesting in their own farm remained the same. This is caused mainly by increased use of the mechanical thresher, which replaced foot threshing. In 1979 76 per cent of the total village rice harvest was threshed mechanically. In 1980 this rose to 97 per cent of the total rice harvest (Table 7.5). Yet, the share of female family labor in harvesting and threshing only decreased by 1 per cent.

With respect to hired labor, the female contribution is affected more seriousiy. From 1979 to 1980 there was an increase in contract labor (*pakyaw*) from 57 per cent to 82 per cent of the total village rice yield

Table 7.5 Percentage of total rice harvest per harvesting arrangement and threshing method in the Iloilo village, 1979–80(62 households), 1980–81 (70 households).

Harvesting arrangement	Threshing method	1979–80 % of total harvest	1980–81 % of total harvest
Pasapar	Foot	17%	2%
(everybody can	Mechanical	23%	12%
join)	Total	40%	14%
Pakyaw	Foot	4%	1%
(contract group)	Mechanical	53%	81%
	Total	57%	82%
Family labor	Foot	3%	1%
	Mechanical	–	2%
	Total	3%	3%
Not known	Foot	–	–
	Mechanical	–	1%
	Total	–	1%
TOTAL	Foot	24%	3%
	Mechanical	76%	97%
	Total	100%	100%

harvested, because a larger first rice crop made it worthwhile to organize contract groups (Table 7.5). The prevalence of the thresher stimulated the formation of contract groups, since the thresher operators and owners prefer to work with contract groups. This is because contract groups harvest larger areas and quantities, which reduces the fixed cost of the transportation of the thresher to the rice field per sack of rice.

This shift in harvesting arrangements means that women at present have access to only 18 per cent of the village rice yield which is mainly harvested under the *pasapar* arrangement and partly with family labor (Table 7.5). This reduces women's harvesting and earning opportunities considerably, and limits them mainly to the very first rice crops harvesting in the rainy season when most of the *pasapar* harvestings take place. Total female work load however, may not have decreased that much, because some of what they harvest is still foot-threshed. Under *pasapar* and family labor still some part of the harvest is foot-threshed, while under the *pakyaw* arrangement virtually all the harvest is threshed mechanically (Table 7.5).

Women's returns in the regular harvesting for other farmers are lower than those of men. This is not only because of the arrangements under which they harvest or the technology they use (Table 7.4), but also because fields under these arrangements are often small parcels with low yields, where a contract group would not want to work. In addition to this the composition of a *pakyaw* group which is limited to less than 10 persons guarantees higher daily earnings for harvesting with mechanical threshing than in *pasapar,* wherein more persons may participate (Table 7.4).

The relatively low profitable ratoon harvesting (Table 7.1), is done nearly exclusively by women. This rice is harvested for a few hours per day and foot-threshed in small quantities. Ratoon rice is harvested in farms belonging to other people only by women of poor households. Their opportunities for ratoon harvesting have decreased because of double-cropping and the increased use of new varieties which may be less suitable for ratooning.

Changes in women's role in rice production: an assessment

A decrease in female labor use over the period 1970 to 1980 occurred as a consequence of decreasing labor use requirements of operations in which women participate, i.e. transplanting, harvesting and threshing. Women's contribution to rice production declined absolutely and relatively. Men increased their labor use due to double cropping, because the typically male activities of land preparation and fertilizing increase with the crop area. These increases largely made up for the decrease in male labor use in other operations. Women, however, only saw their labor was reduced. Furthermore, the spreading of harvesting labor over a longer time span meant that women's labor was no longer needed to meet high seasonal labor demand. Therefore, available male labor could be used throughout the harvesting season and partly be substituted for female labor. A shift from total hired labor to family labor took place during the first part of the decade (Kikuchi, Huysman and Res, 1982), suggesting that women's role as an unpaid family laborer may not have changed much initially. Later both female family and female hired labor reduced. The last three years' labor data demonstrate this decline clearly (Table 7.6): total male contribution to rice production was 18 per cent in 1978, 16 per cent in 1979, and decreased to 13 per cent in 1980. The decrease in the latter year was mainly due to a decrease in hired labor (Table 7.2).

Table 7.6 Total hours of 24 households in rice production: family labor plus wage labor of household members; female labor as a percentage of this; and the percentage change in male, female and total labor in rice production between the years 1978, 1979 and 1980*, in the Iloilo village.

Year	Total labor in rice production	% female labor	% change in male	female	Total
1978	18,857	18%	(+1,355) + 9%	(–224) – 7%	(+1,131) + 6%
1979	19,988	16%	(–2,115) –13%	(–838) –27%	(–2,953) –15%
1980	17,035	13%			

* Excludes ratoon harvest in 1980.

Demographic changes confirm this trend. From 1970 to 1978, when female labor decreased, but male labor could still be absorbed, the male village population grew by 16 per cent, while the female population increased by only 8 per cent, resulting in a relatively high sex ratio which increased from 102 to 110. This is due to higher outmigration of single young women, who saw their opportunities in the village reduced. In the last three years of the 1970s, the female population decreased, but the male population decreased even more. Both male and female youth migrated, but more female migrants returned from the city to get married in the village. The sex ratio (108 in 1980) still remains in favor of men.

The displacement of female labor in rice production does not mean that all women reduced their labor input in this enterprise. Only women of the higher income households who could afford it retreated from rice production work. Women of low income households remained heavily involved in rice farm labor. Like households headed by women, they remain dependent on the income-earning opportunities rice production gives them. Their working conditions however, have become increasingly marginal. The relative productivity of their work is low compared to that of men, in the sense that they more often use old technology, like foot-threshing, and that their daily earnings are less than those of men. In addition, their opportunities in rice production and ratoon harvesting are decreasing.

Aside from the importance of rice production in enabling low-income women to contribute to the household's income, women play an essential role in financial management and do have a certain influence on decision making with respect to rice production.

For women whose labor input in rice production has declined during the last decade, alternative income earning opportunities are available to a certain extent. Vegetable growing and marketing is an increasing opportunity open to all women in as far as they have access to a small piece of land. The opportunity of pig raising, and more so of pig breeding, is more easily accessible for women of higher income households, however. The profitability of both activities, and thus women's productivity in these, can be increased when financial support, especially for low income women, becomes available. Therefore, it seems important that agricultural extension and credit programmes should also focus on women and their activities in crop as well as animal production and not, as is presently the case, focus exclusively on men.

Notes

1. Although their reproductive significance is well recognized, social activities, such as participation in village meetings and attendence at weddings, are not included here, for practical reasons.
2. Ratoon rice is rice which grows if the rice plant resumes its growth after rice harvesting.
3. For a more detailed description of the agricultural change process in relation to demographic changes, see Kikuchi, Huysman and Res, 1982.

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8 Women and the modernization of rice agriculture: some general issues and a Javanese case study

Benjamin White

Introduction

The main part of this paper uses data from various available small-scale studies to outline some consequences of Java's 'green revolution' rice intensification strategy for rural women. Before turning to Java, however, the first section outlines some general issues concerning the impact of agrarian transformations on women, in order to provide some framework for the enquiry. The need for a class-specific approach is emphasised and some of its implications outlined; in particular, that it is not 'technology' as such but rather the agrarian relations determining its ownership and access to the incomes it generates, that should be the focus of our attention and the target of policy analysis.

The main focus of the case-study is on changes in modes of labor recruitment and payment, since as will be argued small-scale rice cultivation in Java, despite very small farm sizes, is primarily a wage labor economy and the majority of women who work in the rice sector do so as wage laborers. Limitations of space mean that little attention can be devoted to important aspects of the involvement in rice cultivation of women in farm rather than wage-labor households, such as their control of production resources, the production processes and the product and their access to the various formal institutions on which rice cultivation is becoming increasingly dependent.

Women and agrarian transformations: some general issues

In recent years several authors have discussed the methodological problems of assessing the impact of agrarian transformations on rural women (for example, Agarwal, 1981; Beneria and Sen 1981; Deere et al. 1982; Ember 1983; Huntington 1975; Meynen 1981; Palmer 1977, 1979 and n.d.; Palmer and von Buchwald 1980; Rogers 1980; Safilios-Rothschild 1980; Staudt 1978; Tadesse 1982). To these studies, which mainly restrict themselves to non-socialist contexts, we may add a number of analyses of the impact of socialist agrarian transformations on women through comparative or single-country studies (Andors 1981; Croll 1979, 1981; White 1982, 1983). Besides these, general studies on the social and economic consequences of the 'Green Revolution', while generally neglecting women, provide insights into specific aspects of the Green Revolution (particularly class specific ones) which are relevant to the analysis of gender-specific impacts (Griffin 1978; Pearse 1980 and the series of UNRISD studies on which the latter is based).

The authors mentioned above do not share any general framework and no attempt will be made here to summarize the enormous range of issues which they raise. Nevertheless, it is worth attempting to distil some general issues, selecting specially those which are most likely to be relevant in an agrarian society such as Java, characterised by a very dense rural population, small farm sizes, high rates of landlessness and near-landlessness and extreme povery among the landless and near-landless classes which make up the majority of the population.

A first point is the need to examine the class-specific effects on rural women of agricultural changes, rather than assuming women to be a homogeneous category who will be affected in similar ways by the changes in question. This point has so often been raised that there is no need to argue for it here, although in what follows we will expand on some of its implications.

A second related point concerns the assumptions underlying our interest in the effects of technological change on a particular social group (in this case, women). We may begin our examination of this issue with the paradox already noted in the overview paper of Unnevehr and Stanford (this volume). One the one hand, rural Asian men and women are among the most overworked people in the world. Many recent time-allocation studies have shown that working hours of the rural poor are much longer than any western standard of 'full employment'; that rural women in general work longer hours than men; and that poor rural women are the most overworked category of all. The facts of this hard life of drudgery – too much work for too little income – point to the need for labor-saving technologies to reduce the burden of working-hours and/or to achieve greater productivity per working-hour. On the other hand, reliable studies in the same societies (often by the same authors!) complain equally correctly that new labour-saving technologies are reducing work-opportunities – as if more, rather than less work should be the objective of agricultural development policies.

This seeming paradox is reflected in the common ambivalence towards questions of technological change and employment, and the failure to understand (or at least, to translate into policy) the fact that employment is not an end in itself, but only a means to an end in development. This is one reason why comparisons between totally different kinds of agrarian structure are instructive. It is only in societies where the majority of direct producers earn their livelihood through the sale of labor, rather than through (individual or collective) ownership of the product of labor, that this contradiction is observed, a contradiction resulting in the irrational situation where technological progress makes it possible to generate more income from less work (which I think is not a bad definition of 'development', or at least of its techno-economic aspect) but working people are unable to share in the benefits of this progress, since the only way in which their incomes can improve is through an increase, not a decrease, in the demand for their labor. This contradiction is one that, historically, non-socialist societies at all levels of development have not solved. We may recall, for example, that one main issue in the historic struggles of working people in the industrialized capitalist countries was (and still is) the demand for shorter working hours; with at the same time, a parallel thread of campaigns for the 'right to work'. The pairing of these demands is not irrational, but rather reflects a truly 'development-oriented' attitude to technological progress, with the objective of ensuring that its benefits are retained by those whose drudgery is replaced by labor-saving technology, rather than shifting to a smaller minority by virtue of their control of non-labor production factors.

This issue underlines again the importance of a class-specific approach to the employment consequences of technological change in agriculture, in which it is recognized that technologies in themselves are neither 'good', 'bad' or 'neutral' from the point of view of employment and income distribution (any more than 'employment' is in itself a good thing); their effects depend completely on the institutional or socio-political context within which they are introduced (cf. Agarwal 1981 : 96), which determines who gains access to incomes generated by the new technology, and who loses access to incomes available under the old technological régime.

A good example is the subsidised introduction of motorised rice-hullers, which by the mid-1970s had virtually extinguished all wage-opportunities for Javanese women in hand-pounding (cf. Collier et al. 1974), or of paddy-tractors in the later 1970s in some areas of Java (cf. Sinaga 1978). If, rather than wealthy villagers and urban people, those who depended on manual wage-labor (men hoeing, women hand-pounding) had been granted subsidised credit for the collective purchase and operation of tractors or hullers — thus retaining the incomes deriving from land-preparation and rice-processing, reducing drudgery and freeing time for other income-earning pursuits or leisure - then the double objectives of technological progress (less work and improved incomes) would have been achieved. But in the present circumstances of their ownership, these machines offer the landless or near-landless wage-worker no release from drudgery, but rather a reduced chance of earning a living from agriculture, and probably a search for manual labor opportunities in other crowded sectors in which wages or labor-incomes are likely to be even lower.

In summary, it is not ‘technology’ as such but rather the agrarian relations determining its ownership and access to the incomes it generates, that should be the focus of our attention and the target of policy analysis. The relevant question, then, concerns the ways in which new technologies, introduced in specific agrarian structural contexts, may mean the transfer of agricultural incomes from one group to another: from one class to another, from one gender to another, and sometimes both.

The employment issue becomes further complicated in the case of women workers. Various authors have noted the double-edge implications of women’s entry into the labor market (whether urban or rural) as a result of the proletarianization that accompanies agricultural intensification and commercialization in non-socialist contexts. On the one hand, it is recognized that women almost universally earn lower wages than men both in agriculture (cf. Unnevehr and Stanford, this volume) and in available alternative off-farm or urban employment such as manufacturing, and often suffer exaggerated gender-specific forms of exploitation and labor control besides wage discrimination. On the other hand, it has been argued that despite often appalling work conditions (which, as in the case of child labor are often an important ingredient of certain stages of ‘savage’ capitalist accumulation in agriculture or industry), the movement of women from home-based work into wage-work and their new status as independent wage-earners may represent one step on a long road of struggle for social and economic emancipation; see, for example, discussions of this dilemma by Pinchbeck (1969) for women workers in the English Industrial revolution, or by Arizpe and Aranda (1981) for women in the strawberry-processing industries of rural Mexico. In contrast, Mather argues in a recent paper (1983) that the processes of labor recruitment and control of rural Javanese women migrants to manufacturing industries on the fringe of Jakarta result in the reinforcement rather than weakening of mechanisms of women's subordination.

Turning to some issues more specifically related to the 'Green Revolution' (GR hereafter) type of agricultural transformation strategy (whose essential elements are agricultural intensification and commoditisation, aided by state subsidies and/or services and specific technologies – new seed varieties, increased fertilizer use, techniques of weed-, water-, pest-control etc. – and often though not always accompanied by moderate land-tenure reforms), we may first consider the possible effects on women of commoditisation of input and output markets and of the labor process itself. Does this, for example, lead to a sharper ideological distinction between the notions of 'productive' and 'reproductive' labor and in turn, a sharper separation by gender of those two spheres of activity and influence? Another aspect of the GR is the increasing dependence of agricultural producers on formal state institutions: the formalization or institutionalization of information networks (research and extension, farmers' associations), of credit arrangements (banks, cooperatives), of input and output markets (cooperatives, marketing boards), of water-control (water-users' associations), sometimes also of land rights: in each case, there is a possibility that institutionalization may mean the shift of an activity, a sphere of influence or control, an 'access' or even a property right from women to men. A simple illustration might be the example of credit, which (in the case of Java) was often handled by women through small-scale, autonomous and relatively informal rotating credit or savings-and-loan associations; with the advent of subsidised state agricultural credit packages (and of local branches and officials of the bank, who expect to deal with male 'farmers'), men rather than women may now become the primary conduits of production credit (cf. White and Hastuti 1980).

I will not comment in detail on these problems (which are clearly documented, for example, in Dey's African overview paper, this volume), since they concern mainly women in farm households while our Javanese case-study will focus more on women wage laborers. However, it is important to remember that while state agencies often play an active role in the process associating 'formalization' with 'masculinization', the reversal of this process will not be achieved simply by the removal of ignorance and prejudice and a change in gender attitudes on the part of policy-makers, or even on the part of lower levels of state apparatus charged with implementing policies.

While these changes are of course necessary (and may be aided by increasing the number of women staff at all levels of the relevant agencies), there is also the question of gender attitudes and gender relations within the community of producers themselves. Even when policies change, rural women will still have to organize and pressurize at local level to protect — or to regain, in cases where they have lost it — their position on an equal basis in the production process.

Another general aspect of GR strategies is that they may succeed in dramatically increasing average yields, but with increased risk of harvest failure (especially where irrigation is unreliable, where pest-identification and control systems are inadequate), and of greater cash losses when harvests fail because of the increased input costs. This might be expected to increase the vulnerability of small or marginal farm households. What actions do these households take to resist this vulnerability (for example, in developing multiple income sources) and what extra burden does this place on women?

There is widespread agreement that GR strategies, when introduced in already-differentiated agrarian structures and without radical land reforms, tend to accelerate the already-existing processes of agrarian differentiation (cf. Griffin 1978; Pearse 1980). It thus becomes important to consider not only the workings of these mechanisms of differentiation, but also their consequences for women in the different (and differentiating) agrarian classes. For convenience, we might crudely consider three broad classes:

1. 'Large' farm households (defined by relative terms rather than some agronomic standard, i.e. in terms of their size in relation to other farms in the community: in Java, for example, this might be as little as 0.5 or 1.0 ha, while in the Philippines 2.0 or 3.0 ha.). For these households, (who have some capital and, because of their position as a powerful minority, access to more capital and other state resources) the GR has meant an increase in agricultural surplus. How is this surplus invested? And, in terms of gender relations within the household, who decides? Who controls the surplus? And who benefits from the investments? For example, surpluses may be used for 'unproductive' investment (land concentration, usury, conspicuous consumption, children's education, political advancement etc. — in some cases, to attract a second wife); or for more 'productive' purposes (land improvement), agricultural machinery, a rice huller, a truck, a mini-bus, a small industry, trade). It may also be used to reduce the labor burden or household members, in either direct production or reproduction, either through capital investment (a bicycle, a well) or by shifting from family to hired labor (in field-work, in the home with domestic servants, etc.).

2. Small/marginal farm households: these are agricultural 'deficit' households, with farms too small to provide a surplus, and less access to the inputs necessary to maximize output. How do they survive (for example, by chronic debt, agricultural wage-labor, off-farm activities including out-migration, etc.)? What division of labor emerges: if men migrate, for example, do we see a 'feminization' of farm-work and farm-management?

   And what of those whose farms *don't* survive, i.e. who are dispossessed of farm-land through sale, or a land-owner's repossession of tenanted land? What impact does such proletarianization have, at a global level (on the markets for male and female labor) and at micro-level (on the internal household division of labor, and the capacity of men and women to earn and control incomes)?
3. Landless households: our concern here will clearly be focussed on the impact of the GR and associated processes of differentiation – including the growth in numbers of this class, on the demand for hired labor and on the conditions of male and female labor recruitment and payment. We will return to this topic (with which the case-study in the second section of this paper will also be mainly concerned), but first we should consider in a more general way what kinds of changes in women's work might be expected to accompany the GR.

As Palmer (n.d.) has noted, the changes in women's (agricultural) work accompanying the GR will depend on a number of factors:

the pre-existing labor-intensity of cultivation;
the objective/technical requirements of the new crop, new method, or new cropping pattern;
the pre-existing sexual division of labor;
the forms of mechanization introduced, if any; and
the class-status of women.

GR cultivation practices generally are more labor-intensive, in the absence of mechanization: both because of greater labor intensity per crop (if only because of the need for more intensive weeding, and larger crops to be harvested and processed), and greater labor-requirements per ha. per year because of shorter growing seasons and greater cropping intensity. All of these may increase women's labor inputs (depending on the prior division of labor), which in turn (depending on class-structure) may mean heavier burdens on farm women, or more wage-opportunities for marginal/landless women.

While changes in total (per hectare or per year) labor requirements are obviously important, changes in the timing of these requirements may have equally important effects on relations between labor supply and demand and hence, presumably, on wage levels. When the demands of irrigation rotation or of pest control lead to uniform planting schedules in a specific region, we may find that peaks of labor demand become higher, but also thinner (so that high wages are available, but for a shorter period of time); conversely, when more staggered planting schedules result in a more even distribution of labor demand over the year (or a virtually unchanging level of demand, for example if the continuous cultivation 'rice garden' systems currently under experimentation at IRRI and elsewhere were ever to be generally adopted over a wide area), this may create stable but low levels of labor demand, and more permanent employment, but perhaps at lower wages, and for smaller numbers of men or women laborers.

In considering the effects of wage employment on women, clearly we need to look at many more factors than changes in numbers of women employed and wage levels (although firm conclusions on even these questions are difficult, as will be clear in the next section); we must also examine changes in the manner of labor recruitment and payment. While these changes relate to the position of women within an agrarian structure, they may themselves have important consequences for gender relations within the household, a matter on which there is little information, as Sen has noted in her research on women wage-workers in India:

> Are relations of subordination eased or strengthened by women's participation in wage labor? Do women become more or less dependent on male household members? Does this vary by class for different households? How is it affected by worker and small peasant organisation? By women's militancy? How does women's participation in wage labor affect the sexual division of labor within the home in tasks such as cooking, cleaning, child care? Such studies are both extremely necessary and only just beginning . . . (Sen 1982: 59f).

In conclusion, since I have been stressing the importance of seeing 'gender'-related consequences of agricultural change within a 'class' perspective and in the context of specific 'agrarian structures', I should explain briefly how I understand these terms. Any 'structure' (whether in the physical, natural or social sciences) consists of a number of elements and a set of relationships between these elements, and an 'agrarian structure' in the sense used here is something different from both a 'farming system' or the sets of relations between abstract production 'factors' (land, labor, capital) analyzed by agronomists or agricultural economists (cf. Harriss, 1982). The 'elements' in an agrarian structure are human groups (the agrarian classes) defined primarily by their relationship to the means of production (not 'land', 'labor' and ‘capital’ but rather ‘land*owners*’, ‘labor*ers*’, and ‘capital*ists*’, although many agrarian classes combine more than one of these), and the primary relationships which define the structure and its dynamic are those between ‘direct producers’ (those who work on the land, for example) on the one hand, and those who do not work on the land but lay some claim to part of the product, directly or indirectly, by virtue of their ‘class’ position.

While I do not think that women can be considered a ‘class’ in the normal sense of the word (except perhaps in those societies in which women are *de facto* or *de jure* completely debarred from property rights, as has been argued for Greek women in the classical period, (cf. de Ste. Croix 1983: 98–103), nevertheless ‘gender’ relations (based ultimately on the social distinction between ‘productive’ and ‘reproductive’ labor) place women in a position within the household somewhat analogous to a class relationship (since ‘gender’ allows men in some degree to control women’s reproductive labor and to appropriate its product) and also in turn create differences between the positions of men and women within the extra-domestic world of class relations (for example, through wage-discrimination and other gender-specific mechanisms of female labor exploitation and control within wage relations).

Women’s employment and the modernization of rice agriculture in Java‘

While there have been several studies of rural women in Java (various detailed time-allocation studies are now available, for example), most of these have been concerned with describing women’s living and working conditions at one point in time rather than with changes over time. On the other hand, available village-level studies focusing on agrarian changes (and particularly the consequences of the relatively successful rice intensification programmes of the late 1960s and 1970s) have often failed to pay due attention to gender-specific consequences. In the notes which follow, therefore, I have not been able to focus on a particular village study or set of village studies, but have had to shift from one study to another in trying to fill in various parts of the picture: a procedure hard to justify methodologically. A further limitation springs from the unfortunate tendency for many studies of changing labor conditions and relations in agriculture, while separating men’s and women’s labour (and land, etc.) at the point of data-collection, to re-aggregate these data in analysis, for example in the series of preliminary reports beginning to emerge from the Agro

Economic Survey's recent re-studies of various villages first surveyed in the late 1960s.[2]

Agrarian structure in the 1970s

The agrarian structure of Java in the smallholder sector in the 1970s can be depicted crudely as follows. As might he expected under conditions of extreme population density, farm sizes are extremely small (mean and median farm sizes at the 1973 Agricultural Census were about 0.65 and 0.33 ha. respectively). The results of the 1973 Agricultural Census and the 1980 Population Census, while both containing their own inaccuracies and not permitting comparisons over time without great caution, allow us to arrive at a rough, simplified division of the rural population in terms of operated landholdings as shown in Table 8.1. Large farms of more than 2.0 or even 1.0 ha. are relatively rare (3 per cent and 7 per cent of all households in 1973) but this small group controls just over one half of all agricultural land. There are no large-scale statistics on the ownership of land in Indonesia. Small-scale studies have found isolated cases of owners of 50 and even 100 ha, but in most villages the largest landowners have been found to own only 15, 10 or even 5 ha.

Table 8.1 Distribution of farm sizes among rural households in Java: a rough approximation.

% of all rural households	farm size	% of all land controlled
ca. 30%	none (landless)	0%
ca. 30%	less than 0.25 ha	ca. 20%
ca. 20%	0.25 – 0.50 ha	ca. 20%
ca. 20%	more than 0.50 ha	ca. 80%

Sources: Distribution of households by farm size is based on the 1980 Population Census (Indonesia 1981 : Table 8.1). The right-hand column (% of all land controlled) is based on the proportion of land controlled by each farm-size group at the 1973 Agricultural Census (Indonesia 1976), these data not being available for 1980. All percentages have been rounded to emphasise the crudeness of these calculations.

A second feature of the agrarian structure is, therefore, the relative absence of a class of large landlords and (its corollary) that the great majority of these tiny farms are owner-managed rather than rented or share-cropped. Both the 1973 Agricultural Census and 1980 Population Census found 73 per cent of all farms (though the exact correspondence is probably coincidence) to be completely owned by the operator household. The 1980 census data suggest some concentration of the ‘wholly unowned’ farms in the < 0.25 ha. class (probably mainly share-croppers) and of the ‘partly unowned’ farms in the > 0.50 ha. class (suggesting expansion of holdings through cash rental from either smaller or larger owners in need of cash).

Another important feature, which might not be expected given the very small farm sizes, is the very high proportion of hired rather than family labor inputs in rice cultivation. Collier’s calculations from village-studies of the late 1960s suggest that hired labor then provided about 80 per cent of all labor time in rice production and as we shall see, the proportions are higher still in the main female tasks of trans-planting, weeding and harvesting. In this regard it is worth remembering that although the great majority of *farms* are less than 0.5 ha., four-fifths of all the *land* is held in farm units of more than 0.5 ha., and it is at this farm-size level – still very small by the standards of most other rice-growing countries – that ‘farmers’, both men and women, tend to become mainly ‘managers’ of hired labor.

Thus, although there certainly exists a rather small class of farm households (mainly in the upper range of the < 0.5 ha. class) who are neither net buyers or sellers of labor – and probably a high degree of wage-circulation among farmers within that class – the great majority of wage transactions are those between classes, i.e. where a rather small class of farm-‘manager’ households buys labor from a much greater number of marginal-farm and landless households. The main way in which the majority of households derive income from rice-cultivation is therefore from the sale of their labor on larger farms. The rice agriculture of Java could thus be characterized as primarily a ‘wage-labor’ economy, despite the parallel existence of both small ‘peasant’ farms on the one hand, and also of rental and sharecropping relations as already indicated. In terms of the framework suggested in the previous section, then, the dominant relationship through which one class lays claim to the product of another class’s labor is through the wage form (and to a lesser degree through share rental and leasing).

Table 8.2 gives (for 9 village case-studies from Central and East Java in the late 1960s) estimates of male and female, family and hired labor-use per ha. in various major operations, before the introduction of HYVs.[3] These 9 cases underline the difficulty of making generalizations about proportions of female labor, (which varies from 9 per cent to 55 per cent) or even about men’s and women’s tasks (see weeding and harvesting), but they do show clearly the very high levels of hired labor use in the main tasks in which women’s labor is used, even in the samples with small average farm-sizes of 0.4 or 0.5 ha.

These levels of labor-intensity and of hired labor use are nothing new. A series of detailed village-level studies in the late 1920s suggests an average labor intensity of more than 1,500 person-hours ha. per crop

Table 8.2 Proportions of male and female, family and hired labor in various major operations, in 9 village case-studies in the period 1968–70 (wet season and local varieties only, in hours per ha.).

Village (province)	Date (mean farm size)	Preharvest Total (hours)	% F	% H	Ground Prep. (M) (hours)	% H	Planting (F) (hours)	% H	Weeding (M)	%H	(F)	%H	Harvesting (M)	% H	(F)	% H
Sukorejo Lor (C.Java)	68–69 (1.0 ha)	840	26%	96%	225	99%	113	98%	245	98%	66	100%	14	100%	77	100%
Djanti (E.Java)	69–70 (0.5 ha)	476	55%	85%	151	79%	79	100%	1	(–)	170	99%	28	100%	86	100%
Wanarata (E.Java)	68–69 (1.3 ha)	987	50%	96%	270	98%	248	97%	139	94%	266	99%	n.a.		n.a.	
Banyutowo (C.Java)	68–69 (0.6 ha)	1302	33%	92%	321	94%	172	96%	510	98%	36	84%	0	(–)	355	100%
Serang (C.Java)	68–69 (0.5 ha)	1685	51%	87%	454	88%	448	88%	203	88%	447	95%	n.a.		n.a.	
Bulus Pesantren (C.Java)	68–69 (0.4 ha)	1958	9%	51%	519	98%	157	98%	426	82%	0	(–)	n.a.		n.a.	
Sidomulyo (E.Java)	69–70 (0.4 ha)	599	51%	78%	290	71%	105	100%	4	0%	178	100%	45	100%	134	100%
Geneng (E.Java)	70–71 (1.0 ha)	996	54%	88%	446	91%	341 (F)					98%[a]	96	58%	376	84%
Gemarang (E.Java)	68–69 (1.0 ha)	1000	39%	79%	352	66%	203	97%	139	28%	207	94%	n.a.		n.a.	

Source: Data from the Agro-Economic Survey, Rice Intensification Study, calculated from various tables in Collier (1980).

Notes: H = hired, M = male, F = female, n.a. = not available.
'Ground preparation' includes seedbed; *'planting'* includes pulling, transporting, marking-out and transplanting but excludes any male inputs in these tasks.
[a] For this village, transplanting and weeding inputs (all female) are not separated.

(Collier 1980); indeed Collier argues a subsequent decline in labor-intensity, although precise comparisons are difficult because of differences both in the village samples and in data-collection procedures. The same studies in the late 1920s also found hired labor averaging 61 per cent of all labor inputs. By this time, it could be said that Javanese small-holder rice production already exhibited a high degree of both intensive techniques and 'commoditization' — with lively markets in land, labor (both male and female), and credit.

As far as the sexual division of labor in rice cultivation is concerned, plowing, harrowing, hoeing and the construction or repair of dykes are virtually always men's work, but beyond that it is hard to generalize since exceptions can always be found. Preparation of the seedbed, pulling seedlings and adjusting water-supply are also mainly men's tasks; women's main tasks are transplanting (with very few exceptions), weeding and harvesting (with more exceptions, cf. see Table 8.2). Weeding seems particularly volatile, having been found to shift from women to men and back to women, or vice versa, in some villages. Foot-threshing of harvested stalk-paddy (a new task appearing with HYVs, local varieties being stored in bundle form) seems to be mainly a female task, although where men are harvesting they may also often be found threshing.

As Locher-Scholten has noted, the colonial introduction of forced cultivation and later plantations for export-crop production in the 19th century, although of course removing large amounts of male and (mainly after 1879) female labor from rice and other subsistence cultivation, seems not to have caused any important shift in the sexual division of labor in rice cultivation: similarly, commercialization and differentiation in the colonial rice economy itself 'influenced labor relations and ways of rewarding, but not the division of tasks itself' (Locher-Scholten 1983:18).

Nevertheless, there is some evidence (again from small village samples) of an overall reduction in the female proportion of total labor inputs: Collier's (1980) calculations suggest a reduction in the female share from 65 per cent (late 1920s) to 53 per cent (late 1960s) to 37 per cent (late 1970s). This decline (which may not be as great as these figures suggest — the village samples are only 6, 4 and 4 respectively) appears mainly due to a reduction in harvesting hours (due to a partial shift from women to men, and partial replacement of the *ani-ani* (finger-knife) with sickles), an increase in male ground-preparation inputs, and a reduction in transplanting hours (according to Collier's calculations, although it is hard to see why this last change should have occurred).

These notes on agrarian structure and division of labor would not be complete without adding that both men and women in all the agrarian classes devote large quantities of labor, and obtain large proportions of their income, outside paddy cultivation and also outside agriculture. This pattern of occupational multiplicity occurs at all levels, but for different reasons which have already been described in general terms above. Members of agricultural ‘surplus’ households invest a part of this surplus in relatively capital-intensive off-farm income sources (‘large-scale’ trading and shopkeeping, small industries employing wage labor, rice hullers, pick-up trucks etc.) giving rather high incomes per hour or day of labor input. The landless and near-landless on the other hand, as agricultural ‘deficit’ households unable to support themselves from agricultural work alone (on their own land or for wages), transfer not capital but labor into a variety of highly labor-intensive, capital-starved and overcrowded occupations (small trading, handicrafts, making snacks for sale, etc.) in which incomes per hour of work tend to be even lower than the prevailing agricultural wage-rate. The unequal distribution of non-agricultural incomes, then, tends to parallel that found in agriculture. Many of these off-farm activities involve the labor of men, women and children together; where men and women are producing independently and their labor-incomes can be compared, the difference matches that which we will see below in agricultural wages.

Perhaps because of this pattern of multiple occupations (which also change seasonally), the sexual division of labor within the household is in practice not so clearcut as ideology suggests. Men, for example, will sometimes stay at home to babysit and cook a meal while adult women and girls are off harvesting, or trading at the market. Similarly, attempts to study household decision-making patterns have found that wives are neither so excluded from decisions in the extradomestic domain of production, nor so wholly in charge of the domestic (reproductive) domain as is implied by the normative segregation of these spheres of influence in community ideology; an ideology also reflected in the division of official rural extension efforts into ‘agriculture’ for men and ‘home economics, health and family planning’ for women (cf. White 1983: 12–15; Wigna 1982).

Returning briefly to some points made earlier, the fact that rice cultivation in Java was already in an advanced stage of labor-intensification and commoditization (including women’s involvement in production) before the introduction of the ‘green revolution’ strategies of the late 1960s may be one reason why the changes observed since that period (although serious in many of their implications for the welfare of the majority of rural men and women) have not represented such a drastic transformation of agrarian structure as in some other countries; rather it is a question of the continuation and perhaps acceleration of already existing trends, rather than some qualitative break with the past, as I hope to suggest in the following section.

As indicated in Table 8.3, Java's rice-intensification strategy has been relatively successful in terms of production, with production almost doubling and yields increasing by two-thirds in the 14 years 1968–1981. Indonesia, which at times during the 1970s has imported as much as one-third of all the rice on the world market, even achieved a brief period of self-sufficiency in rice in 1981 for the first time in living memory; more recently there have been problems with drought, but there is now at least a prospect of self-sufficiency in normal years and, as Table 8.3 shows, Java has made more than an average contribution in terms of yield increases compared to the rest of Indonesia.

Table 8.3 Changes in paddy area harvested, production and yields, 1968–81 (Java, outside Java and all Indonesia).

	Area harvested [a]			Production [b]			Yield [c]		
	1968	1981	(%)	1968	1981	(%)	1968	1981	(%)
Java	4.26	4.86	+14%	7.07	13.50	+90%	1.66	2.78	+67%
Outside Java	3.76	4.43	+18%	4.59	8.17	+78%	1.22	1.84	+51%
All Indonesia	8.02	9.30	+16%	11.67	21.61	+86%	1.45	2.33	+61%

[a] millions of hectares
[b] millions metric tons milled rice (production measured by new CBS methodology). Dry stalk paddy converted to milled rice at 0.52, paddy 0.68.
[c] tons milled rice per hectare.

Source: Mears (1981 : 488).

Who, in the agrarian structure I have tried to describe above, has captured the increased income represented by this increased production? In Table 8.4 I have tried to look at this question in a highly simplified way (which is certainly not the only way to approach the question) with data from five village re-studies conducted by the Agro Economic Survey's Rural Dynamics Study.[4] The table shows the absolute quantities, and proportions, of total product which go into the pockets of the 'farmer' (in this case, owner-operators only) and into the pockets of the laborers before and after the green revolution. 'Farmer's share' here means the farmer's paddy income net of paid-out labor and non-labor costs, (thus a Chayanovian bundle of returns to everything that the farmer owns, which a conventional farm management analysis would break down into imputed family-labor wage, imputed land rent, etc. and 'operator's surplus'), 'hired labor's share' is the paddy equivalent of the total paid out in wages.

Table 8.4 Changes in the share of paddy production accruing to farmer and wage-labor during the 'Green Revolution': some village case-studies in Java

				% change	
Village S (West Java)		1969–71	1980–81	Absolute	Relative
Yield/ha. (tons paddy)		1.53	2.13	+ 39%	
Farmer's share:	tons	0.42	0.99	+136%	
	percentage	27%	46%		+170%
Hired labor's share:					
	tons	0.81	0.90	+ 10%	
	percentage	53%	32%		– 40%
Village A (Central Java)		1968–69	1973–74		
Yield/ha. (tons paddy)		3.7	4.8	+ 30%	
Farmer's share:	tons	0.71	1.68	+137%	
	percentage	19%	35%		+ 84%
Hired labor's share:					
	tons	1.43	1.15	– 20%	
	percentage	39%	24%		– 38%
Village J (West Java)		1969–71	1980–81		
Yield/ha. (tons paddy)		3.42	4.25	+ 24%	
Farmer's share:	tons	1.51	2.57	+ 94%	
	percentage	44%	60%		+ 36%
Hired labor's share:					
	tons	1.24	1.09	– 13%	
	percentage	36%	26%		– 28%
Village C (West Java)		1969	1979		
Yield/ha. (tons paddy)		3.1	3.8	+ 23%	
Farmer's share:	tons	1.21	2.32	+ 92%	
	percentage	39%	61%		+ 56%
Hired labor's share:					
	tons	1.32	1.07	– 19%	
	percentage	43%	28%		– 35%
Village B (West Java)		1968–71	1978		
Yield/ha. (tons paddy)		2.6	3.1	+ 13%	
Farmer's share:	tons	1.40	1.75	+ 25%	
	percentage	54%	56%		+ 4%
Hired labor's share:					
	tons	0.83	0.86	+ 4%	
	percentage	32%	28%		– 13%

Source: Village studies conducted by the Rural Dynamics Study, Agro-Economic Survey, Bogor (using base-line data from the Rice Intensification Study, Agro-Economic Survey).

In all cases, the farmer's paddy income grew twice, three times or even four times as much as the increase in yield, and in all cases hired labor's share either grew more slowly than production (two cases) or actually declined (three cases). Here then, is one way of looking at the growing divide, in terms of ability to command income from paddy production, between the owners of non-labor production factors on the one hand and the owners of labor on the other. But, assuming the trends observed in these five cases are occurring more generally, how has this happened? Is less hired labor being used, are wage-rates declining or stagnant, or have some changes in modes of labor recruitment and payment occurred which function indirectly to reduce the unit wage? And have the changes been the same for women and men? [5]

As far as hired labor use (or even total labor use) is concerned, it is still difficult to come to a firm conclusion despite the growing availability of village-study data. There is some consensus that harvest-labor use per ha. (per crop) has declined overall, both because of the spread of sickles and because of labor-recruitment practices which limit the number of harvesters allowed to join the harvest. For preharvest labor, although tractors in some areas are replacing manual (hoeing) labor or ploughing, and rotary or toothed weeders replace hand-weeding when straight-row planing is practised, available evidence on the overall effects of HYVs and associated practices is inconclusive. Data in Barker and Herdt's forthcoming study (cf. Unnevehr and Stanford, this volume, Table 3) suggest a substantial increase in labor days per ha. in West Java, a small increase in East Java and a decrease in Central Java. Another forthcoming study by the Agro Economic Survey compares preharvest labor use in Wet Season 1970/71 and 1980/81 in 10 villages of West, Central and East Java: increases were observed in 6 villages and declines in 4, but with no clear difference between regions and with overall inputs virtually unchanged at approx. 900 person-hours per ha. (unpublished data in a draft report provided by Dr. Faisal Kasryno). In short, we do not yet have conclusive evidence of either an overall increase, a decline, or no changes in total preharvest labor use per crop; we must therefore leave this question unanswered and turn to the issue of wage rates.

Changes in male and female wage rates and wage relations: studies from West Java

No large-scale statistics on agricultural wage rates are available which can offer a long enough series to cover the period from the late 1960s to the present. However, the Agro-Economic Survey has been conducting regular monitoring of wages and prices in 6 villages of the

Cimanuk river basin (West Java) since 1976, and has also located data for the same villages from 1967–1976 from another source. These data are worth examination not only for what they can tell us about changes during this period, but also for insights into the working of local labor markets in which men and women are involved.

The Cimanuk river basin, in which the 6 sample villages are located, cuts across the eastern part of West Java from north to south and offers a wide range of agricultural and agrarian conditions. Its broad north coastal plain (Cirebon, Indramayu and southern Majalengka regencies) is characterised mainly by monocrop paddy agriculture, large-scale irrigation systems and highly seasonal cropping patterns, with consequent fluctuation in seasonal patterns of labor demand. It is also a region of high landlessness (generally more than 50 per cent and often as much as 70 per cent of households). The central and southern uplands (northern Majalengka, Sumedang and Garut regencies) in contrast, have a dominant pattern of wet-paddy and mixed-garden cultivation, small-scale irrigation systems with water generally available year-round, and consequently a more even pattern of seasonal labor demand. Landlessness rates here are also lower (generally lower than 50 per cent and often as low as 30 per cent).[6]

A survey of all 795 villages in this river basin, conducted by the Agro Economic Survey in 1975, provides some useful information on wage rates. As may be seen in Table 8.5, women's wages in paddy cultivation

Table 8.5 Male and female wage rates in the Cimanuk river basin, 1975 (median of all villages, Rupiah per hour).

Task	M/F	No. of Villages	Rupiah/ hour	Hours/ day
1. Ploughing	M	561	147	4.8
2. Hoeing	M	657	30	6.2
3. Transplanting	F	484	19	5.3
4. Weeding	M	551	30	6.5
5. Weeding	F	625	20	5.0
6. Female/male wage ratio (%):				
a. (3) / (2)		62%		
b. (5) / (4)		66%		

Source: Unpublished data from the Agro Economic Survey, Rural Dynamics Study (West Java), Village Census (1975).

Notes: The total number of villages included in the village census was 795. Cases missing in the table represent villages where paddy agriculture is not practised, where wages are not given for specific tasks, or where data are missing. The wage rate given here is the cash component of the wage, not including the value of any meals taken.
Official exchange rate at this time was $1.00 = Rp. 415.

at around Rp 20 (US 5 cents) per hour are about two-thirds of male wages, both when we compare two gender-specific tasks (female transplanting, male hoeing) or male and female wages in the same task (weeding). This ratio suggests a rather worse degree of wage discrimination by gender than most other Asian countries for which data are available (cf. Unnevehr and Stanford, this volume, Table 1.4; Orissa and Tamil Nadu in India also are close to the two-thirds ratio; cf. Acharya and Patkar, this volume).

Women's most important opportunity to earn relatively high wages is in rice harvesting, which is generally paid with a *bawon* (in-kind proportion of the quantity harvested) rather than in cash. Table 8.6 shows an interesting pattern of local variation in *bawon* levels: the upland regencies of Garut and Sumedang, with year-round water supply and more even labor demand have rather low *bawon* shares (1/10 or less), while in lowland Cirebon and Indramayu, with sharply fluctuating labor demand, *bawon* tend to be 1/6 or more, with the mixed lowland and upland regency of Majalengka, as might be expected, showing both patterns equally. The influence of seasonality and planting schedules on wages, and its implications for women workers, will also be seen in the six village case-studies from the same region, to which we now turn.

The six sample case-study villages reflect the regional variations already noted, with village W (Cirebon) and L (Indramayu) representing the lowland pattern of high landlessness, land concentration and seasonal labor-demand fluctuation and villages G and M (Majalengka), S (Sumedang) and C (Garut) representing the upland pattern. Figure 8.1 shows the movements of wet-season real wage rates for male (hoeing) and female (weeding) laborers in the 6 villages for the 15-year period 1967–1981.

Male and female wages seem to have moved relatively consistently with each other in each village, but we have clearly six different individual village patterns of wage movement, even though the greatest distance between any of the six villages is only 75 km and most of them are only 30-40 km (or about a day's walk) apart. This suggests that local labor markets are relatively isolated, and that local changes in agricultural labor demand are a more important determinant of wage rates than overall changes in the region as a whole (which may surprise readers aware of the high degree of seasonal labor migration in this region, particularly in the north coastal plain).

Figure 8.2, which includes also transplanting wages but covers only the five-year period 1977–81, shows monthly movements in real wages in each village and indicates dramatically the influence of the timing of labor demand on wages. Wage rates for all three kinds of labor (male hoeing, female weeding and transplanting) fluctuate quite wildly in the lowland villages where planting schedules are abrupt and highly

Table 8.6 Percentage distribution of 795 villages by harvesting wages *(Bawon)* in the Cimanuk river basin (1 975).

Bawon-payment for untied labor:	Cirebon	Indramayu	Majalengka	Sumedang	Garut	All Cimanuk
1/10 or less	22%	5%	33%	91%	85%	39%
1/9 - 1/7	7%	1%	8%	0%	10%	5%
1/6 and above	47%	82%	31%	7%	2%	39%
(No pure *bawon*)	24%	11%	29%	2%	3%	17%

Source: Unpublished data from the Rural Dynamics Study, Census of 795 villages (1975).

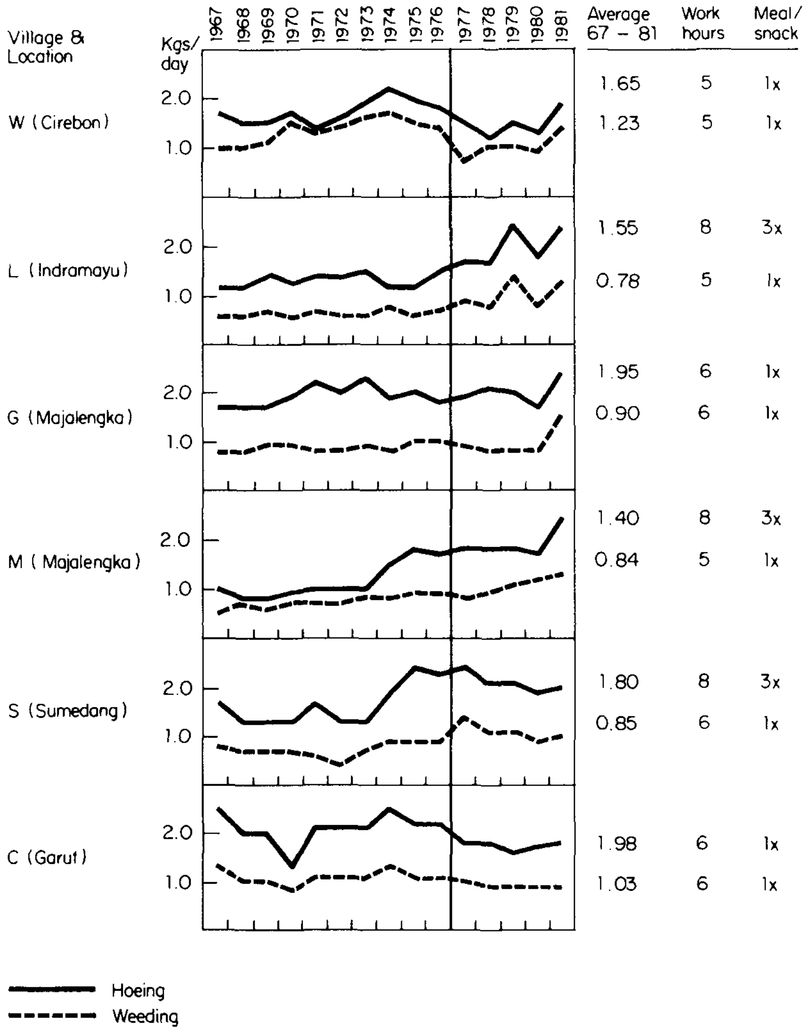
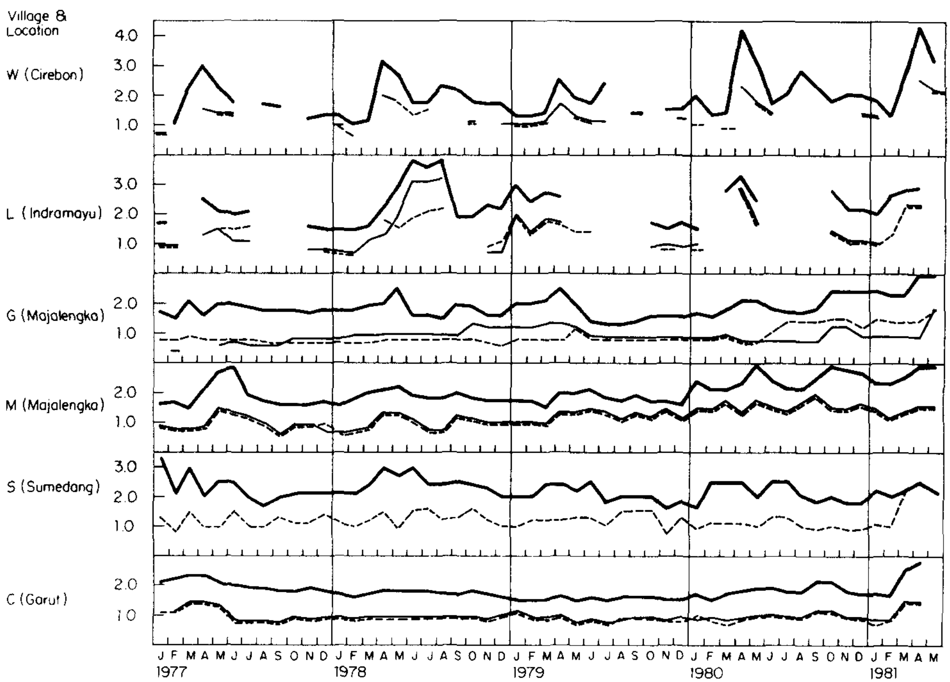


Figure 8.1: Changes in real wage rates for male (hoeing) and female (weeding) labor in 6 West Javanese villages, wet season, 1967–81 (in kgs milled rice equivalent per day)

Notes: Wage-rates in the graph represent the cash portion of the wage, converted to milled rice equivalent at local retail prices. 'Wet season' is approximately October–March. Thus, '1967'in the graph = October 1966–March 1967, etc.
The change in data-sources between 1976 and 1977, marked by the heavy upright line, may result in some inconsistency.

Sources: 1967–1976 Field-notes of subdistrict-level agricultural officials, compiled by the Agro Economic Survey.
1977–1981 Agro Economic Survey, Rural Dynamics Study twice-monthly wage and monitoring (Makali 1982).



—— = hoeing —— = transplanting ----- = weeding

Figure 8.2: Monthly fluctuation in real wages rates for male (hoeing) and female (transplanting and weeding) labor in 6 villages of West Java, January 1977 – May 1981 (in kgs milled rice equivalent per day).

Note: The absence of' transplanting wages in Village 'S' is because in that village, no cash wages are paid for transplanting. Instead the *ceblokan* labor-tying system (in village s, called *neken*) as decribed in the text, is used.

Source: Agro Economic Survey, wage and price monitoring (Makali 1981).

seasonal, and where high temporary peaks of labor demand are followed by periods in which no agricultural work is available at all (in Figure 8.2, a break in the line indicates periods when wage-data could not be recorded, no wages being offered for that type of work). In all villages except one (village C, which shows virtually no seasonal variation), wages for both male and female labor tend to peak in the period March-May, the ‘turnaround’ period following the main wet-season harvest when farmers are hurrying to plant the second crop; this is naturally most evident in the two lowland villages W and L. The impact of this fluctuating labor-demand pattern is a double-edged one, and it is difficult to conclude which pattern is most advantageous from the laborer’s point of view. High wages in peak periods, for both men’s and women’s work, are balanced with periods of no wages and often the necessity to migrate in search of a living elsewhere (in village L, an extreme case, a seasonal outmigration rate of 59 per cent of the total labor-force was recorded in 1976); furthermore, these highly seasonal monocrop regions have been known since the colonial period as regions of chronic indebtedness among both landless and marginal-farm households, so that a high proportion of wages received (and particularly of the high harvest *bawon* wages, already noted) is likely to be swiftly re-appropriated by wealthy farmer-employers or other moneylenders in the form of debt repayment at high rates of interest.

In two important respects the data in Figures 8.1 and 8.2, which suggest no general decline and some increases in both male and female wage rates, particularly in recent years may be misleading. First, real wages have been measured in terms of paddy equivalent while for various reasons paddy prices have been rising more slowly than other consumer prices in recent years.[7] When measured against a rural cost-of-living index (as the Agro Economic Survey plans to do in the future), these wage increases will prove to be less dramatic and in some cases may disappear. Secondly, in many villages there has been an increasing tendency for women to receive no wage at all for transplanting (and sometimes also weeding) but only the right, some months later, to work in the harvest and earn a *bawon* share.

Changes in rice-harvesting in Java have attracted widespread attention (some English-language studies are Collier et al. 1973 and 1974; Boedhisantoso 1975; Utami and Ihalauw 1973; Sinaga and Collier 1975; Stoler 1977; Sairin 1978; Hayami and Kikuchi 1981). I will not attempt here to summarize the great variety of changes observed in different case studies (for example, shifts from the finger-knife *ani-ani* to sickles, from open to closed harvest, from *bawon* to cash wages, etc. and sometimes from women to men).

Most, but not all, of these studies have assumed that the changes they report began rather abruptly after the introduction of HYVs, and also that methods of harvesting (and the recruitment and payment of harvest labor) had been fixed in some ‘traditional’, non-market way for long periods before the change. The three case-studies shown in Table 8.7, which have tried to pinpoint both the direction and the timing of change, are revealing in many ways. They indicate first that in any one village at any one time, we cannot speak of ‘one’ harvest system but rather of a range of arrangements (as has also been observed by Stoler, 1977 and Utami and Ihalauw 1973), depending on the relation between employer and harvester. Case A shows a gradual decline in the level of *bawon* payment, from 1/5 to 1/10; in cases B and C (B, incidentally, is village ‘W’ in Figures 1-2 above), a shift from open to closed access to *bawon* and also from *bawon* to the arrangement here called *ceblokan* (in other parts of Java, *kedokan, ngepak-ngedok, pajegan, bawon, tanduran, neken*) in which earning a *bawon* is conditional on previous work without pay in some other task or tasks.

The implications of such labor-tying arrangements for women workers go beyond the simple fact of ‘more work for the same wage’, important as that is; they also mean, for example, when *ceblokan* becomes widespread, that a period of the cropping cycle that was previously a time of income for women (for example, planting), becomes a time of work with no income; the probability of going into debt thus increases, and it is quite likely that the natural source of a loan of cash or paddy is the employer (who in any case ‘owes’ the transplanter a harvest wage, and can be sure of repayment of the loan by simply deducting ‘at source’ when the *bawon* wage is paid). Such arrangements are not ‘new’ (there are many reports from the early 20th century, for example) but they do appear to be increasing. In some villages (Village ‘S’ in Figures 8.1 and 8.2 for example), cash payments for transplanting do not exist at all.

Another clear implication of these three cases is that the changes did not begin with the ‘green revolution’ but long before; what we observe during the past 5, 10 or 15 years is the continuation of a process already long in motion. It is perhaps because of the tendency to relate harvesting changes in some mechanistic way to technological change that few researchers have paid attention to the conflicts and struggles that surround them. This brings me to an issue that should also have been mentioned in the first part of the paper, regarding the need not to regard women as mere passive recipients of change in the process of agrarian transformation. In some areas, for example, the labor-tying *ceblokan* system was actually banned during the 1960s thanks to the active pressure of militant left-wing organizations (cf. Boedhisantoso 1975; Tjondronegoro 1978). The spread of *ceblokan, bawon* reductions etc. during the period of the ‘green revolution’ does not only reflect changes in rice technology, or new economic pressures on farmers to

Table 8.7 Changes in the level and manner of harvest labour payment in 3 West Javanese villages.

A. Kampung M (Subang, West Java	Percentage of employers and the level of *bawon* payment given:						
	1/5	1/6	1/7	1/8	1/9	1/10	Total
Before 1950	100						100
1950–1959	63	37					100
1960–1964	43	43		14			100
1965–1969	13	54	17	13	4		1 00
1970–1974		18	21	29	7	25	100
1975–1979			11	32	11	64	100

B. Kampung W (Cirebon, West Java)	Percentage of employers using various methods:				
	Normal PO (1/6)	Harvest (OV) 1/6	with (1/6) Bawon LN	Ceblokan (1/6)	Total
Before 1968	61	3	15	21	100
1970–71	54	5	15	26	100
1974–75	51	4	14	31	100
1975–79	41	3	17	39	100

C. Kampung C (Subang, West Java)	Percentage of employers using various methods									
	Bawon[a]				Ceblokan[b]					
	PO	OV	OM	LI	1/6(T)	1/7(T)	1/7(T+W)	1/7(H+T)	1/7(H+T+W)	Total
1950s	35	29	18	18						100
1960–61	29	31	21	19						100
1962–63	16	34	33	17						100
1964–65	9	16	16	32	27					100
1966–67	3	10	8	27	52					100
1968–69	1	4	6	19	44	24	2			100
1970–71			2	10	33	51	4			100
1972–13				8	17	67	8			100
1974–75				7	15	67	10	1		100
1976–77				4	7	67	18	2	2	100
1978				4		72	19	1	4	100

[a] *Bawon* system: PO – purely open, OV – open for villagers only, OM – open with maximum limit, LI – limited to invitees.
[b] *Ceblokan* system: 1/6, 1/7 – harvesters' share; T, W, H – obligatory work to establish the harvesting right (T – transplanting, W – weeding, H – harrowing).

Source: Agro-Economic Survey, Rural Dynamics Study, Research Training Workshops on Land Tenure and Agrarian Relations (for discussion of case B, see Wiradi et.al. 1980; for cases A and C, Hayami and Kikuchi 1981).

Notes: PO = Purely Open
OV = Open to harvesters within the village only
LN = Open but with limited number of harvesters
Ceblokan = Open only to those who have worked in transplanting (sometimes also hoeing and weeding) without extra pay.

reduce labor costs, but also the erosion (due to abrupt changes in the character of Indonesian political life after the 1965–66 change of government) of the political capacity of women to resist them.

Notes

1 Strictly speaking, one should only talk of 'modernization' of rice cultivation in Java in very guarded terms. While there has been significant progress in the adoption of 'modern' production techniques, other requirements for 'modern' agriculture lag far behind. Access to state services is partly dependent on relations of power and patronage, which in turn are related to the abandonment since the late 1960s of attempts to 'modernize' the structure of access to land and the agrarian relations which accompany it.

2 A good example of this problem is Hayami and Kikuchi's recent book (1 981). In 60 pages devoted to the results of two West Javanese village re-surveys, with a particular focus on changes in modes of labor recruitment and payment in rice harvesting, the authors manage to discuss these changes without once informing the reader that women were involved. In fact their text and tables are not populated by men and women at all, but only by a curiously genderless class of 'laborers'. This is all the more surprising since one main purpose of their analysis is to argue that the function of these changes has been to bring 'traditional' (women's) harvesting wages down to the level of the prevailing 'market' wage rate (defined as the wage-level in land preparation, an exclusively male task), implying a remarkable degree of linkage between the markets for male and female labor.

3 The few households, already using HYVs in some villages have been excluded from the sample in this table.

4 Several more re-studies have been conducted in the past two years, but the results are not yet available.

5 At this point it would have been useful to disaggregate the 'hired labor' side of the calculations into men and women to see how each have fared relative to each other. Unfortunately, although male and female hired labor inputs and wages were distinguished during data collection they have been merged at some stage of data processing, an example of the problem already noted.

6 Information in this paragraph is taken from White & Wiradi (1979).

7 Among these reasons are good paddy harvests; devaluations in 1978 and again in 1983 which increase the price of imports; rising costs of energy and raw-materials for consumer items such as textiles, soap and kerosene. While wage rates in terms of paddy-equivalent have

risen by an average of 26% in these villages from 1977–1981, for example, the amount of Tetron cloth that can be purchased with a day's agricultural wage has declined by 8% in the same period (unpublished data provided in a draft report by Dr. Faisal Kasryno, Agro Economic Survey).

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9 The impact of new farming technology on women's employment

Pudjiwati Sajogyo

Introduction

Technological change in rice cultivation is a necessary condition to improve the standard of living of rice farmers with their families, especially the poor ones. Most high-yielding rice varieties require a high level of fertilizer, better pest control and better water management. It seems that this new package of rice farming technology and better irrigation has increased the income of land owner and operator significantly, but that of labor only slightly. Another problem has developed due to the new farming technology, particularly caused by adoption of high-yielding varieties. It seems that women laborers are being displaced in the agricultural labor market by institutional changes that favor the employment of male labor.

This paper concentrates on the impact of new technology on women's employment, and whether women have benefited from the introduction of new rice technologies.

Agricultural types

Two main types of farming in Indonesia are wetpaddy (helped by modernized irrigation, and multiple cropping) and upland shifting cultivation in forest areas or secondary growth.

The first type is mainly found in Java, and Bali with dense populations, while the second type is found on other islands. Dependent on manual labor, both types have about the same farm size per worker and in prewar days also about the same level of productivity: 1 kg milled rice per hour labor input.

The shifting cultivation type has since the 1920s adopted elements of ‘semi-permanent tree crop gardens’ with rubber, coffee, coconut and pepper as commercial crops for a world market. On this basis farmers’ standards of living in the latter pattern have been higher than levels achieved by Java’s farmers who are mainly food crop producers. Since the turn of this century Java’s farmers have also developed upland farming but with ‘secondary’ foodcrops (corn, soya, peanuts, tubers) besides double cropping in its wetpaddy.

Looking back over the last 25 years, it is the wetpaddy system that has received major priority in national policies, to attain the national goal of self-sufficiency in rice, in a race against population growth. Efforts to modernize wetpaddy by introducing a package of modern technology (centered on use of HYV) began before the arrival of the IRRI-varieties in 1967/68, with the introduction of locally improved rice varieties, the product of national efforts and importing fertilizer for the purpose, in the first wave of the Rice Intensification Program (RIP) of the Paddy Centre (1959–1961), mainly in Java. A second wave came in 1964/1965 after the results of an action-research project by Bogor Agricultural University (IPB) in three villages in West Java that successfully tested a more intensive type of extension-work, with students staying in the village for a whole season. It resulted in its adoption as a model for a revived national program that has been named ‘BIMAS’ (‘mass guidance’)

With the opening up of the national economy for foreign investors since 1967, for several years loans from foreign companies were accepted to fund RIP directly: it provided the imported new inputs from modern industry while introducing the new IRRI varieties. At that stage the locally improved varieties introduced earlier showed about the same level of yield performance compared to the first batch of new IRRI varieties. Comparing levels of labor inputs, data collected by the Agro Economic Survey in 1968–1971 showed the same level of labor use for each of the two varieties: around 150 man-days (8 hours/day basis) per hectare pre-harvest work on farms larger than 0.5 ha. (For comparison: in the 1930s pre-harvest labor in wetpaddy was an average 960 hours/hectare or some 120 man-days/hectare on 8 hours/day basis.)

With strong population pressure on limited land resources and an almost unlimited labor supply the trend of decreasing returns to labor relative to land has been inevitable. With scarce land, as in Java/Bali, the modern rice varities are part of a new package of landsaving and labor using technologies with much higher yield and larger surplus for farmers (Sajogyo, 1982).

Changes in labor use in rice cultivation

Data from population and agricultural censuses and labor force surveys are important to indicate changes in the contribution of women's labor in agriculture, in terms of the number of persons working in the agricultural sector as a whole or on individual farms, on a per farm or per hectare-basis.

Looking at the percentage of labor force ('economically active') in Indonesia's agriculture (Table 9.l), the proportion of the labor force

Table 9.1 Labor input per hectare and proportion of labor force in agriculture, selected countries, 1965 and 1977.

Country	Percentage of Labor Force Economically Active in Agriculture		Total Labor input (persons) per ha. Seasonal Crops		Seasonal and Permanent Crops	
	1965	1977	1965	1977	1965	1977
Egypt	56	52	1.9	2.0	1.8	1.9
Nigeria	66	56	0.6	0.6	0.6	0.6
Bangladesh	86	85	2.0	2.5	2.0	2.5
India	72	65	0.9	1.0	0.8	1.0
Pakistan	60	55	0.5	0.6	0.5	0.6
Sri Lanka	56	54	3.0	2.7	1.2	1.3
Burma	64	54	0.7	0.8	0.7	0.7
Indonesia	71	61	2.2	2.0	1.8	1.8
Malaysia	59	50	0.6	0.7	0.3	0.3
Philippines	57	48	1.5	1.4	1.0	0.9
Thailand	82	77	1.1	1.0	1.0	0.9
China	71	62	2.2	2.4	2.2	2.4
Japan	26	13	2.4	1.8	2.2	1.6
Korea	59	42	2.7	2.8	2.6	2.6
Brazil	49	41	0.6	0.5	0.4	0.4

Source: FAO Production Year Book, various issues in 'Labor Absorption in Indonesian Agriculture' by Arun Abey, Anne Booth and R. M. Sundrum; *Bulletin of Indonesian Economic Studies,* Vol. XVII, No. 1, 1981.

engaged in agriculture has declined from 71 per cent in 1965 to 61 per cent in 1977 and the total labor input (persons) per hectare for seasonal crops, from 2.2 in 1965 to 2.0 in 1977 (Abey, Booth & Sundrum, 1981).

The data collected in the 1973 Agricultural Census (Table 9.2) show the number of workers employed per farm and per hectare of agricultural land, divided into family and hired labor. On average, Abey et al. have found that labor input per farm is higher in Java than in the Outer Islands (2.5 for Java, 2.2 for Outer Islands), owing to the greater use of hired labor in Java, while more family labor is used per farm in the Outer Islands. But average farm sizes also differ between the two regions, being greater in the Outer Islands. Therefore, one should also consider the difference in average labor input per hectare. It is apparent that in per hectare terms both kinds of labor are used more intensively in Java than in the Outer Islands, the ratio being more than double in the case of family labor and about five times in the case of hired labor. This is a first indication of the greater involvement of women in the labor force in Java, both family and hired workers. (In 1980 average household size in Indonesia was 4.9, in Java 4.6 and in Outer Java higher than the national average.)

Table 9.2 Regional differences in labor absorption.

	Java	Outer Islands	Indonesia
Labor input (persons) per farm:			
Total labor	2.5	2.2	2.4
Family labor.	1.8	2.0	1.9
Regular hired workers . .	0.7	0.2	0.5
Labor input (persons) per hectare:			
Total labor	3.9	1.5	2.4
Family labor.	2.9	1.3	1.9
Regular hired workers . . .	1.0	0.2	0.5

Source: Abey, et al., 1981. Based an Agricultural Census, 1973.

The intensity of cultivation which affects the use of labor is also different from region to region, because of varying cropping patterns. Wetpaddy *(sawah)* in Java is considered one of the most labor intensive of all crops, seasonal or perennial. As a whole, *sawah* farms have a per hectare total labor input about three times that of dryland paddy.

In the cultivation of *sawah*-rice (wetpaddy), in Java the practice for a long time has been for men to do the hoeing, plowing and harrowing. They construct or repair the dikes *(galengan),* and prepare the *bibit-*

beds (young plantbeds). Transplanting and weeding are mostly women's work; that is also true for harvesting the ripe paddy, stalk by stalk with the *ani-ani* (hand knife).

Women in Java's rice farming system are an important part of the labor-force, especially in paddy harvesting which is also an important source of family income. Harvest wages are higher with an equal or better labor income (Rp./hour) than from hoeing by male workers (Kasryno, 1981). Female activities (planting, weeding and harvesting) are traditionally rewarded with a share in the harvested amount (*bawon*): 1/4 to 1/5 or 1/8, which is a highly appreciated source of income. Nowadays, the *bawon* ratio has been reduced following the local supply and demand of labor, with faster growth in supply. Specific social relations between harvester and the wetpaddy-owners are also decisive: the nearer the blood and residential ties, the higher the share in the harvest (Stoler, A. 1975). Harvesting as well as weeding has brought equal pay for equal work for both sexes, women having an advantage over male harvesters by their greater experience. They know to pick the best ears of the paddy and how to bind the stalks in the most profitable way and bring them to the farmer's house where the harvesters receive the *bawon*-share. Typically, harvesting was open to everybody. By tradition, the farmer did not limit the number of harvesters.

Changes in women's labor contribution in rice cultivation is better measured in terms of labor use per hectare, especially hours per hectare, in which one should compare hired labor use and female/male family labor use (Collier, 1979).

In his study of declining labor absorption (1878 to 1980) in Javanese rice production, Collier has shown that the average hired labor use of the Javanese villages studied was 61 per cent in 1926–1931, 82 per cent in the Dry Season 1969, 79 per cent in the Wet Season 1969/ 1970, and 63 per cent in the four villages in the 1975 to 1979 period (Table 9.3). Unfortunately, the 6 areas in 1969/ 1970 and the village in 1975/ 1976 did not include harvest labor which is almost entirely hired and female; this would have increased the hired percentage. Each period has a range of percentages, in which non-family hired labor in rice production has remained important in the 50 years between 1929 and 1979.

Changes in input levels of female labor in the cultivation of rice in Java seem to have occurred also. In Table 9.4, Collier (1979) points out percentages (based on village studies) of female labor in rice production from 1926 to 1979. In the 1925–1929 period, female labor use was an average of 65 per cent for rice production in the studies of five villages. For the 1969 period in the four villages, the average female labor use was 53 per cent of the total amount used to cultivate rice. In

Table 9.3 Percentage hired and family labor use in Javanese rice production.

Location and Year	Family labor (%)	Hired labor (%)	Total labor use
1926–1931			(hours/ha.)
Lumajang, East Java, 1929/30	28	72	1144
1930/31	31	69	1309
Kenep, Surabaya, East Java, 1925/26	59	41	2208
Jetis, Mojokerto, East Java, 1926/27	42	48	1547
Kertorejo, East Java, 1926/27	32	68	1376
1927/28	28	72	1123
Sawo, Ngawi, East Java, 1926/27	48	52	1012
Karangmalang, Ngawi, East Java 1926/27	48	52	1172
Berbek, East Java, 1926/27	29	71	1215
Average (1926–1931)	38	61	1345
Dry Season 1969			
Gemarang, Ngawi, East Java:			
Local/National improved varieties	25	75	2111
HYV	16	84	1620
Sidomulyo, Sidoarjo, East Java:			
Local/Nat. improved varieties	28	72	1349
HYV	16	84	979
Geneng, Ngawi, East Java:			
Local/Nat. improved varieties	11	89	1303
HYV	10	90	1799
Average	18	82	1526
Wet Season 1969/1970 (No harvest labor)			(workdays/ha.)
Pemalang, Central Java	17	83	205
Kendal, Central Java	8	92	257
Kebumen, Central Java	48	52	313
Banyumas, Central Java	15	85	229
Ngawi, East Java	20	80	286
Sidoarjo, East Java	19	81	266
Average 1969/1970	21	79	259

Table 9.3 (continued)

Location and Year	Family labor (%)	Hired labor (%)	Total labor use
Wet Season 1969/1970			(hours/ha.)
Janti, Sidoarjo, East Java	23	77	1331
Wet Season 1975/1976			(hours/ha.)
(No harvest labor)			
Banyutowo, Central Java			
.01 – .19	73	27	1454
.20 – .29	64	36	1256
.30 – .49	50	50	1055
.50 – .99	25	75	801
1.00 +	11	89	824
Average Banyutowo	55	45	1127
Wet Season I978/1979			
Kraton, Lumajang, East Java	47	53	1396
Gemarang, Ngawi, East Java			
.01 – .24	42	58	1670
.25 – .49	40	60	1150
.50 – .99	28	72	1090
1.00 +	10	90	1010
Average Gemarang	30	70	1166
Sumokembangsri, Sidoarjo, East Java	17	83	1708
Average 1975 to 1979	37	63	1423

Source: William L. Collier, 'Declining Labor absorption (1878 to 1980) in Javanese Rice Production; Agro Economic Survey. Rural Dynamics Study.

Table 9.4 Percentage and average labor use by male and female workers in rice production between 1926 and 1979.

Item	Percentage female labor (%)	Percentage male labor (%)	Total labor (hours per ha.)
Sawo village, Ngawi, East Java, 1926/27	70	30	964
Pasaredjo village, Pasuruan, E. Java:			
Wet Season 1927/28	69	31	2168
Wet Season 1928/29	69	31	2140
Dry Season 1928	69	31	2392
Kenep village, Surabaya, East Java:			
Wet Season 1925/26	59	41	2118
Wet Season 1925/26	52	48	1834
Djetis village, Modjokerto, E. Java:			
Wet Season 1926/27	64	36	1407
Wet Season 1927/28	64	36	1596
Karangmalang village, Ngawi, E. Java:			
Wet Season 1926/27	68	32	1104
Djatisari village, Lumajang, E. Java:			
Wet Season 1929/30	65	35	1231
Wet Season 1930/31	70	30	1377
Average	65	35	1666
Gemarang village, Ngawi, East Java:			
Dry Season 1969			
Local/Nat. improved varieties	59	41	2111
HYV	69	31	1620
Sidomulyo village, Sidoarjo, E. Java:			
Dry Season 1969.			
Local/Nat. improved varieties	40	60	1349
HYV	46	54	979
Geneng village, Ngawi, East Java:			
Dry Season 1969.			
Local/Nat. improved varieties	59	41	1303
HYV	51	49	1799
Janti village, Sidoarjo, East Java,			
Wet Season 1969/70			
Local varieties	49	51	1331
Average	53	47	1499
Banyutowo village, Kendal, C. Java.			
(pre harvest) Wet Season 1975/76	47	53	1173
Gemarang village, Ngawi, East Java,			
Wet Season 1977/78	37	63	1173
Kraton village, Lumajang, East Java,			
Wet Season 1978/79	24	76	1396

Table 9.4 (continued)

Item	Percentage female labor (%)	Percentage male labor (%)	Total labor (hours per ha.)
Sumokembangsri village, Sidoardjo, E. Java, Wet Season 1977/78	41	59	1708
Average	37	63	1363

Source: William. L. Collier, 'Declining Labor Absorption (1878–1980) in Javenese Rice Production', Agro Economic Survey Rural Dynamics Study No. 002,1979 page 19–20.

the 1975 to 1979 period the average percentage of female labor use was only 37 per cent for the studies in the four villages. These villages are all in lowland, predominantly rice growing, densely populated areas that have adequate irrigation facilities. Furthermore, the villages in Sidoardjo and Ngawi *Kabupatens* (counties) which were studied each time, are located within a few kilometres of each other. Although there are not enough cases to be absolutely definite, in his study Collier stated that the percentage of female labor in rice production had declined in the last fifty years, and the greatest decline may have occurred in the late 1960s and early 1970s. Most of this decline was in hired female labor.

Since the innovation in rice farming of new HYV wetpaddy, farmers have tried hard to limit harvest-laborers. Recent data show that total labor use is still at a high level in Java, even after various efforts to exclude more labor, especially in harvesting.

In Java, however this better-paid work is now available for women but only for young women and mothers who are strong enough to use sickles to cut the paddy; the old ones and younger girls have been excluded from this work (Sajogyo *et. al.* 1980).

Entrusted with the job of transplanting in the beginning of a season, a more limited number of farm-laborers (male or female) will get a right to a fixed share of the harvest; this institution is called *kedokan,* a labor-harvestshare exchange system. Sometimes wetpaddy farmers just before harvest time sell the crop to a *penebas*-trader who is a middleman: coming with his own labor (smaller in number) and using a sickle instead of the *ani-ani,* because new HYV shatter more easily, *penebas*-traders have pushed harvest-shares down. They even use a scale to weigh harvesters' shares or pay their harvest laborers in cash rather than in kind.

Hayami and Kikuchi (Sajogyo, 1982), as economists, predict that farm-wage levels will have a better chance to improve if farmers (getting higher returns from HYV) and laborers are wed in a ‘patron-client’ relationship, such as in the *kedokan*-harvestshare exchange system. They call such a process ‘stratification’ in which the social mode of a ‘moral economy’ (Scott, 1976) is maintained in a situation of ‘differentiation’, from landlords to landless laborers. In this case Sajogyo (1982) made the comment that Hayami et al. only mention ‘benefits on either side’, out of their relations in the farm-business, seen as a ‘personalized market’; they do not mention specifically, any other costs (or obligations). Another point is, that in Hayami’s ‘model-village’ in West Java, (where farm wage levels did increase) alongside *kedokan*-labor one still finds piecework and hired labor (41 per cent of non-household labor), especially in land preparation (plowing, hoeing, by men).

If this is the case, one may put the question: are all these wage-laborers (after land preparation) in later phases to become *kedokan*-farm-laborers? In the more probable case that there are a lot more farm-laborers at hand, this means that only a portion of them will be taken up in the *kedokan*-system. Other farm-laborers (including female labor) will not be taken up in such a ‘patron-client’ system and will be without patron(s). Again, the question is: in what ways does this latter situation reflect a process called ‘polarization’, with impersonal market relations between landowners and casual laborers, who are a ‘majority’?

Thus, Sajogyo (1982) concluded that both ‘stratification’ and ‘polarization’ (as Hayami/Kikuchi define them) do exist side by side at the same time in the same village.

Other changes in women’s employment came after the adoption of rice hullers, affecting earnings of female laborers engaged in hand-pounding of rice on Java (Collier, 1974).

In the past, a small farmer typically would hand-pound the rice for his family’s consumption, while the rice he sold would be in the form of stalk paddy or *gabah* (unhusked rice). This hand-pounding would be done by family members, for small daily amounts, and by wage laborers if larger amounts were needed for a special occasion. The many small rice traders employed a large number of female laborers to hand-pound rice into *beras* (de-hulled rice).

Data from the Agro Economic Survey in Java show that, until the wet season 1969/80, sample farmers used hand-pounding to mill their rice. After 1970 the number of hullers in the sample villages increased rapidly. For example in one village in West Java the number increased from two in the wet season 1969/70 to nine at the beginning of 1973 and in another village from five to eight (Collier, 1974).

According to a former rice-trader now turned mill-owner he used to employ eight women to hand-pound rice. To hand-pound 100 kilograms of *gabah* required four women, each working for five hours.

During the two months of the harvest season, this rice trader could buy 200 kilograms of *gabah* a day. Thus, over the harvest season, these 8 women earned perhaps 60 litres of *beras* each, or enough to feed themselves for four months. Another farmer stated that in the past there were more than 100 women hand-pounder laborers in his village (Central Java).

These examples show that many women in the sample villages have lost work opportunities and income formerly provided by hand-pounding.

In the wet season of 1972/73 Collier (1974) found in a sample of 344 farmers in 12 villages in Java who used to hand-pound rice, that 54 per cent of farmers did this with their own labor (family), 27 per cent with hired labor and 18 per cent with both family and hired labor. The work-capacity of a hand-pounding woman was an average 3.9 kg *gabah* (unhusked rice) for hour, producing 2.4 kg milled rice per hour. For 1974 Collier did submit an estimate of some 40 per cent of the total rice crop in Java that was processed with hand-pounding. This contrasts with an estimate of a high 80 per cent of rice crop hand-pounded in the late 1960s! The principle reason for the sharp shift to rice hullers was their low cost. A hand-pounding wage-laborer, who was getting 10 per cent of the product plus a meal, was getting a 2.7 times higher wage income ($1.45 per 100 kg milled rice in 1973) than the cost of milling rice with a rice huller ($0.54 per 100 kg, including the value of by-products kept by the miller).

If in 1974 40 per cent of the total rice crop in Java was hand-pound, (or 2.4 million tons of rice), this meant work for hand-pounding laborers for an equivalent of 100 million women-days, (8 hours/day), with earnings (estimated) of $44 million.

The shift from 80 per cent to 40 per cent hand-pounded rice in Java's rice crop in the 1969–1974 period, has probably pushed out some 1.5 million women hand-pounders (working 2 months/year). In their place, in 1974 workers in rice hullers' mills (who are males), received (estimated) earnings of only $4 million a year.

The proportion of the total harvested area in *sawah* is also shown in Table 9.5 for Java and the Outer Islands. As this proportion is so much higher in Java than elsewhere, it must be a factor indicating the higher labor input per hectare in Java. Another factor concerning cropping patterns which contributes to the higher labor input per hectare in Java is the more intensive use of house gardens. Recent studies in Central Java have shown that house gardens can provide as much employment as *sawah* if intensively cultivated. Employment (mostly women) generated by house gardens is particularly important in the very small holdings, which use labor most intensively (Stoler A., 1978).

Table 9.5 Indicators of cultivation intensity

Indicator	Java	Outer Islands	Indonesia
Percentage of harvested area under seasonal crops	132	54	84
Percentage of harvested area in *sawah*	57	22	36
Percentage of net area in *sawah*	48	26	34
Percentage of farms using:			
chemical fertilizer	52	16	38
insecticides	27	10	20

Source: Abey,et al., 1981, based on Agricultural Census, 1973.

The change of certain tasks specific to women with new technology

While at earlier phases it has been no more than a fertilizer revolution (Indonesia is now producing most of its needs), recent trends do show that it has also become a wetpaddy revolution, centered on the HYV, pushed by a national organization reaching out to farmers' small groups in their fields and hamlets. In the last 14 years rice production has more than doubled, in 1982 to reach 23 million tons for 136 million people. The yield increases, especially through the *BIMAS* rice intensification program as a vehicle for the rapid spread of the modern rice farm technology, were mainly due to improved irrigation facilities and the adoption of new farm technologies. But this technological change on the other hand has affected work opportunities in farming for rural women, especially hired labor.

Data from three villages in West Java (Kasryno, 1981) show the dramatic decline in the employment of female labor in harvesting. When harvesting was done using the *ani-ani* nearly all the laborers employed were female laborers. Since harvesting has been carried out using sickles and threshing performed at the same time in the field, male labor has dominated: of the total harvesting labor an average of 53 per cent (189) hours was male labor. When farmers started to use sickles, women were excluded from those specific tasks of cutting and threshing the paddy. But the female harvesters have since adjusted very quickly. Two of three women work together as a group, doing the cutting with sickles first, and later on one of them will leave the cutting and do the threshing. In this change in technology, some women were quick in developing a new organization of work, even though the older ones and the girls are being excluded from harvesting.

Decreasing work in the agricultural sector has brought women into non-agricultural work. Tables 9.6 and 9.7 show female employment in the non-agricultural sector in terms of number of hours and the income earned by the female workers (Kasryno, 1981 ; Sajogyo, P. et al., 1980).

Looking at the different operations in rice cultivation, such as preparing seed beds, preparation of the field, transplanting, fertilizing and spraying, weeding, harvesting, drying and storing, and comparing the labor use (hours per hectare) on those different operations, before and after the 2nd World War (1878, 1923–1930 and 1969, 1978) in Java, Table 9.8 shows changing patterns in rice cultivation (Collier, 1979).

Table 9.6 Employment per capita per year of landless agricultural laborers in agricultural sector and non-agricultural sector in the 3 selected villages in West Java, 1981.

Village	Male (Hours) Agric.	Male (Hours) Non-Agric.	Male (Hours) Total	Female (Hours) Agric.	Female (Hours) Non-Agric.	Female (Hours) Total
Sentul	3	1,038	(1,041)	16	283	(299)
Jatisari	229	656	(885)	118	105	(223)
Mariuk	902	224	(926)	605	179	(784)

Source: *Technological Progress and its Effects on income distribution and employment in rural areas: a case study in three villages in West Java, Indonesia,* Faizal Kasryno, 1981.

Table 9.7 Income earned (Rp./hour) by female and male workers at different jobs in 2 villages in West Java (1977-78).

Activities	Strata/ Sex	Sukabumi village I low ±0.03 ha.	Sukabumi village II middle ±0.32 ha.	Sukabumi village III high ±1.04 ha.	Sumedang village I low ±0.25 ha.	Sumedang village II middle ±0.36 ha.	Sumedang village III high ±0.86 ha.
Farm labor	F	47.28	41.15	32.38	54.23	48.87	51.84
	M	58.12	48.59	50.48	47.06	88.63	64.76
Non-farm labor	F	35.26	34.86	44.10	44.18	62.90	89.13
	M	58.22	69.77	98.46	114.89	61.16	92.03
Services	F	0	128.67	0	0	7.29	160.26
	M	59.12	88.64	150.71	4.42	243.89	120.37

F = Female; M = Male.
Source: Personal Data LPSP–IPB and SDP–SAE, Bogor in *The Role of Women in Different Perspectives,* by Pudjiwati Sajogyo, et al., 1980.

Table 9.8 Comparison of labor use (hours/ha.) by operations between 1878, 1923–30, 1969 and 1978 in Java.

Locations and size of operations	Operations (hours/ha.)							
	Seed-bed	Field prepa-ration	Trans-plant-ing	Ferti-lizing and spray-ing	Weed-ing	Har-vest-ing	Dry-ing & stor-ing	Total
1878: Kediri	63	595	230	–	594	286	120	1888
1923–1930:								
Sawo, Ngawi	21	230	314	–	10	444	–	1019
Karangmalang, Ngawi	29	167	409	–	43	526	–	1174
Jaan, Berbek	10	136	305	–	15	740	–	1206
Jatisari, Lumajang	39	223	258	–	290	501	68	1377
Demak	n.a.	173	n.a.	–	n.a.	540	–	n.a.
Surabaya	66	209	280	–	386	839	–	1780
Rembang	n.a.	252	310	–	n.a.	476	–	n.a.
Surakarta	n.a.	959	351	–	n.a.	520	–	n.a.
Besuki	n.a.	141	n.a.	–	n.a.	459	–	n.a.
Banten	n.a.	216	151	–	359	316	–	1042
Cirebon	67	102	355	–	253	339		1136
Prijetan, Surabaya 1923	n.a.	116	382	–	28	n.a.		n.a.
Prijetan, Surabaya 1924	n.a.	156	411	–	n.a.	n.a.		n.a.
Kuningan, Cirebon	88	229	690	–	421	406	–	1834
Maja, Cirebon	74	381	673	–	124	277		1529
Kenep, Sidoarjo (.41 ha.)	26	413	484	–	459	876	–	2258
Kenep, Sidoarjo (.33 ha.)	92	447	412	–	254	713	–	1919
Average	51	267	386	0	220	531	68	1523
1969:								
Geneng, Ngawi								
Local (.45 ha.)	44	241	242	16	264	415	21	1303
HYV (.19 ha.)	51	328	270	50	573	475	47	1799
Semarang, Ngawi								
Local (.22 ha.)	69	393	303	53	591	647	49	2111
HYV(.38 ha.)	40	245	249	29	346	678	133	1620
Sidomulyo, Sidoarjo								
Local (.19 ha.)	65	431	200	73	316	166	98	1349
HYV (.46 ha.)	43	331	144	49	282	87	43	979
,Sidoarjo								
Local (.58 ha.)	63	370	208	59	310	195	126	1331
Average	54	334	231	47	384	389	60	1499
1978								
Semarang, Ngawi (.82 ha.)	n.a.	260	215	n.a.	287	284	n.a.	1046 (incl. fertilizing and spraying)

Source: *Declining Labor Absorption (1978 to 1980) in Javanese Rice Cultivation,* William L. Collier, 1978.

The declining labor use in harvesting after the war, due to a new technology package, is more convincing. There is an increase in weeding, which can be explained by double cropping in *paddy sawah* because of the use of fertilizer and the adoption of new varities. This might mean an increase in work opportunities for female workers, because traditionally weeding has been done mostly by women; but again since men also do the weeding using *landak* which work more effectively, but are disliked by women, this means decreasing work opportunities for the women. In the case of fertilizing and spraying, even though it has meant additional labor use (0 before the war and 47 hours/ha after the war), this work in rural Java is done only by men.

Table 9.8 shows that average labor use (estimates) between the 1878–1930 periods and the 1969 period is very similar. The average for the 1920s was 1,523 hours per ha. and the 1969 average was 1,499 hours per ha. It seems that there is no change in average labor use in seedbed preparation and in drying and storing. But in field preparations, fertilizing and spraying, and in weeding, the average labor use has increased, from 267 hours/ha. to 334; from 0 to 47 hours/ha. and from 220 to 287 hours/ha. respectively.

In the case of transplanting and harvesting there is a decrease of average labor use, from 386 before the war to 231 hours/ha. after the war and from 531 to 389 hours/ha. respectively. From these data Collier (1979) stated that the main declines seem to have been in harvesting and weeding which are primarily hired female labor. Thus, one can confidently state that the decline in labor use per hectare has been primarily in hired female workers.

Variations of women's labor input (hours/ha.) and income by size of farm

In Java's peasant-farming, in terms of status and farm-size, owner farmers are the top stratum, followed by owner-tenants who lease in additional land and with landless tenants at the bottom.

Behind the shifts in tenancy status from 1963 to 1980 one can see the effects of the 'green revolution' (use of HYV package) (Sajogyo, 1982).

From 1963 to 1973, the percentage of tenants dropped (35 per cent to 25 per cent), with sharper drops in Java. With new HYV and cheap bank credit (BIMAS-program) own farming has become more attractive: more owner-operators have come forward. Over the longer term (1963–1980), the percentage of owner-tenants has dropped steadily (29 per cent to 22 per cent and 11 per cent). Even when rice farming has become more attractive, farmers' terms of trade have not improved so that relatively more enterprising farmers may have shifted their interests to other non-farming businesses. More landless tenants have come into the picture, especially from 1973 to 1980: from 3 per cent to 15 per cent. With 80 per cent of them in the marginal farm-size (less than 0.5 ha.) it is now known how many are in fact within a *kedokan*-harvestshare exchange system, but a high estimate is more probable.

On the whole, it is the top stratum of small farmers (average 1.2 ha.) who lease out land to the landless and marginal farmers. It is within this context one will get more understanding of the effect of new technology on women's employment.

Data on time allocation from different work activities in two villages in West Java (1977–1979), show that women's labor use in rice cultivation is still higher than in other farming activities (Sajogho, P. et al. 1980) (Table 9.9). There are more varied opportunities for farming activities among women in the higher income groups (dryland, garden, ponds and animal husbandry).

Table 9.9 Average hours per year in different work activities by male and female in agriculture in Pasawahan and Sukaambit, West Java (1977–78).

Activities (owned land cultivation)	Strata/ Sex	Average Hours per Year SUKABUMI I 0.03 ha.	SUKABUMI II 0.32 ha.	SUKABUMI III 1.04 ha.	SUMEDANG I 0.25 ha.	SUMEDANG II 0.36 ha.	SUMEDANG III 0.86 ha.
Paddy field	M	191.2	538.0	801.9	645.2	694.0	1,063.3
(*sawah*)	F	91.8	307.1	259.9	246.8	385.0	400.4
Dry land	M	73.9	162.1	129.7	409.3	260.8	490.3
(*Tanahkering*)	F	0	66	31	251.3	215.8	276.5
Garden	M	22.1	0	10.0	8.9	6.2	21.2
(Pekarangan)	F	0	0	5.5	9.2	17.9	23.3
Ponds	M	0	8.9	7.6	266.9	261.8	370.0
(Kolam)	F	0	0	0	148.6	177.8	152.5
Animal husbandry	M	22.1	87.6	12.6	0	4.1	72.8
(Ternak)	F	0	25.8	0	0	20.9	7.7
Total	M	313.4	796.7	961.9	1,330.4	1,226.9	2,017.5
	F	91.8	399.2	296.4	655.9	817.4	860.4

F = Female; M = Male.
Source: Household Study, LPSP–IPB and SDP–SAE Bogor in *The role of women in different perspectives,* Pudjiwati, S. et al., 1980.

Data on Table 9.10 show the involvement of women's labor in different activities in the non-agricultural sector. Trade as an income earning activity plays an important role in women's economic life, for well-to-do as well as poor households. Small or marginal farmers (*petani gurem*) may themselves want to take advantage of outside employment in busy seasons when casual wages are highest. Hart (1978), argues that the survival strategy of the landless in the rice-growing areas of north-

Table 9.10 Average hours per year in different non-farming activities — male and female in 2 villages in West Java (1977–78).

		Average House per Year					
		SUKABUMI			SUMEDANG		
Activities	Strata/ Sex	I 0.03 ha.	II 0.32 ha.	III 1.04 ha.	I 0.25 ha.	II 0.36 ha.	III 0.86 ha.
Services	M	508.5	184.4	184.3	0	494.7	60.9
	F	4.3	52.2	0	0	0	82.5
Trade	M	388.4	230.0	512.8	235.8	45.0	125.3
	F	326.6	148.8	357.1	45.4	84.0	279.9
Handicraft and Home-industry	M	8.2	8.2	254.3	17.0	273.0	158.4
	F	0	14.3	130.8	4.6	83.0	2.0
Collection of firewood, vegetables, grass, etc.	M	7.5	40.4	6.9	77.2	37.6	47.9
	F	13.7	18.3	3.0	57.3	9.9	2.2
Others	M	13.0	50.9	73.6	19.4	15.1	22.4
	F	0	0	0	2.7	9.0	9.5
Total	M	925.5	513.9	1031.8	349.3	865.4	414.8
	F	344.6	233.5	491.0	109.1	185.9	376.2
Total Farming/ Non-farming: (hours/year)	M	1238.9	1310.6	1993.7	1679.7	2092.3	2432.3
	F	436.4	632.7	187.4	765.0	1003.3	1236.6
(hours/day)	M	3.44	3.64	5.54	4.66	5.81	6.16
	F	1.21	1.76	2.19	2.12	2.79	3.43

F = Female; M = Male.
Source: Household Study, LPSP–IPB and SDP–SAE Bogor in *The role of women in different perspectives,* Pudjiwati, S. et al., 1980.

central Java induces them to maintain established work patterns as seasonal laborers, even if this means forgoing more lucrative work opportunities of uncertain duration.

Stoler's account of rice harvesting in the Yogyakarta region suggests that women from small land-owning households are quite often engaged in activities such as preparation of soyabean cake *(tempe)* or brown sugar which means they have little time for harvesting activities (Stoler A., 1977).

Looking at income earned by female workers as farmwage labor, we can see that availability of agricultural land affects their income: the more land is available, the more work they can get, which means that their income will increase (Table 9.11). Table 9.11 also shows that

Table 9.11 Income earned per hour by male and female groups related to class status and different jobs (farm and non-farmwage) stated in Rupiahs in 2 villages in Sukabumi and Sumedang, West Java, (1977–78).

Activities	SUKABUMI				SUMEDANG			
	Female		Male		Female		Male	
	N	Rp./hour	N	Rp./hour	N	Rp./hour	N	Rp./hour
Strata I (Low)								
Farm-owner and farm labor	39	47.30	18	58.10	75	54.20	97	57.10
Non-Farm	19	35.30	61	58.20	19	44.20	65	114.90
Services	0	0.00	41	59.10	0	0.00	3	4.40
Strata II (Middle)								
Farm owner and Farm labor	30	41.15	9	48.60	65	48.90	59	88.60
Non-Farm	12	34.86	127	69.80	10	60.00	48	60.00
Services	9	128.70	41	88.60	1	7.30	50	243.90
Strata III (High)								
Farm owner and Farm labor	8	32.40	16	50.50	44	51.80	41	64.80
Non-Farm	10	44.10	57	98.50	12	89.10	56	92.00
Services	1	0.00	39	150.70	25	160.30	34	120.40

Source: *Peranan Wanita Dalam Keluarga, Rumahtangga dan Masyarakat Yang Lebih Luas di Pedesaan Jawa,* Pudjiwati, S., 1981.

women from rich and poor households do have different work: farm-work and nonfarm-work such as trade, services, small industries etc. We can say that women from the poorest stratum need additional income in order to meet the primary requirements of life for their families. The types of work to which they have access are wore restricted and even the returns to labor are lower than those enjoyed by women from the better-off strata. This is even more evident when a comparison is made with the situation of men, since the poorer women are at a disadvantage in having more limited education and skills.

Table 9.12 shows that in the field of agriculture, since the better-off households (stratum III) control greater areas of land, it is these households that obtain the greatest incomes in both villages. Employment as a hired laborer still appears to be important for households from all strata in both villages.

Table 9.12 Income earned household level (Rp./hour, kg. rice/hour, %-time allocation) in different activities, related to class status, in villages in Sukabumi and Sumedang, West Java, 1977–78).

Activities	SUKABUMI Rp./hour	SUKABUMI Kg-Rice/hour	SUKABUMI Time allocation (%)	SUMEDANG Rp./hour	SUMEDANG Kg-Rice/hour	SUMEDANG Time allocation (%)
Strata I (Low)	(N = 16)			(N = 23)		
Own agric.[1]	16.64	0.12	(11)	23.95	0.16	(54)
Off Farm[2]	51.01	0.37	(41)	50.80	0.34	(18)
Wage labor	33.90	0.24	(48)	39.52	0.26	(28)
Average	39.01	0.28	260*	33.08	0.22	340*
Strata II (Middle)	(N = 25)			(N = 15)		
Own Agric.[1]	15.69	0.11	(41)	40.74	0.28	(53)
Off Farm[2]	49.62	0.35	(24)	114.13	0.8 1	(18)
Wage-Labor	48.85	0.34	(35)	30.90	0.22	(29)
Average	35.44	0.25	317*	50.90	0.36	356[3]
Strata III (High)	(N = 18)			(N = 22)		
Own Agric.[1]	84.26	0.61	(42)	62.92	0.44	(53)
Off Farm[2]	68.78	0.50	(48)	182.73	1.28	(18)
Wage-Labor	48.46	0.35	(10)	34.11	0.24	(29)
Average	73.38	0.52	374*	78.56	0.55	492*

[1] Income earned (Rp./hour) at points la, 2a and 3a are nett income in agricultural sector.
[2] Off farm activities: Services, trade, small industries.
[3] hours/month.

Sources: *Peranan Wanita Dalam Keluarga, Rumahtangga dan Masyarakat Yang Lebih Luas di Pedesaan Jawa,* Pudjiwati, S., 1981.

Summary

The role of women in rice farming systems has been analyzed by looking at the problems in that area within a broader context of institutions: social-cultural, economical, ecological, etc. This approach, indicating structural consequences using the role-concept (*what* role? towards *whom*?), is useful to get more understanding about problems faced by women.

For Indonesia, particularly Java, the role of women in income-earning work such as rice production cannot be overlooked. Through time allocation analysis and the returns to outlay labor and the value of housework, women's contribution in rice farming system has been analyzed.

The following findings concerning the impact of new technology in rice farming on women's employment are of significance.

With strong population pressure on limited land resources and unlimited labor supply the trend of decreasing returns to labor relative to land is inevitable. With scarce land, as in Java/Bali, the modern rice varieties are part of a new package of landsaving and labor using technologies.

In the field of agriculture (based on several cases in West Java), since the better-off households control greater areas of land, it is these households that obtain the greatest incomes.

Since the contribution made by agriculture, especially rice cultivation to the income of the poorest household is extremely small, there is a tendency of greater involvement of women in non-agricultural employment (trade, services, small-scale industry). There is a need for measures to expand and increase job opportunities outside agriculture and bring better earnings.

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10 Women's access to land resources: some observations from East Javanese rural agriculture

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Summary

This paper reports some preliminary results of women's access to land resources following the introduction of new rice technology in East Javanese rice farming systems. The major aims of this study were to investigate any changes resulting from the adoption of the new rice technologies in women's rights to land ownership, partial ownership and working on land where there was a standing rice crop. In particular, this paper attempts to highlight existing changes in access to land resources due to the past introduction of the new technologies. A major stimulus for this study is the need to understand whether women have benefited from the past introduction of new technologies in rice production. The data come from a field study in four villages of four different regencies in East Java. The paper is organized as follows: the second section discusses women's opportunity over land resources prior to the introduction of new technology; the third section describes women's opportunity to derive some income from rice farming activities after the new rice technology has been adopted. The conclusions are presented in section four.

Women's access to land before the introduction of new technology

A discussion of land resources would not be adequate without looking at the problem of land tenure. This is the concept that involves the relationships established among people that determine their varying rights to control, occupy, and use landed property. In Java, which contains some of the most densely populated areas in the world (690 inhabitants per sq km in 1980), tenurial forms have become more complicated as a result of population pressure, limited areas of agricultural land and the existing social relations among rural inhabitants. In the early 1960s, a scholar (Geertz, 1963) introduced the concept of 'agricultural involution' based on his study in a village in East Java. This phrase was introduced in part because of the intricate land tenure and work sharing systems among family and village members. Although Geertz's ideas about agricultural involution have recently been attacked by a number of writers (see for example Collier, n. d.; Stoler, 1977) especially with regard to the adoption of new labor saving technologies and some institutional changes in rice harvesting methods, the intermingling arrangement between rights of land which he pointed out is significant.

Historically, the land tenure system in Java was of a different nature to that of the Western concept of land tenure. Kano (1977) and White & Wiradi (1981) who have recorded the Javanese land tenure systems in the nineteenth century, wrote that to make a living, the most important classification of land for Javanese peasants was wet paddy fields. Land possession of wet paddy fields was categorised into the following types: heritable individual possesion, communal possesion, and salary fields for officials. Partial transfer of rights on this land already existed. Soentoro et al. (1981) described the past system of land control in three East Javanese villages in similar categories.

Since the passing of the Basic Agrarian Law in 1960, there have been some changes. Basically, the land ownership system comprised privately owned land and public land. Among the principles of this law is that agricultural land is for the farmers who till it. Consequently, article 53 of the law states that temporary rights (that is partial transfer of property rights) to agricultural land including fixed leasing and share cropping are to be abolished within a short, but unspecified, time. Until recently, access to land resources still occurred through tenency as well as by working on the land during the cultivation period and harvesting of the crop.

While many papers discuss land tenure systems in great detail, little has been mentioned about women's involvement in particular land systems such as privately owned land, salary fields, partial transfer of rights, etc. (see for example Kano, 1977; White and Wiradi, 1981;

Soentoro et al., 1981; Lyon, 1976; Geertz, 1963; Kroef, 1960; Wijaya, 1981). Even when the topic of discussion is women's role in agriculture, almost no mention is made of the importance of women in land ownership and no effort is made to identify women as sole operators or to analyze their involvement in tenancies. Little mention has been made of the fact that land which is privately owned can be inherited by both male and female heirs (White, 1976; White and Wiradi, 1981). White (1976) wrote that there was an increasing tendency for land and other assets to be divided equally among male and female heirs when the parents died or just before their death. Regarding the size of inheritance, Stoler n.d., p. 42 noted:

> Women can and do hold the land in their own right. Although Islamic and Javanese customary *(adat)* law both prescribe that on the death of a parent a son will inherit twice as much as a daughter, in fact neither law is strictly adhered to. In Kaliloro sons and daughters alike inherit rice land; however no hard and fast rules determine who will receive how much, although generally women do not inherit house-garden land.
>
> In marriage women retain land, and in the event of divorce take the property they brought with them to the marriage. Whereas *adat* again prescribes that men should retain twice as much as women of the communal property, in fact the division is usually more equal. Thus women have full rights and access to the strategic resources upon which social power is based.

Land ownership may be acquired through buying land. No statistical data are available to help us understand to what extent women independently buy and manage their own land. As far as the author is aware, no mention of this aspect of land tenure has been made in the literature. Privately owned land can also be acquired from a gift. Again, nothing is revealed about it in the literature. The Indonesian government provides land free to transmigrants from the inner islands to the outer islands. The existing regulations, however, make it impossible for the females to join the programme, and thus female farmers are deprived of opportunities to gain access to land resources.

The need to produce more rice is painfully obvious when one contemplates population growth rates and increased demand in countries where rice is the staple food. One way a country might meet demands for more food is to utilize new technology to produce more from every unit of rice-producing land. Some scholars have already noted the degree of independence rural women had in the rice-production activity before the introduction of the new rice technology. At one extreme, farm women may control all of the rice production activity on their privately owned land. At the other extreme, involvement of women workers in rice production such as transplanting, weeding and rice harvesting is already wellknown. Although it is over a decade since new technology has been introduced, its impact on women's earning opportunities is not yet clear. It is also not well understood whether the new technologies affect women's access to land resources, or whether access to land resources is necessary if women are to benefit from the new technology.

Opportunities for women after the adoption of new technology

Data from the 1980 Population Census indicate that 33.6 per cent of rural inhabitants were women workers, and 56.7 per cent of the women labor force in Java sought employment as farmers (Statistical Centre Bureau, 1982). These figures suggest that farming is an important source of employment. No information is available regarding the proportion of women who work in rice farming. Given the importance of rice as the staple food and the fact that the largest proportion of irrigated land for rice farming was in Java (54.2 per cent of total irrigated land in Indonesia according to the 1973 Agricultural Census, Statistical Centre Bureau, 1976) it can be inferred that rice farming provides employment for a large proportion of the women in the labor force in Java.

Detailed information about the number of female farmers who are sole operators, who are actively engaged in contractual arrangements with others and how many farmers are 'nominal farmers' only, is not available from official statistics. Lack of this basic information makes it difficult to conduct formal surveys when time to conduct research and other necessary research resources are limited. Therefore, a field study was used to collect data from the villagers. The selected villages were situated in the regencies of Ma, Mo, K and B, where rice farming was dominant. The key people who were interviewed were land owners, tenants, landless women farmers, village officials, and other villagers judged capable of providing valuable information and an in-depth insight into the subject being investigated. In particular, information concerning women's land rights and the rights to work on cultivating and harvesting the rice crop was documented to meet the aims of the study.

Women's access to privately owned property

The information gathered from the selected villages in East Java indicates that access to land resources was not affected by changes due to the adoption of the new technology. Similar to what has been reported by some writers (see the previous section), before the new technology was applied, village inhabitants recognized the right of women to own rice fields, which could be acquired through inheritance, marriage, gift, or purchase. Despite the changes in rice cultivation, all informants stated that no changes occurred.

The practice of transferring ownership rights to heirs is considered one of the customary laws in the sampled villages. There has been a belief that privately owned land is a precious capital resource needed to sustain the life of its owners as well as his or her heirs. This is rather different from Barlowe's (1972) suggestions on the important goals in planning inheritance arrangements, which were '(1) minimizing the cost, time, and trouble involved in estate settlement; (2) maintaining productive properties as economic operating units; (3) safeguarding the security of the parents; and (4) securing fair treatment of their heirs.' (p. 439) The land owners in the studied villages stressed the importance of the welfare and well-being of their prospective heirs. The large number of farmers (including the landless) and the limited amount of land (Table 10.1) makes property-inheritance arrangements more important regardless of the concern of the Indonesian government about problems of inefficiency and poverty due to land parcelization resulting from inheritance.

Table 10.1 Number of farmers, total arable land and agricultural densities in the 4 villages, 1983.

Villages	Regencies	Total number of farmers	Total arable land (ha.)	Agricultural density (ha.)
S	Ma	1,479	227.0	0.153
T	Mo	948	383.0	0.404
B	K	2,555	259.7	0.102
J	B	1,084	172.0	0.159

The Basic Agrarian Law (1960) converts the heritable individual possession and communal possession assigned to villages in return for particular village duties into privately owned property. The consequence of the conversion law is that now the communal possession can be inherited. In essence, although land parcelization is forbidden if it leads to a farm size less than 2 hectares (Government Regulation in Lieu of Act No. 56, 1962), customary law with respect to inheritance persists to an even greater extent than before the passing of the law. No statistical data are available at the village level regarding the evidence of land parcelization due to the practice of land inheritance. Inhabitants appear unwilling to report the evidence, and thus they avoid the impression of acting against the law. On the other hand, the village officials are also reluctant to legalize the right of the new owners to the inherited land for the sake of the security of the heirs and hence the village inhabitants. Usually, as long as the village officials can identify the persons who are responsible to pay the land tax, no problems occur.

Two ways are normally used to disguise the farm size when this is less than that required by law. One way is to leave the land in the name of its former landowner (regardless of the fact that he or she has died). The second way is to allow the eldest to act as representative in the formalization of the transfer of private property. In village S, regency of Malang, if the heirs want the transfer of rights to be formalized, all of their names are reported as the new owners of the land. In practice, the land is divided among themselves into more or less equal shares. A term used for this arrangement is *bagi garapan* (farm sharing). This indicates that transfer rights occurs from owners to their heirs informally despite government regulations.

The concern of this paper is the inheritance of female heirs. There is a belief that every descendent has an equal right to make their living out of their parents' land. Therefore, all of the descendants regardless of sex should be allowed to have access to the land, rather than the entire land being assigned to the ownership of an individual.

It is interesting to note that the type of crop to be cultivated makes no difference to the arrangements. Nor do the former owners or prospective heirs take into account the kind of technology in crop production to be used on the land. In this way the new rich technology does not affect the access of women to privately owned land.

Access to Partial Transfer of Property Rights

Partial land rights occur because of contractual arrangements between resource owners which involve partial transfers of property rights in one form or another such as leasing, share cropping or mortgaging. In the villages where the study was undertaken, fixed leasing and share cropping were common, while mortgaging was less common.

Fixed leasing arrangement

The existing fixed leasing arrangement covered several contractual arrangements. These were *sewa, ijon* and *tebasan.* The mortgage type of contract was called *gade* or *jual beli.* This type of contract can be classified as fixed leasing. All of these arrangements are of the types in which the rights to land and its produce are exchanged for cash. The cash rental is paid in advance. Therefore the arrangements consist of a series of contracts which vary according to the set of rights which are leased and the time remaining before a given harvest time.

Tebasan is the contract with the shortest duration before a given harvest. Under this arrangement a farmer sells to a *penebas* (a marketing agent) a standing crop which is within a few days of being ready for harvest. This contract system has existed for a long time. In recent years its importance as an option for harvesting rice has increased (Collier et al., 1973).

Ijon involves the land owner transferring his rights to a young crop to the lessee for payment in cash several months or several weeks prior to harvest. The lessee then assumes complete responsibility for, and the costs and risks of, growing, harvesting and selling the crop. This contract is a recognized credit transaction and characterized by borrowing cash and repaying in kind.

The *sewa* contract is the type of contract that most economists would view as leasing land for cash. With *sewa,* the right to use land rather than the right to use a specific crop which exists on the land is transferred by the land owner to the renter. The rent is normally paid in cash in advance. The agreement is usually for a number of seasons or years, and the lessee has considerable independence in his operation of the land.

It has been reported that it is not only male farmers who can involve themselves in these contracts. When questioned as to whether female farmers are allowed to make these contracts, all of the informants stated that every farmer, male or female, has the same opportunity. It is common too for a *penebas* to bargain with the farmer's wife during the negotiation of the *tebasan* contract. The explanation of this is that women are considered to have more business sense than men when it comes to making a reasonable profit and better skill in negotiating. Many males who were interviewed said that often the marketing of the rice was left to their wives.

No female *penebas* was found for rice crops. The reason for this was not known, even by female traders. Limited time as well as research resources left this matter unexplained, but it maybe a point of fruitful future research if we are to understand rural women. My speculation is that part of the work a *penebas* does is wandering from farm to farm and from village to village searching for suitable crops and this is considered improper for women. The tradition that women have always involved themselves as rice harvesters (Kolff, n. d.; Stoler, n. d; Stoler, 1977) may also explain this evidence. Besides, considerable capital is required to become a *penebas.* Even when an opportunity comes, women do not become a *penebas* (although they are traders), because this would change their position entirely, from that of harvesters, to a *penebas* who controls a band of harvesters on somebody else's land.

While the practice of *ijon* on rice land is today rarely mentioned by villagers in all the studied villages, it is sometimes still practised, not between rice-crop owners and notorious money lenders who make profit from lending money at high interest rates, but between crop owners and other farmers (not necessarily the rich) who can afford to buy their young rice crop and cover the costs and risks of growing, harvesting and selling the crop. It is not uncommon to find that female farmers call in to other female farmers' houses to sell their crops under the *ijon* system.

Fixed leasing contracts which are arranged between land owners and other resource owners are arrangements whereby both the tenant and the land owner can be either male or female farmers. Again it is not uncommon for a fixed lease contract to be negotiated between the land owner's wife and prospective female-tenant farmer, although the contract is later formalized between their husbands. In this way, the women's role in land control in the farming system is important. The same approach is also applied to *gade* system. Again, women have the right to conduct *gade* contracts either as the land owner who partially transfers her ownership under the *gade* system, and thus loses control over her land before she can repay the loan, or as the money lender who thus assumes wider control over land resources.

The new rice technology changes the nature of the crop, the cultivation of the crop and the harvesting system of the rice. It appears that the partial transfers of property through the several types of contractual arrangement described above are not affected by these changes. Most respondents stated that changes in technology for producing rice do not necessarily change the existing contract, that it offers benefits to those involved in the contract, as long as the rights and the responsibilities of each party are fulfilled. During the period when the new technology was being introduced, a number of respondents recalled that it was rather difficult to find rice crop buyers under *ijon,* because the new technology was not yet understood, nor enough skill possessed by many farmers. But this was a general problem, faced both by male and female farmers.

Many land owners noted that because of the shorter maturing time of the new HYVs which allows the rice field to be cropped three times in a year, the price of land has increased, as has the price of fixed renting and the amount of cash that a farmer wants to raise from a given plot of land under the *gade* system. For a short time, the respondents recalled that it was rather difficult to find a *penyewa* (lessee) owing to the increased capital required. Again, the problem was faced by both male and female farmers.

Share cropping arrangements

Several different types of share cropping have existed. Each type of contract has a different name in the local language and each is distinguished by the specified proportions of output which are received by the land owner and by the supplier of non-land inputs. Just as fixed leasing contracts lie on a continuum of changing rights, so too do the share contracts. At one extreme is share cropping where the tenants supply many non-land inputs including the labor for all the farming tasks. At the other extreme is the arrangement where workers supply one type of labor, for example, harvesting labor, against a claim on part of the harvested crop. The latter will be discussed in the next sub-section.

Maro is derived from a Javanese word which means to divide the produce equally into two parts. Thus *maro* contracts represent a fifty-fifty division of output. In this case there is variation in the type of inputs provided by each party to the agreement. In village J, regency B, the land owner provides land only and pays the land tax. In the other villages *maro* contracts have adapted to the introduction of the use of the HYVs, fertilizer application, and protection against pests and diseases by the application of chemicals. The land owner provides the land and pays the land tax, and shares half of the cost of the seeds, fertilizer, and pesticides. The share tenant pays half the value of seeds, fertilizer and pesticides, and is responsible for cultivation. The produce is divided equally into two parts after harvesting costs are deducted. Before the new technology was adopted, the land owner provided only the land and paid the tax. After a few seasons with the new technology, the land owners agreed to pay extra by sharing the costs of the new non-land inputs. This evidence is contrary to the views of several economists who have commented on the resistance of land owners to help pay for the extra costs (see e. g. Mosher, 1966; Sinaga, 1978).

While it was common for women farmers to share out their land, all share tenants under the *maro* system were male. The reason for this was that the cultivation tasks consist of physically demanding work such as hoeing, fixing the dykes and land preparation using bullocks.

Another class of share contracts: is that in which the workers receive between one-fourth and one-sixth of the output in return for providing some particular forms of labor. In various parts of the selected villages such contracts are known as *majeg* or *ngedok* (villages T and S), *mbajeg* (village S) and *kedokan* (village B). Among these contracts, *ngedok* in village T was rather different from the others.

With the *ngedok* contract, the worker in village T is responsible for two days of planting, two days of weeding and one day of harvesting. All of the *ngedok* workers in T are females. While one working day for transplanting and weeding is about 5 hours, during the harvesting these women extend their working hours by two or three hours. When the work is transplanting or weeding, the workers start working at about

7.00 a.m. During the harvesting, they start working as early as 4.00 in the morning, so that they can harvest as much as they can. This sytem has existed for a long time. The oldest respondent, of about 70, recalled that this has been the system for as long as she can remember.

The new technology does change the *ngedok* system a little. No changes occur for transplanting and weeding. As in traditional rice cropping, the women are fed once in the morning and no cash payment is made. During the harvesting time, the workers are allowed to have with them another helper, one worker each. In this way, in fact, the workers have the right to harvest two working days each. For traditional varieties of rice, the workers take with them a woman helper each. The traditional rice varieties are harvested by *ani-ani,* a little hand-held knife. The HYVs necessitate harvesting rice with a sickle. Because the rice is easily threshed off during the harvesting, the workers usually thresh the rice in the field, put it in bags, and carry the bags to the land owner's house. The work is heavier, but the use of sickles make the harvesting quicker. On average, the HYVs required 65–90 working days/ha., and for the traditional rice varieties an average of 180–275 working days/ha., or about three times as many. Because the work is heavier, the women workers have male workers to assist them. Certainly this has reduced the harvesting opportunities available to women. According to the women laborers, since the introduction of the HYVs they feel that the number of working days in agricultural activities has declined, especially with respect to harvesting. The sweet potato which is usually the secondary crop following the second rice crop during the year does not normally require women laborers. These women adapted themselves to non-agricultural activities such as trading and provision of services to their fellow villagers.

In village B, regency K, under the *ngedok* system, the worker is responsible for nursery labor, fixing the dykes, pulling seedlings, transplanting, weeding and harvesting on a plot of rice field which is assigned to him. The workers for *ngedok* in this village are all men. However, both male and female members of the worker's family participate in the tasks. The males perform some of the tasks, whereas transplanting, weeding and harvesting are done by the females. As a return, the worker receives one fourth of the harvested crop, which is actually a family income. Thus, although they did not have the opportunity to undertake the *ngedok* arrangement themselves and have had to rely on the men to do it for them, these women are still capable of working on the land and contributing to their household income.

In village B, regency Ma, the author found during her study in early 1978 that the *ngedok* institution in wet rice fields which used to be conducted by women laborers disappeared entirely almost at the same time as HYVs of rice began to be widely used in this village in the early 1970s. The explanation of this as stated by a number of villagers was that *ngedok* was considered expensive compared to paying laborers in cash according to the wage rate. It appeared that the new rice raised land owners' income through planting three times a year rather than the usual twice a year, and enabled them to pay the laborers with a cash wage for planting and weeding and paying a one-tenth to one-twelfth share for harvesting. The women workers were unhappy of course facing the fact that their position as share cropper was lowered to that of wage laborers. Lack of alternative employment, capital and skill appear to be the reasons why these women were willing to step down the agricultural ladder. In-depth research to find out why and to what extent women workers are affected by the new technology that forced them out from share cropping into wage laboring activities is urgently required.

The incidence of the *ngedok* system in village B was not the same in all areas of the same regency. In village S, where the *ngedok* workers were men, new technology did not affect the existence of this institution. The *ngedok* workers were responsible for cutting down and burning the straw from the last harvest, caring for the nursery, pulling seedlings, transplanting, weeding and harvesting. Their tasks are greater than those of *ngedok* workers in regency K, and yet they receive the same proportion of the harvested crop, that is one-fourth.

Questions arise from the above evidence. Why is it that men can retain the right to work on the land through *ngedok?* Why cannot women enjoy the same right? My hypothesis is that men are still considered as providers in their household and therefore work opportunities ought to be given to them. Other speculations relate to the nature of the agreement that can be handed over between generations. Many *ngedok* workers in village S could not remember how long they had these rights. It has been many years already and several mentioned that as long as they can remember their grandfathers were the holders of these rights.

Opportunity to work as hired laborers

As has been mentioned previously, transplanting, weeding, and harvesting are regarded as the women's job. Weeding and harvesting were the kind of tasks where in some areas women laborers were hit by the new technology. It is interesting to find that in several villages where this study was undertaken, the *landak* or rotary weeder is not widely used. This implement is already known in all villages, but was not popular for reasons such as hand weeding doing a better job with respect to cleanness, selective weeding, and avoiding damage of the crop root. The *landak* was only used by some farmers in village B. Approximately 25 male working days were required per ha. to complete weeding using this tool, whereas 60–100 women days were required for hand weeding. This evidence indicates that women's labor was replaced by male laborers with rotary weeders.

Many writers have mentioned that opportunities for women to work as harvest laborers have decreased owing to the adoption of the HYVs. In all villages, this trend was observed. Worst of all, in village J, regency B, the rice field was dominated by male laborers. Since the women lost access to harvesting opportunities, they sought work elsewhere. Some of them became small traders, some weaving pandanas mats, while some still sought work as agricultural laborers. Some workers mentioned increased land use intensity from one crop a year to two or more made possible by the introduction of the HYVs. Total opportunities for transplanting and weeding increased, but the complaint was that this did not compensate for the benefit from the harvesting opportunity they used to have. Several workers who were interviewed reported that usually in each planting season they worked two weeks for transplanting and about three weeks for weeding, while harvesting could be as long as a month. Yet they figured out that the return on harvesting was approximately double that on transplanting and weeding. If this was true, the women-workers' productivity decreased.

In regency Mo, village T, the informants said that harvesting with the sickle needed only approximately one-third of the harvesters previously employed using *ani-ani.* In village S, regency Ma, the respondent figured out that harvesters could be reduced to as little as one-half of the number of harvesters using the hand bladed knife, with a harvest share as payment varying from one-tenth to one-sixteenth. In village B, regency K, IR varieties began to be widely cultivated in 1981. Two or three years before this the harvesting of the newly introduced HYVs was done by sickle and most of the laborers were male harvesters. From 1981, female laborers started joining the male workers, using the sickle harvesting the rice. In 1983, it was reported that rice harvesting was dominated by women. Male workers were need only to carry bags of rice from the field to the owner's house. This evidence indicates that it takes a while for women to adjust to changes. More importantly it shows that rural laborers were able to adapt themselves to changing technology. Use of the sickle by women used to be considered as improper or 'male',[1] but pressure to survive and the threat of losing a means of livelihood encouraged these women to break common practices which have probably existed for centuries. While in this village the women harvesters could restore their position in harvesting the rice, the use of the sickle definitely reduced the number of harvesters to as little as one-third of the number of rice harvesters using the *ani-ani.*

To understand the whole strategy of how women laborers try to overcome shortages of employment in rice farming due to labor saving technology, is not possible through this field study. It is important to bear in mind that most of the women laborers were tied to their family unit. Their income was only part of the total family income that was earned by other family members, especially the male who was still regarded as the family provider. Many landless families hold multiple jobs. In the village of B, regency K, for instance, from the landless laborer families who were interviewed, it can be inferred that both the husband and the wife had other jobs outside agriculture. The women worked outside agriculture selling their labor as small traders, helping other women during birth, assisting tailors, house-maids, hand crafting (basket making), cigarette factory laborers and building laborers. Their husbands had extra jobs as builders' laborers, brick makers and basket makers. In village S, regency Ma, many women of landless households revealed that they also worked as traders, including vegetable peddlers, buying and selling second-hand goods, food sellers and developing a stall at home. The husbands sought extra jobs as carpenters, pedicab drivers, house-maintenance workers, factory workers, buying and selling second-hand goods, and working in labor intensive projects in the sub-district.

This decrease in the work opportunities for women at the village level is serious, yet if Durand and Sinha's (Ware, 1981) hypothesis that 'women's participation falls in the early stages of economic development to rise again at a later stage' (p. 216) is correct, then it must be an indication of economic development.

Conclusion

A field study has been undertaken in several villages of East Java to study the impact of the introduction of new technology on women's access to land resources. Traditionally women could own land privately. They could also partially transfer the rights on privately owned land, as well as being the recipients of the partial transfer of rights on privately owned land. As in many parts of Java, women have for a long time had access to employment on the farm as agricultural laborers.

The new rice technology in East Java resulted in some changes. It has been found that introduction of the new technology has not changed women's rights with respect to privately owned land. The technology has however, changed some of the rights characterized by partially transferred private property, such as share cropping. Others which are classified as fixed rent have not been affected. There is evidence that as a result of the introduction of new rice technology women have been deprived of the opportunity to perform certain tasks both during the pre-harvest of the crop and at harvest time.

Researchable questions are whether the incidence as concluded in the above has altered over time in the studied villages and whether the incidence in other areas in East Java is different from that observed here. The existence of job segregation on the basis of sex due to the new technology is an intriguing matter for further research.

Notes

1 This explanation may partly explain Schiller's (1978) comment which questions why it is that men and not women use implements such as rotary weeders and sickles.

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11 Women's role in the improvement of rice farming systems in coastal swamplands *

Greta A. Watson

Summary

Women assume a major role in rice cultivation and associated farm management in traditional agriculture. Rice farming systems in tidal and coastal swamp areas demand specific methods of labor intensive cultivation in which women's participation is still of paramount importance. These include seedbed preparation, transplanting, harvesting and processing of rice, vegetable and other secondary crop cultivation, fishing, animal husbandry and household management including child care.

This paper examines indigenous rice farming systems in tidal swamp areas of Kalimantan, Indonesia and women's role in their improvement. Present methods and future prospects for rice cultivation within multi-crop systems are analyzed. Possible effects of changes in labor and technology are discussed in relation to women's roles. Extension

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training in rice cultivation, secondary crop production and marketing is essential. Women's credit and labor cooperatives are advisable.

Introduction

Tidal and other coastal swamps have only recently been recognized as regions with potential for agricultural development. The role of women in improved systems of cultivation and management is uncertain.

Equitable incorporation of women into improved farming systems for tidal swamps demands an analysis of swampy farming systems and women's present role in them, an evaluation of new or improved technologies with attention to potential impacts on female allocation of labor, decision-making and control of production, and the effort to insure participation of women in training programs, including areas of access to credit, tools and technology.

These parameters for female participation in farming systems development are easy to list and difficult to obtain. Literature on traditional systems of coastal resource management is scarce. Research on improved rice and vegetable cropping in these regions has just begun. There is virtually no literature on women's participation in the tidal or tidally influenced swamp agriculture.

This paper focuses on coastal swamp farming systems of Indonesia. Women's participation in these systems is analyzed for labor. It contains an outline of tidal and inland coastal swamp environments, and their potential for agriculture. Settlement patterns along tidal waterways are described. General methods of rice cultivation are enumerated for the tidal/coastal zones of Kalimantan. Tree, vegetable and fruit crop production, fisheries and home industries of rice farming systems are assayed. Women's role is examined within the context of traditional 'tidal' rice farming systems in South and Central Kalimantan. Changes within the female labor force will occur with rice or secondary crop improvements. The impact of new cropping systems on women's livelihood and control of resources and women's role in the future development of coastal zone whole farm management is discussed.

Tidal and swampy coastal plains

What is commonly called a 'tidal swamp' is usually a composite of fresh and saline environments. A tidal swamp is a coastal wetland region which is directly affected by saline or brackish water tides on a daily or diurnal basis. These swamplands may undergo tidal inundation through all or part of the year. Tidally influenced swamps are freshwater swamps which experience fluctuations in water level as a response to tidal patterns. Other coastal swamps may undergo no observable tidal influence but are inland regions of deltaic plains which once were part of a tidal swamp. These areas experience flooding when rainfall is heavy and this water is backed up by tidal inflow. Coastal swamplands may also become dry and parched during the dry season.

In tropical areas, coastal swamplands are comprised of a number of environments. Mangrove swamps, peat swamps and other inland swamps predominate. All of these present diverse soil, water, climatic and floral conditions. These environments are fragile, and management strategies for resource preservation and use must be accordingly developed. Where agriculture is feasible, it must either be adjusted to these physical and biological factors or the prevailing environmental conditions must be changed to accommodate farming.

Coastal swamp regions are considered to be secondary regions for agriculture because of their environmental and economic constraints to development. In mangrove swamps brackish water inflow can be problematic through all or part of the year. Where tide fluctuation is great, crops can be submerged or affected for long periods. However, tidal inundation can also transport silt to levee areas, increasing soil fertility for agriculture. Peat swamps have low natural fertility, are generally acid, and under natural conditions are waterlogged and provide a poor substrate for crop roots. As with other inland mineral soil swamps of coastal areas, unanticipated seasonal flooding is common; flash fires in the dry season also occur. Acid sulfate or potential acid sulfate soils can occur in any of these environments as a surface or subsoil; this release of toxic elements can substantially reduce yields.

Rice farming systems in coastal swamplands

Although tidal and other coastal swamplands are secondary regions for agricultural development, indigenous occupation and spontaneous migration to these areas has occurred for generations. Voluntary expansion into these regions generally occurs with the decrease in more fertile, arable uplands and with diversification of farming systems to include swampland crops and fishing areas. Initial habitation may be either on a seasonal or permanent basis.

In all rice farming systems in swampy coastal areas farmers must both adjust to and modify their habitat. Most types of cultivation in these regions involve the control of water for drainage. Only limited tidally influenced areas use no water control. Drainage usually involves the deepening and lengthening of small feeder rivers and the creation of canals which lead from inland areas into major waterways. Secondary or tertiary drainage systems are common. Drainage of swampy areas exposes soil or reduces water level to enable cultivation. The use of bunds or flapgates helps to retain or maintain constant water levels. Other methods of water control such as extensive diking or polderization require high capital input and highly organized labor. This is only possible through government aid and is financially unfeasible for many areas in developing countries.

Demographic maps promote the idea that coastal swamplands are sparsely settled in relation to their area. Most populations, however, tend to settle along river levees or adjacent to waterways. Populations are often dense in these environments while inland habitation is relatively sparse. Permanent settlements also tend to spread from areas which are rarely or only intermittently inundated with brackish water to more saline regions. This is reasonable considering the need for drinking and bathing water, the fact that most crops are intolerant of high salty conditions, and the increasing amplitude of tides near seas or oceans.

Land ownership and inheritance vary among ethnic groups, and may be based on traditional rights, religious dictates or government decree. In most coastal swamps hereditary use right is the norm, while title to land is a recent innovation. Increase in populations and the expansion of roads has prompted further settlement and title ownership of land.

On the whole, rice production in coastal swampland is primarily for home consumption. Yields are low and income is usually supplemented from secondary and tree crops or fishing.

Coastal rice farming systems in Kalimantan, Indonesia

The swampy lowland coasts of Central and South Kalimantan, Indonesian Borneo, have been settled for generations by Banjarese, Dayak and Buginese ethnic groups. In the 19th and early 20th century, these groups seasonally migrated to the tidal regions to fish and cultivate coconut groves. Rice farming systems today involve the incorporation of tall, strong-rooted, tidally resilient Indica varieties in less saline upriver or inland, tidally influenced areas. One crop is grown a year on these clay, silt or peaty soils (see Figure 11.1). Production is enough for subsistence and minor sales. Double cropping has been introduced but is presently applicable only within a limited region.

Except on river levees and higher ground, coastal swamp soils must generally be deeply canalized and row mounded to support crops other than rice or pineapple. This modification may involve peat subsidence and compaction, release of elements through burning and mulching,

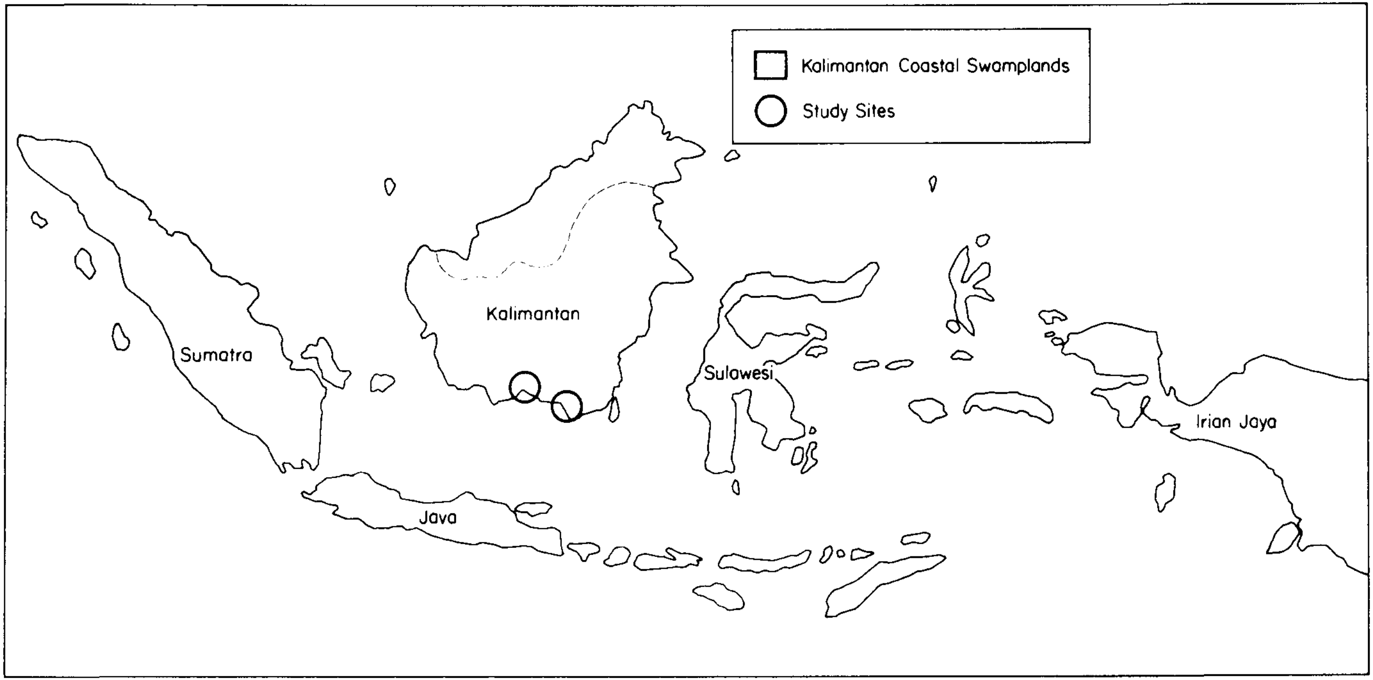

Figure 11.1 : Map of Indonesia

reduction of acidity through leaching and aeration, and submergence of soils within the annual cycle and through mounding.

Other aspects of farming systems vary. Coconut is the major food cash crop of the Kalimantan coast and is exported to Java. Bananas and citrus are also prominent. Fish and shrimp are exported as far as Japan.

Land inheritance varies according to custom, religion and government decree. There are still vast areas of unclaimed swampland. Farmers can lay claim to forested land as soon as they open and plant it by reporting to the village head and county office. Titles to land can take years to process. In many areas land which is not farmed for three years may be claimed by a new owner.

Only titled land can be bought *per se,* but perpetual rights to cleared land or its tree products is frequent. Customary inheritance follows Moslem law: women receive one portion of land and men two. Women can own land, but farms that are jointly owned by a family are registered in the man's name.

Rice cultivation in higher tidal areas

These areas are under tidal influence and cleared of original mangrove vegetation. Soils are alluvial. In the dry season there is often brackish water inundation. During the rice growing period in the rainy season, water levels fluctuate with the tides, often rising and falling a metre or more a day. One rice crop is harvested each year. Land can be claimed, bought or borrowed; sharecropping or tenancy arrangements are uncommon. Later maturing varieties of 8-12 months are commonly used. Seedlings are transplanted 2 or 3 times to increase their height so that they can withstand tidal inundation. Plants are from 1½ to 2 metres tall. There is no soil tillage. Weeds are cut down, composted and spread on soil as green manure prior to final rice planting. Inorganic fertilizer and insecticides are rarely used. Weeding is uncommon since the tall spreading plants shade out all but the most persistent weeds. Most fertilization is obtained from siltation. Rice matures unevenly and must be harvested with a hand knife. Family labor predominates. Communal and imported wage labor is often used. Threshing is done by foot while winnowing uses wind to separate grains from chaff. Rice yields are high for coastal areas, ranging from 2 to 3 tons of unhusked padi per hectare.

Rice cultivation in tidally influenced and inland coastal plains

These areas undergo little or no fluctuation in water level in response to tidal cycles. Prolonged flooding often occurs. At these times water in fields frequently reaches depths of a metre. Brackish water rarely inundates fields during the growing season. Soils may be alluvial or peaty. Rice growing sites are metamorphosed *galam* or freshwater swamp forest sites. Land is canalized and drained. One crop is grown and is final planted during the rainy season. Rice varieties mature in 5 to 11 months; the taller tidal types are still planted in poorly drained areas, while shorter, earlier maturing varieties are planted on well drained soils. Seedlings may be direct seeded or transplanted up to two times depending on flooding patterns, rice variety and terrain. Peaty soils are usually burned to promote compaction so that rice plants root well, and to provide fertilizer. Green manuring occurs but is not ubiquitous. Other fertilization or pest control is scarce. Rodenticides are commonly but inefficiently used. There is no soil tillage. Family labor is most important. Communal and wage labor are frequent at planting and harvest times. Rice matures unevenly, is harvested with a hand knife and is threshed by foot. Yields are low and generally vary from 3/4 tons/ha. to 2.0 tons/ha.

Double cropping

Double cropping has been introduced in South Kalimantan. A first crop of a modern variety is succeeded by a traditional rice. MV rice is planted in a farmer's field. During this time a traditional rice crop is transplanted from seedling beds to field borders. When the high yielding variety is harvested, the rice straw is cut down and the traditional rice immediately planted in the same field. The TV is harvested 4 to 7 months later. Some transmigration sites in Central Kalimantan also practice double cropping.

Rice sale

Rice production barely covers the subsistence needs of the ordinary farmer. Some rice is always sold at harvest time to pay back debts, buy upland food produce, or buy cloth or gold (for savings). A low rice yield can cause farmers to experience rice shortages months before their next rice harvest. Rice is owned and managed by the household, but male heads generally make final decisions on sales.

Other aspects of farming systems

Multiple cropping makes use of humanly modified soil and water regimes. In Kalimantan the cropping scheme is successional; mounds are built up in rice fields. Coconut is the major tree crop. Other tree crops include banana, mango, papaya, citrus, jackfruit and rambutan. Taro, yam, sweet potato, and cassava are major root crops. Production of cucumber, squashes, eggplant, long bean and watermelon is high. Ginger, laos, lemon grass, and leaf spices are planted. Planting patterns are successional and are influenced by shading, soil hardness, changing pest populations and water conditions.

Other income producing farm activities include fishing, in inland swamps, drainage ditches, rivers, and along seacoasts. Chicken and ducks are reared for eggs and meat. Home industry includes production of fishing equipment, baskets, mats and thatch roofing or siding. Local forest or swamp products are collected; these include rattan, bamboo, nipah or sago palm leaves, resins and wood. Hunting occurs in isolated areas.

Off-farm labor; wage and 'in-kind' labor agreements

Both women and men, including families, often make seasonal trips to upriver areas to help in rice planting or harvest. This labor sometimes involves a reciprocal arrangement between households. A few men work in sawmills and coconut oil factories, but most off-farm labor involves ditching and harvesting of coconut; women's off-farm employment predominantly involves food crop marketing, excluding rice or coconut. In this case, proceeds generally accrue to the women.

Women's role in coastal swamp rice farming systems

In coastal swamplands in Kalimantan, women are actively involved in all aspects of agriculture and many auxiliary activities in farming systems. Tasks which require upper torso strength have less female participation (also see Deere 1977). For other jobs which require stamina and an intricate knowledge of cultivation techniques and farm management, women play an important role. This work includes labor in rice and less important cash crops, crop cultivation from seedbeds to harvest, and subsequent marketing. Rice is the major crop.

Women's participation in rice cultivation

The data for this study was collected from 60 farming households in Semuda Kecil village, Central Kalimantan, Indonesia. Households cultivate tidally influenced and inland peat areas. All family members aged 13 and over were considered to be able to join fully in rice agriculture. Results are illustrated in Tables 11.1 and 11.2. Table 11.1 breaks down female and male participation within the household. Table 11.2 addresses communal, wage and child labor.

Table 11.1 Women's participation in coastal swampland rice cultivation in Semuda Kecil, Central Kalimantan, Indonesia, 1981-82.

	Hoeing/ Ditching	Slashing Weeds	Preparation of Seedbeds	Transplanting	Planting	Weeding	Harvesting	Threshing	Winnowing
Women, Age ≥ 13 Years Participating in Activity	1	19	73	67	78	66	83	42	51
Men, Age ≥ 13 Years Participating in Activity	52	68	71	64	76	67	77	71	68
Percentage of Activities performed by Women	2	22	51	51	51	50	52	37	43
Percentage of Total Female Work Force	1	18	70	64	74	63	80	40	48

Survey Sample Size = 60 households
Total Survey Population = 351
Total Family Members Age ≥ 13 Females = 105, Males = 94.

Table 11.2 Communal hired wage and children's labor utilization for coastal swampland rice cultivation. Household enumeration. Semuda Kecil, Central Kalimantan, Indonesia. 1981–82.

	Total Households Participating from 60	Hoeing/ Ditching in Rice Fields	Slashing Weeds	Preparing Seedbeds	Transplanting	Planting	Weeding	Harvesting	Threshing	Winnowing
Exchange and Communal Labor	29 48%	–	5 8%	–	1 < 2%	5 8%	2 3%	18 30%	15 25%	4 7%
Hired Wage Labor	28 41%	–	21 (male) 45%	–	–	8 (female) 13%	2 (female) 3%	10 (mixed) 17%	1 (female) < 2%	–
Households with Children 7–12 years Participating	27 45%	–	1 2%	8 13%	10 17%	14 23%	6 10%	16 21%	7 12%	3 5%

Survey Sample Size = 60 households

Women participate in all major aspects of rice cultivation. Labor is highest during the growing cycle of the crop; women constitute at least 50 per cent of the work force. Only in land preparation for agriculture do women assume a less dominant role.

Hoeing and canalizing swampy soils is backbreaking work. Hoeing is carried out in order to smooth uneven terrain. Ditching shallow canals in rice fields allows for runoff of flood waters. These are ‘men’s jobs’. Few women undertake them; when they do, they average only 50 per cent of men’s productivity in performance. Only one woman in the survey carried out this task. Hired labor is often used.

Slashing weedy regrowth in rice fields prior to planting is also a strenuous job. Long-handled scythes or machetes are used. Hired labor is commonly employed. Like hoeing or ditching, this activity demands upper torso strength. However, this activity is essential to rice farming, whereas rice can be grown without hoeing or ditching. Slashing is always the preliminary task to rice farming. In poorer households which cannot afford hired labor for clearing, women often participate in this task. 22 per cent of the household labor force for slashing weeds is female.

Rice cultivation and harvest have the greatest amount of female participation. In all of these activities women represent over 50 per cent of the labor force within households. The tasks of planting and harvesting are the most time consuming part of labor. A full 74 per cent of women 13 or over join in planting and 80 per cent in harvesting, while seedbed preparation, transplanting and weeding consume 70 per cent, 64 per cent and 63 per cent of the female labor force. Ancillary activities in the rice field include cooking meals and fishing, tending vegetable or root crop plots and caring for children.

Post-harvest processing is recorded for threshing and winnowing. 37 per cent of the female survey population joined in threshing rice and 43 per cent at winnowing. There are various methods for winnowing, and women usually practice those that require less lifting strength.

Hulling, once performed by women, is now almost exclusively done by machine. Most women interviewed considered hand pounding tedious and time-consuming, and considered the 10 per cent tariff collected for hulling by machine worth the price. Rice flour is still pounded by hand in most cases.

Considering the time and effort involved in childcare and household and other whole farm activities, women contribute substantially to rice production in coastal swamplands. Table 11.1 does not include female labor involved in meal preparation or transport of rice and tools to and from the field. Women have a major role in both these areas, too. Women generally work in husband-wife teams.

Secondary crop cultivation relies on the expertise of women. Vegetable and root crops excluding cassava are almost exclusively women's domain in coastal swamp agriculture. Vegetable crops are planted at the end of or directly prior to the beginning of the rainy season to avoid risks of flood and drought. This also reduces conflict in labor use, since most vegetable cropping does not interfere with work in rice cropping. Cultivation occurs both in backyard gardens and on mounds in fields. Females prepare tree seedlings from cuttings, grafts and seeds, and participate in the fruit harvest, except for that of banana and coconut. Weeding and ditching of tree crops are primarily men's activities. Post-harvest production of copra, coconut oil and cassava chips is largely women's role. In-village marketing is the almost exclusive domain of women, who control and manage these funds. A large percentage of these are weekly and permanent market merchants.

Table 11.3 shows some of the results of a survey conducted to assay edible plant cultivation (coconuts and rice were not included). These lists included only 92 named crop varieties or species out of a probable 300 or more. Varietal types of taro, sweet potato, cassava and banana were reviewed. Households were encouraged to enumerate additional crops if possible.

The average household grew 40.5 species, predominantly vegetable, spice and fruit crops. If food crop varietal types were also counted this would exceed 50. One female informant (not included on the survey) enumerated over 200 edible plants which she cultivated or gathered. Other women informants helped to list over thirty varieties of banana, together with data on its cultivation in particular environments and the differential use of each variety for marketing, cooking and leaf quality.

In a more recent survey in four villages of South and Central Kalimantan, women's groups were interviewed with regard to within-village and market sale of their crops. Table 11.4 compares major food crops sold in each coastal swamp village. These villages vary in the type and amount of vegetables marketed. Much of this variation may be due to the length of establishment and ethnic group inhabiting a particular village. The oldest village, Lupak Dalam has been seasonally populated for at least 150 years, and permanently populated for the last 40 by spontaneous local Banjar migrants. Purwosari I is a government-settled Javanese village established by the Dutch in 1936. Tamban Raya was settled in 1956 by local Banjarese settlers after the Indonesian government opened a transport canal through the area. The most recently established government transmigration site, Tamban Lupak was opened in 1977 to Javanese settlers.

Intra-village sales are generally for only small quantities of a crop.

Table 11.3 Vegetable, fruit and root crop survey, Semuda Kecil, Central Kalimantan, Indonesia. 1981–82.

	Vegetables	Taro	Sweet Potato	Cassava	Spices	Fruits	Bananas Major Var.	Bananas Other Var.
Number of Cultigens Listed on Survey	22	6	3	3	12	41	5	(household enumeration)
Range of Cultigens Listed per Household*	1–24	0–6	0–3	0–3	3–12	2–44	1–5	0–17
Mean Number ($\bar{X}$) Cultigens per Household	9.7	2.9	0.7	1.3	6.3	21.0	4.3	5.4
Standard Deviation(s)	4.4	2.0	1.2	0.9	1.8	7.0	1.0	4.0

Survey sample size = 60 households.

* Number of cultigens grown may exceed total cultigens originally listed in survey. Households were encouraged to enumerate other species.
Mean number cultigen species (not varieties) grown per household, ($\bar{X}$) = 40.5 standard deviation = 11.8
Percent households selling bananas = 70%
Percent households selling coffee = 58%.

Table 11.4 Major vegetable, fruit and root crops marketed by women in South and Central Kalimantan (women's group interviews May 1983).

Crop Type	South Kalimantan		Central Kalimantan	
	Purwosari I	Tamban Raya	Tamban Lupak	Lupak Dalam
Vegetables				
Eggplant	X	X		X
Cucumber	X	x		X
Yellow squash	x	x		X
White squash	x			X
Corn	x		X	X
Loofa	x	x	X	X
Long beans	x	x		X
Cassava leaves	x	x	X	x
Sweet cup	x	x		X
Amaranth				X
Bitter cucumber				X
Celery leaf		X		x
Water spinach		X		x
Chilies		X		X
Soybean			X	
Spices				
Ginger	X	X		X
Laos *(Alpina galanga)*	X	X		X
Kunyit *(curcuma domestica)*	X	X		X
Kancur *(Kaempferia galanga)*	X	X		x
Temu (*Curcuma* spp)		X	x	
Lemon grass	X			X
Major Root Crops				
Cassava			X	
Taro				
Colocasia esc.			x	X
Xanthosoma				X
Sweet potato or Yam			x	X
Fruit Crops				
Banana var.	X	X		X
Pineapple	X	X		X
Citrus spp.	X	X	x	X
Mango spp.	x	X	x	X
Jackfruit	X	X		x
Soursop	X	X		X
Water apple spp.	x	x		X
Star fruit	x			X
Kasturi		x		X
Papaya	x	x		X
Guava	x			X
Watermelon				X
Rambutan	X	X		
Coffee	x	X		

X = frequently sold in weekly or permanent workers
x = frequently sold within village

However, many women sell a wide variety of vegetables, fruits and spices within their villages on an irregular basis to neighbors or intermediary buyers. Squashes, cucumbers and eggplants are major vetetable crops. Mangoes, rambutans and other small fruits are marketed in season. Spices are grown all year round but are usually harvested only once or twice a year. Coffee is irregularly sold. Larger quantities of food crops are sold through weekly or permanent markets of larger towns. Women entrepreneurs generally specialize in vegetables, spices and small fruits. One woman explained that she derived US $100 (approximately 30 months wages) from the sale of root spices.

Fishing

Since settlements are located on waterways and frequently include major tracts of inland swamps, fish and shrimp are predictably an important part of the diet. Sea fishing and fishing along major rivers with trawls and nets are men's tasks. Women obtain fish and shrimp for consumption and sale from canals, rice fields and swampy depressions, mainly using poles, baskets and traps. Fish pond culture is occasionally practiced.

Animal husbandry

The number of chickens and ducks that are tended varies from household to household and throughout the year. Except in cases of large flocks which require household effort, women generally manage and control the care and feeding and sale of these fowls. Birds both provide eggs and act as 'walking investments' since the price of meat is high, and birds can be sold as necessity demands.

Home industries

Women commonly weave mats, baskets, fans, sun hats and thatch palm siding and roofing which are sold to nearby markets. One village in Central Kalimantan shipped thatch siding as far as Java. Cooked goods such as cakes or rice dishes may be hawked from door to door. In regions further from oil processing plants, women process, bottle and sell coconut oil.

Off-farm labor

Off-farm labor for women farmers is carried out mainly in the areas of peddling, marketing and reciprocal planting and harvesting arrangements with other villages. It is difficult to assess returns to much of women's local labor. Many products are traded and sold in small quantities on an irregular basis and rarely enter the market economy.

Women's role in the improvement of coastal swamp rice farming systems

The improvement of coastal swamp rice farming systems involves the integrated resource management of the total system with an emphasis on increasing rice production. Projects which focus on increasing food production through coastal agriculture improvement must attend to changes in the division of labor which occur with the implementation of new technologies. In past agricultural development, these effects have not always been positive for women. This has often resulted in decreased female participation in control of capital, loss of individual income and autonomy (Cloud and Overholt, 1982; Castillo 1977; Whyte and Whyte 1982).

There has been little attention directed toward women's participation in Indonesian policy planning for coastal swamp rice improvement. Technical assistance, farming inputs and credit systems for intensified single and double cropping have been organized within male groups of farmers. These include projects both for indigenously settled areas and transmigration sites.

As has been illustrated for Central and South Kalimantan, women's role in all aspects of coastal farming systems has been substantial. However, with the prevailing attitude that men as 'heads-of-households' are the logical recipients of extension services, it is likely that women's management capacities will decrease. Exclusion of women from decision-making for choice of rice seed, and the use of technological inputs will reduce the capability of the total farming community. The repercussions will be especially severe in households headed by women and predominantly female households, where adult male members pursue fishing, forestry or trading as their major occupation.

Impacts of rice improvement programs on labor

In Indonesian tidal, tidally influenced and inland swamp regions, the impact of new rice technologies on labor is still minimal. Rice seed varieties which have been introduced (IR 5, 36, 42) are adaptable to a limited region of coastal swamps where there is little risk of brackish water inundation and where peats are shallow (Collier et al. 1981). In farming villages surveyed in South and Central Kalimantan, double cropping of rice using a modern variety as a first crop was implemented on 0–10 per cent of the rice field, and yields were low. Females concurred that their labor increased, but that return to labor was low because of lack of pest control and inability of rices to withstand environmental problems.

If improved rice varieties are to be introduced to increase production these must be tailored to specific microenvironments. Characteristics which will increase rice production include earlier maturity (4 or 5 months), elongation ability or submergence tolerance, reduced susceptibility to pests and disease, salinity or acidity tolerance, even maturing of panicles and reduced shattering. Rice will be planted direct from seedling beds. Erect-leaved, moderately tall (125–135 cm) types will both be able to withstand higher water tables and help to suppress weed regrowth. New varieties can increase yields to 3.0 tons/ha., but stable and sustainable yields are not possible without additional land preparation and maintenance, and inputs of fertilizer and pesticides.

Modifications in new rice technologies will affect labor in the following areas.

Substitution of tools and techniques

New rice varieties may incorporate characteristics which demand substitution or change in labor, agricultural tools and work techniques. Present harvesting is done with the hand held finger knife, which is used to harvest only ripened panicles of the unevenly maturing, shatter-proof traditional rice variety. Women provide a slight majority of the labor force in this area. The introduction of evenly maturing, non-shattering varieties is associated with harvesting using the sickle. In other parts of Indonesia sickle harvesting has become almost exclusively a male task (Collier et al. 1973). Foot threshing of easily shattered traditional rices will almost certainly be replaced by beating or machine threshing. Small scale technology such as weeders may also be incorporated, and access to the credit for and use of this technology is at present uncertain.

Extensification

Modern rice varieties with tolerance to adverse soil and water conditions of coastal swamps will be employed together with the improved physical parameters derived from better drainage and irrigation systems. This will allow rice cultivation to expand into swampy areas, and open new regions to settlement. Continued increases in population in proximity to longer-established farmers can supply wage labor to those areas. While it is expected that slashing will continue to be a source of male labor, and planting, weeding and harvesting all are predominantly female, both sexes are able to carry out these tasks, and future wage labor patterns are therefore unclear.

Intensification

For improved rice farming intensification of labor includes the absolute increase of labor per hectare together with the concentration of work loads during specific periods. The intensification of labor utilization can promote increased use of hired labor in relation to household labor (Smith and Gascon 1979). In many areas women have equal abilities to participate as wage labor as men do. These areas include weeding, planting, crop fertilization and protection, winnowing and marketing of rice. If rice cropping intensification does promote the increase of hired labor in coastal swamps, there is every reason to assume women's work cooperatives can be formed to insure their continued participation.

Diversification

Inputs and technology involved in fertilization, weeding and plant protection will diversify tasks within rice agriculture. With sufficient incorporation into extension program training and credit systems, women's benefit from participation in these areas is likely.

Women's role in other areas of rice farming systems

Continued problems in the stability and sustainability of rice yields are not likely to be overcome immediately. In Indonesia, a continued reliance on coconut export and secondary food crop production is foreseen. At present, government sponsored programs in coconut, clove and cashew have met with limited success, since methods to cultivate these crops in tidal swamps have been insufficiently developed. Government programs for coconut have succeeded best where they mimic indigenous cultivation. These programs have been directed toward men who, however, are almost exclusively the coconut cultivators.

Aside from rice, women's contribution to multiple cropping systems is obviously in the area of vegetable, spice, root and minor fruit tree crops cultivation. As far as is known, there is no study which completely enumerates these crop varieties, characteristics and cultivation or measures their production, consumption and sale. There is also no present plan to promote production and marketing of crops other than legumes, cassava and corn. In the past, extension work for these latter crops has been afforded to men.

Chicken and duck breeding and aquaculture projects are presently in the planning stage for coastal zones.

Suggestions for future planning

The role of women in the improvement of rice farming systems of coastal swamplands ultimately depends on their integration into the areas of agricultural decision-making and control of income derived from production as much as their absolute participation in agricultural tasks. Equity for women should apply both within the household and among households so that poorer rural women can derive benefits as well as richer ones. Attention should be directed not only to the amount of work women receive but its quality and prospects as an income generating activity. This depends on the efforts of government planning through policy makers and extension workers to include women in development programs. In general, policy must meet the following criteria: (1) initial assessment of women's present role in farming systems, (2) involvement of women into project decision-making from surveys through project design and implementation, (3) inclusion of a female component in extension projects which affords them direct access to project benefits including credit and inputs, (4) periodic evaluation to insure continuing benefit to women's social and economic status, and (5) publication and/or dissemination of information to all parties concerned with this area of agricultural development, including feedback to women farmers themselves.

Using these guidelines to project development, the following suggestions are made to improve major women's roles in rice farming systems of coastal swamps.

Women's labor cooperatives within rice agriculture

Reciprocal planting and harvesting arrangements with both wage labor and 'in kind' payments of cash or rice are already in effect in coastal swamp agriculture. The formalization or creation of women's co-operative groups for intensified rice cultivation would help to preserve and extend predominance in tasks such as seeding, planting, weeding and crop care and protection, and guarantee a continued source of income which is received and allocated by women. These cooperatives could operate on intra and inter-village levels.

Increased use of female extension workers in all areas of farming systems production and directed encouragement of women's participation in rice improvement programs in coastal swamplands

Training must be adjusted to women's ability to participate since constraints such as male avoidance patterns, household labor or seasonality of labor may prohibit attendance (Whyte and Whyte 1982). Access to credit and inputs on an individual rather than a household basis can provide women with greater control of the products of their work. In the swampy areas, widespread projects for rice improvement are only beginning to be implemented. Immediate attention to the above areas is advised.

Vegetable, spice, root and minor tree crop production programs for women

Coastal swamps have great potential for the export of vegetable and other secondary food crops. Varieties and cultivation patterns need to be investigated. Women are the principla cultivators of these crops and are involved in processing and marketing. Nutrition of children is also related to home production. Secondary crop production programs should be implemented to promote continued participation and market expansion.

Coastal swamplands are environmentally complex and problematic regions. Information on local agricultural practices for these areas is incomplete. Virtually no attention has been paid to women's role in farming systems. The organization of female labor and development programs such as the above will insure that women's role in the improvement of rice farming systems in this region is an important one.

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12 Women in rice farming systems in Bangladesh and how technology programs can reach them

Tahrunnesa Abdullah

Introduction

Bangladesh with its high radiant energy, fertile land, suitable temperature for year round crop production and abundance of labor could produce crop yields equal to or higher than those of most Asian countries. Yet in the 1960s and the 1970s food grain output increased only by 1.5 per cent compared with an annual population growth rate of 2.5 to 3 per cent (BADC, 1981).

The major crop grown in Bangladesh is rice. Rice covers 80 per cent of the total cropped areas, some 25 million acres (Ahsan and Huque, 1975) and is the only source of cash income for many farmers. Yet Bangladesh has not been self sufficient in rice for many years. It currently imports large quantities of food grains. It produces only 12.6 million tons of clean rice for its 90 million people. This leaves a food deficit of 2 million tons which is currently met by imports. By the year 2000, the population unless checked may nearly double to around 140 million. This will require 27 million tons of food grains (BADC, 1981).

It is generally estimated that 60 per cent to 80 per cent of rice is consumed by its producers. The rest is sent to the commercial market by surplus farmers for profit, by poor farmers who need cash more urgently than rice and by farmers who ‘trade’ it to supply their other needs. If possible farmers keep aside what is needed for the family and sell only if there is excess. Rice is the people’s main food and major source of energy.

For the most part, families cannot feed themselves from the land. Predominance of subsistence family farming and heavy pressure of population on land have led to a shrinking land-man ratio. The ratio has declined to 0.29 acre in 1979–80 from 0.40 acre in 1960–61 (BADC, 1981). Land ownership and land tenure patterns have acted as a disincentive to the adoption of modern technology. According to the Land Occupancy Survey of 1978, 29 per cent of rural households owned no land other than homestead; 33 per cent owned less than one acre but 3 per cent of households having 5 acres and above owned 25 per cent of the cultivated acreage. Besides, 23 per cent of the cultivated land is under share cropping. Only 16 per cent of cropped acreage is farmed with modern inputs such as high yielding variety rice, chemical fertilizer, insecticide and mechanized irrigation. The rest is basically rainfed and is farmed by traditional patterns of cultivation, using either manual or bullock power and implements such as plough, yoke and harrow. Labor requirements are intensive, but seasonal. The majority of small farmers do not have access to institutional credit to invest in modern agriculture. The bureaucratic deficiencies also create problems for agricultural development.

Women in rice production and technology used by women

Although rural women traditionally do not go to the fields where rice is growing, they play key roles in certain aspects of rice production whether as homeworkers or laborers.

Seed germination is the responsibility of rural women to test the seed, which they have stored, for germination quality before men take it to the fields to sow. Several days before it is time to sow, they take several samples of each variety of seed that is needed from the storage containers where they have distributed them (so that if one container suffers severe spoilage the whole amount of that variety will not have been lost), soak them for a while and then spread them on straw to see which sample is germinating the best – if one sample indicates severe spoilage as far as seed use is concerned, then the whole container is converted to food use. From the containers that produce good germination, women take the amount of the kind of seed required for each plot and prepare it for sowing, again by soaking for the requisite amount of time (which varies according to seed variety), straining the water and spreading the seeds on layers of straw or banana leaves for

24 to 36 hours until the seeds split and are ready to be sown (Abdullah, 1982).

The most concentrated and busiest work for women in rice production occurs when the rice is harvested and brought into the homestead. The steps involved in converting paddy to edible rice include preparing the courtyard with a fresh layer of mud and cow dung so that sand and dirt will not get into the rice; supervising the threshing of paddy by bullocks, draying the straw for cattle food; winnowing and sieving several times; parboiling and usually soaking; drying; husking; supervision of storage; and periodic redrying. The seed stock, chosen by men, requires special processing, especially as regards drying, and special storage procedures. The post harvest technologies of rice processing at farm level are mostly traditional. The labor requirement of post harvest processing of paddy is between 41 per cent to 49 per cent of the total man-days required for its cultivation (Ahmed, 1981) and about one fourth of all agricultural employment. The technology and equipments used by the women during different stages of rice processing are illustrated here.

Threshing

The actual threshing is carried out by men who usually use bullocks to trample the grain. The straw and grain are then separated both by men and women by a riddle.

Soaking

Women have to decide whether paddy should be soaked before parboiling and if so for how long. Paddy is soaked in metal vessels or earthenware pots reserved for this purpose or in multipurpose domestic vessels. As reported by Harriss (1979) soaking hours range from 36 hours in wet weather down to 10–14 hours.

Parboiling

Paddy is placed in batches varying from 2 lbs to 40 lbs. into aluminium, iron or mud vessels. The precise methods of parboiling as described by Von Harder (1975) show four different practices in one village in Comilla. The vessels are filled with water and grain and a straw lining is given at the base of the vessel to protect the paddy from burning. Paddy is then boiled and cooked on a mud stove or *chula* for about 30 minutes in cases when it has been soaked for 24 hours, and for up to 3 hours where it has been soaked for a shorter period. Women can tell by the smell of paddy, by how much it rises and how it splits, whether the parboiling is complete. Generally one household in a day can parboil 160 to 200 Ibs. on a batch basis. High yielding varieties often require double parboiling (Von Harder, 1975). Parboiled paddy facilitates easy milling and absorption of proteins, vitamins and minerals, reduces the amount of broken rice, stores better and the bran from parboiled rice contains approximately 15–30 per cent of oil and is used as food for animals and poultry.

Drying

Proper sun drying before storage or husking is considered to be a critical factor in maximizing yield. If grains are not dried properly, they will break in the mill or in husking and spoil in the storage containers. Drying takes 1 to 3 days depending on the size of the courtyard or surface, temperature and day length. Generally women spread the grains in the courtyard or on the black tarmac surface of a road and turn them periodically with their feet or a *harpata,* a wooden turner. As computed by Van Harder (Von Harder, 1975) drying on the black tarmac surface of the road takes 2.3 times less time than the mud surface of the courtyard. However, only a few homesteads in Bangladesh actually have access to tarmac roads to take advantage of them. Grains must be watched constantly to prevent loss to animals and birds. Von Harder's findings states that 240 lbs. can be dried per woman a day and drying capacity of one family is 320 Ibs. to 400 Ibs. (Von Harder, 1975).

Increased temperature and day length together reduce drying time and probability of rain increases it. Amon is harvested in November-December which is coolest and thus two days paddy drying is usual. Drying of Aus is completed in one day and Boro in hot and wet weather and as such requires special arrangements such as spreading husks on the courtyard floor to blot up standing water or the laying out of paddy on mats, and if a small quantity of paddy is needed urgently it may be dried on the oven.

Husking

Two methods of husking are employed. In the first, the woman pounds the grain in a wooden bowl *(kahal/gail)* with a heavy stick *(sia)* which she holds vertically and allows to drop down into the grain. She can do this by herself or with another woman pounding in turn. The cost of making a *kahal* or *sia* is approximately Tk.50 to Tk.150 based on the kind of wood. Now in some areas people are making them with brick and cement which is cheaper and more durable. The second method is the use of the *dheki,* a foot operated hammer mill, usually located in the kitchen or in a special shelter or hut in the household. It consists of a heavy wooden beam suspended by a fulcrum horizontally between two vertical posters and balanced so that the woman can depress it at one end with pressure from her foot, when it is fully raised she removes the pressure, the beam drops and a hard piece of wood, attached to it at the other end, drops into a hole containing paddy. Three women operate this together (a minimum of two is required), two raising the beam with their feet and the third keeping the container filled with paddy and turning the paddy. The cost of making a *dheki* runs between Tk.100 to Tk.200 again depending on wood. A *dheki* can process on average 80 lbs. per day whereas the *kahal* can process 20 lbs. per day. There are three stages of husking. The first stage (called *a-kara* or without polish) only removes the outer skin. The second and third husking is done to get polished rice. Rice for sale is processed to the third stage but some people prefer to buy second stage rice. A circular machine called the *dalan* is used for rice processing in Teknafa and Moheshkhali near the Burmese border which is capable of milling 1200 lbs. per day (Harris, 1979). (Information collected by personal interview with the women of the area gives the figure 400 lbs. per day.) The cost of a *dalan* varies between Tk.300 to Tk.500. The husking capacity of a *dheki* is four times more than that of a *kahal* and the husking capacity of a *dalan* is 15 times more than a *dheki.* Yet the *dalan* is used only in a limited area. All three rice husking machines are in general individually owned, though usually used by others not having such facilities and customarily not charged. The cost of all three machines is high in comparison to the economic condition of the rural mass and many families just cannot afford to have one. The group ownership system has not yet developed in the villages. Moreover landless families and marginal farmers compose 62 per cent of the total families and they simply cannot manage to save to buy individual rice husking machines and it is also not economical.

Winnowing

Husk, bran and broken rice is separated by winnowing using a flat basket or *kula* with the wind or without the wind.

Rice husk is used for fuel to parboil rice or sold to potters for firing. It is also used as litter for animals, as a blotter for wet courtyards or mixed with mud for plastering the house. Burnt husk ash is used as a washing material, as insecticide and as a fertilizer.

Rice bran is fed to animals, poultry and fish. There are economic markets for these by-products.

Storage

Grain is retained in the store for consumption either in the form of parboiled rice or raw paddy. Any marketable portion is usually stored as raw paddy, though occasionally as parboiled rice. There are different ways of storing grains. The commonly used storage structures are *dole, gola, khari, jabar, motka* and *bag;* these are made of bamboo, earthenware and jute. Other small storage containers are earthen pitchers, drums, tins and wooden chests. The size of these storage structures varies considerably from house to house depending on the economic condition of the family and purpose of the storage.

Seed preservation

Rice seed storage is women's province. It requires specially prepared sealed containers to keep out moisture. Women prepare these containers, usually baskets, by coating them inside and outside with a mixture of cow dung and mud. Cow dung is used to prevent the coating from splitting and to protect it from rats. The seed is put into the containers and covered with straw, a small earthen pot or half a coconut shell. Then the mixture of cow dung is used to seal the top. Earthen jars, sacks and drums are also used.

Thus in relation to rice, the main crop in Bangladesh, women's skill and labor contribute to how well seed is likely to germinate, how much rice can be released from processing paddy, how much seed and rice will survive storage, how much value is added to paddy whether for home consumption or marketing, and how the by-products will be put to use. If these factors of total rice production were measured, the percentage of rice that women are responsible for 'producing' would be seen to be quite significant. Information available on post harvest activities shows that labor requirements in this field runs from 41 per cent to 49 per cent (Jabbar, 1978) and about one-fourth of all agricultural employment (Greeley, 1980). 86 per cent of this labor is supplied by the women (Ahmed, 1981). This reveals that post harvest processing offers substantial employment opportunities for women, although it is one of the low paid jobs. Labor requirements for husking, which is entirely a woman's job, form 52 per cent of the total post harvest employment (Ahmed, 1981) and it is the most labor intensive operation in the total post harvest processing. As such it is obvious that labor saving modernization would be introduced in this sector first. Some attempts have also been made to facilitate drying, threshing and parboiling (especially saving fuel) without much success and no systematic study is available.

Husking is the most labor intensive operation in the whole post harvest processing and accounts for more than 50 per cent of the total post harvest labor requirement. There are about 10,000 small custom mills in Bangladesh (Ahmed, 1981). Capacities of these mills vary from 800 to 1200 lbs. per hour (No. 8 huller) to over 2800 lbs. (No. 2 huller). Actual throughputs are less than capacity. A typical rural mill is powered from a 15–25 h.p. electric or diesel engine. Often a wheat grinder is driven from the same prime motor by altering the flat bolts. The custom mills mill about 20 per cent of all rice (BUET, 1978). Customers bring consignments of dried paddy that have already been through pre-husking stages of processing using *bari* technology. There is a very large cost differential between *bari* based husking technology and huller technology, of the order of 12 to 1 (Harris, 1979). This means that an agricultural family having spare cash and access to a mill will generally switch to mill processing. However in such cases not only does a mill have to be easily accessible, but there should be provision of cash and availability of male members or small girls to transport paddy to and from the mills. As such many farm families are using mills when the situation permits and using *dheki* when it is more convenient.

The custom mills seem to produce varying employment and income effects on different categories of rural poor. There are three categories of rural poor engaged in post harvest food processing at farm level: those who are employed by producer farmers, those who operate small scale paddy processing businesses and those who are employed in rice mills. The diffusion of the huller mill results in massive displacement of female wage labor of the first category as already mentioned because of the large cost differential between *bari* based husking technology and huller, many of the producer farmers are switching to mill processing. One study shows that availability of rice mills displaced 29 per cent of the total husking labor in the sample households (Ahmed, 1981). Finding alternative employment is often difficult for them. The second category of rural poor who operate independent paddy processing businesses, utilize the rice mills to save labor and intensify pre-milling operations. The most spectacular income benefits from rice mills were derived by this group. They increase their paddy processing turn-over several times by switching over from *dheki* to custom milling and using the labor thus saved in pre-husking operation. The third category of rural poor engaged in the rice mills, although very small in number and under-paid, consider the mills as a source of better employment (Ahmed, 1981). The number of mechanized rice mills is likely to increase in Bangladesh, and there is no point to plead for a ban or curb on further extension of this technology particularly when the Government is planning a huge increase in paddy production.

Several Government agencies and NGOs have taken up this issue of providing alternate employment for poor displaced women. The Rural Credit and Training Programme under the Bangladesh Rural Advancement Committee organizes such groups and provides credit facilities on easy terms and conditions. Out of total credit of Tk.16 million, 9 per cent is given for paddy husking. Similarly the Grameen Bank Project has issued a total loan of Tk.9.2 million (which is about 10 per cent of the total credit issued) for paddy husking to 10,219 poor women. The paddy processing business offers profitable alternative employment for poor women displaced by mills. Even if *dheki* technology is used, returns on labor in paddy processing business is reasonably higher (22 per cent to 34 per cent) than the wage rate, while by using custom mills for husking, the return is between 139 per cent to 163 per cent higher than the wage rate (Ahmed, 1981). A recent interview with forty-nine village women in Jamalpur by the author shows that on their investment on every 80 lbs of *dheki* processing of paddy they can make a profit of 6-8 lbs. of rice which means at the current market price Tk.21 to Tk.28. With 80 lbs. of paddy processing a woman can get between 54 lbs. to 56 lbs. of rice. With the current market price of paddy at Tk.160 and rice at Tk.280 per 80 lbs. the margin is Tk.29. The cost of *dheki* processing is negligible because husk and twigs are used for fuel. This confirms the observation made by Saleha Begum and Martin Greeley: 'Women processing their own paddy into parboiled rice contribute value added of approximately twenty-eight takas per maund of paddy;' (Begum, 1978). However the amount mentioned by Harriss shows the margin between Tk.6.47 and Tk.3.00 (Harriss, 1979). This difference may be due to the difference in paddy-rice price. Although the prices of paddy and rice often vary from place to place and also different times of the year, paddy processing has turned out to be a profitable venture among the rural women from poor income groups. The women in small paddy processing businesses (with capital to buy 40 lbs. to 120 lbs. of paddy) usually do not go for mill processing unless it is within walking distance. The transport cost is the main constraint for mill processing. Marketing of rice is usually no problem because it is sold mostly in the village to other poor families either for cash or credit. Vendors also collect paddy from them.

Recently Grameen Bank has issued credit to four groups of poor women to purchase rice mills for business operation. The October 1982 and January 1983 Reports (News Letter) show that the number of members in each group varies between 30 and 40. The capital investment made by the group is between Tk.21.000 to Tk.30,000 most of which is credit from the Bank. At this initial stage the machines are processing on average 1200 lbs. to 2400 lbs. per day which is much below their capacity. The reason may be pauses between the small consignments of customers, the practice of double hulling some varieties of paddy, old machines or poor management. Careful study is needed to assess the feasibility and profitability of such operations by a group of poor and mostly illiterate women.

Pre-husking operations like threshing, winnowing, parboiling and drying are not labor intensive and account for less than half of the total labor requirement in paddy processing. Introduction of any technology for these activities must have high labor productivity in order to compete successfully with the traditional technologies. Manually operated pedal threshers are slowly spreading but do not yet account for a significant part of the total harvest. The main reason is that this equipment is not suitable for the main broadcast harvest and as such its total impact under present cropping patterns is restricted.

A number of custom mills have developed parboiling facilities with improved *bari* techniques. Soaking is done in a number of 80-160 lbs. mud pots or in a 1200-1600 lbs. soaking tank. Parboiling is either done in split 45 gallon oil drums taking 120 lbs. each, over a larger version of the domestic mud stove, or over an underground fire, or it is done using steam generated from a simple boiler made of 3 welded oil drums set in a brick furnace, from which steam is led into 2-3 steaming vats which can take 360 lbs. Paddy is then allowed to dry on cement covered drying yards with capacities varying from 1200 to 4000 lbs.

At Bangladesh Rice Research Institute (BRRI), two kinds of driers have been designed: the natural draught tray drier and the fixed bed drier. The total cost of the first is approximately Tk.750. BRRI claims that this drier brings down the moisture content of wet paddy from 28 per cent to 12-13 per cent in seven hours, seeds are not damaged and it requires 20 lbs. of rice husk to dry 80 lbs. of paddy. The fixed bed drier is made up of a 3 h.p. electric motor, fan, brick, sand, cement, bamboo, woven hessian, polythene and strings and costs approximately Tk.6,500. It brings down the moisture of 1120 lbs. of wet paddy from 28-30 per cent to 12-13 per cent in 10 hours and requires 120 lbs of husk as fuel. Several natural draught tray driers were introduced at various field sites but only a few of them were used successfully. Post harvest losses due to lack of drying facilities did not appear to be high enough to force the farmers to use these driers. Moreover, it is labor intensive, highly fuel consuming and needed routine attendance which bothered the women. The cost effectiveness and drying performance of the driers in terms of amount dried per man-day are low and money invested and space occupied by the drier cannot be justified by the very few occasions when they can be economically used to save paddy from loss. However, these machines might have more use for very large farmers or millers.

The Bangladesh Rural Development Board (BRDB) through its Women's Development Programme carried out an experimental project to improve paddy drying facilities for the women in *bari* based paddy processing businesses by introducing black polythene sheets. Five square metre black polythene sheets were distributed among each of 5150 women engaged in post harvest activities at a nominal charge. The water of parboiled paddy is first drained by spreading it on a mat and then it is spread over the black polythene sheet for sun drying. The advantages are that the sheet can be spread anywhere, even over the grass, the black colour of the sheet helps in faster drying, the paddy can be collected faster in the sheet, it does not occupy space permanently and the sheet can be used for other purposes (to dry pulses, spices or protection from a leaking roof). No study has yet been made of the performance efficiency of this method of drying but there is constant demand for it.

Women's access to technology

As noted above rural women in Bangladesh play a significant role in rice production. Therefore, from the technological perspective, it is equally important to ensure greater access by this group to various inputs needed to carry out their work more efficiently and to generate or adopt cheap and simple innovations which could reduce the strain of women's work. Farm women have little access to non-formal education, rural institutions and extension services. The agricultural extension services are mostly composed of male agents and as such they tend to channel knowledge and training on improved technology to the male farmers. Moreover present post harvest technological innovations are mostly geared for large producers and millers. Women from small farm families can have access to modern technology which could be possible with the reorganization of present individualized operations into consolidated village based group activities. The cost of improved techniques or facilities could be economic if they were divided among many families. Grameen Bank, BRAC, BRDB Women's Programme have organized women's groups in the villages. Extension services and credit inputs are provided to the groups for post harvest rice processing. To improve efficiency, the Grameen Bank has also provided group loans for the installation of rice mills in the centre of the villages, which are managed by the group members. Similarly other technologies such as mechanical driers can also be owned and used effectively by the group provided they are cost effective. It is important to recognize that the whole process of technological dissemination must be related to the economics of the area.

Conclusions

Rural women of Bangladesh play a significant role in rice production. The labor requirement of post harvest processing of paddy, which is mainly women's responsibility, is approximately half of the total man-days required for its cultivation. The post harvest technologies presently used by women are mostly traditional. Little attempt has been made to improve homestead post harvest technologies. Neglect of homestead technology is a manifestation of a widespread ignorance over women's economic activity. The mill technology is diffusing rapidly into rural areas. It greatly reduces processing costs and at the same time brings a larger profit for its owners. However, the availability of rice mills displaces large numbers of female wage laborers. Finding alternative employment is often difficult for them. Group ownership of mills, as is being tried by Grameen Bank with pre-milling processing using *bari* technology, may provide some solution to the problem. This would increase the productivity of women, improve their economic status and have an educative function.

However more systematic study is needed to find out the relative economics and employment effects of this new system and its implication for women.

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13 Women and technology: rice processing in Bangladesh

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Summary

This paper is concerned with the effects upon female employment of technical change in rice milling in Bangladesh. The gender division of labor in Bangladesh agriculture is rigidly demarcated; women are responsible for most agricultural work within the farmyard but do not undertake field or market work. Traditionally, their major economic contribution to agricultural output has been in rice processing, especially husking and polishing. Most women work as unpaid family labor but women from the poorest households depend upon wage labor work provided by their richer neighbors. In recent years increasing landlessness and falling real wages are making more households economically dependent upon female wage labor work. At the same

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time mechanization of milling is reducing the opportunities for female wage labor work.

The results of a year-long survey of 100 households are presented to describe the conditions under which households are forced into dependence on female wage labor earnings and the role of rice processing in providing those earnings. Regional differences illustrate how development of the infrastructure, creating access to rice mills, reduces the opportunities for female wage labor. However, other socio-economic groups benefit from this technical change. The analysis suggest the urgent need to create alternative female wage employment opportunities to alleviate the distress caused to the poorest households by limited and diminishing female wage work.

Introduction

This paper discusses the consequences for women of the introduction of rice mills in Bangladesh. Mechanized rice milling has spread throughout South Asia but, with the possible exception of Nepal (Gautam, 1982) Bangladesh lags behind other countries. Hand and, more commonly in Bangladesh, foot powered techniques are only now being replaced by mechanically powered rice milling equipment on a wide scale.

The most common machine is the Engelberg steel roller huller and it has increased productivity dramatically. Even the smallest machine (the number four huller) processes rice twenty times more quickly than the traditional foot pounding machine (*dheki*).

In the technical change, male labor has replaced female labor. Traditionally rice processing was a farmyard task performed by women. The introduction of village rice mills has industrialized the process: the rice mills employ less labor than traditional methods and employ male not female labor.

This change affects women from different socio-economic classes in different ways. Using evidence from field studies, this paper examines these differences and looks particularly at the consequences for women from the poorest households in rural Bangladesh.

In discussing the introduction of new technology, Boserup (1970) made two important points with respect to its impact upon women: male rather than female tasks get modernized first; and when female tasks do get modernized, they are likely to be taken over by men. The implication of Boserup's analysis is that women are either being neglected or losing control. In some sense, they are victims rather than beneficiaries of economic change.

Another important strand of her argument is that the development of market rather than subsistence activities as the source of household livelihood has negative effects. This involves transferring control of assets and decision making power away from the domestic sphere where women have greater control. These points suggest tension in the attitude towards technological innovation so far as women are concerned. On the one hand, few technological changes are occurring in areas such as kitchen tasks, childcare and many farmyard jobs - where women are important. On the other hand, where technological change in women's work does occur, the result may be a reduction in their control over household assets and decision making power.

Superficially, this argument would seem to hold in Bangladesh. The introduction of rice processing equipment has dramatically affected women. This impact varies by social class.

Some households have crop land or paddy rental income. Traditionally, women in such households would hire other women to process paddy in the courtyard if they were well off, or the family farm women would process the rice themselves. These family farm women can lighten their workload by sending paddy to be processed in the mills. In doing this, they may lose some of the control they exercised over the crop when it was processed on the farm. Issues of control over household assets by women and men are relevant for landed households.

For landless households, the issue is not control over assets but access to employment. Rice mills have increased the productivity of labor, but also decreased employment possibilities. Specifically, landless women who processed paddy for other women find less employment. This is a very serious issue because a disproportionate number of poor households are headed by women (Buvinic et al., 1978).

The gender division of labor

Rural Bangladesh has a very strictly demarcated gender division of labor whereby women specialize in work within or near the house and men specialize in work outside the house. Women's responsibilities can be crudely categorized into maintenance of households, family growth and maintenance, kitchen gardening, and farmyard based activities, including crop processing and livestock care. Agricultural field work and external transactions are the responsibilities of men. This division of labor applies to all rural families, regardless of their socio-economic status.

This traditional division of labor is well illustrated in the production of rice. Rice is planted on 80 per cent of the gross areas sown. For both men and women it is easily the largest source of rural employment. Broadly, men are responsible for all activities in the field, and women are responsible for all activities once the crop has been brought to the farmyard. After harvesting rice goes through a number of operations. The most common sequence is field stacking, transportation, courtyard stacking, threshing, winnowing, drying, soaking, parboiling, drying, husking, and storage. Threshing is the transitional activity for the division between the sexes. Threshing is sometimes performed solely by men, solely by women, or by a mixed team. Traditionally, winnowing, soaking, parboiling, drying and husking are the province of women. All these activities are performed within the farmyard.

When rice has been parboiled and dried and then milled manually, the proportion of total labor time required to process the rice is almost equal to that required to produce the rice from seed to the point of threshing. Ahmed (1982) has calculated that 45 per cent of the total labor time from seed to store is required to process the rice. Our own analysis (Begum and Greeley, 1980a), based upon the ratio of the rice price minus the paddy price to the rice price and adjusted for the milling ratio, shows that the proportion of value added deriving from parboiling, drying and milling varies between 25 and 45 per cent. This rather broad range reflects the imperfections of small local rice and paddy markets as well as seasonal differences in availability.

Even though agriculture is so dependent upon women, it is virtually impossible to get any understanding of female labor force participation from the records of the National Census. According to the 1974 Census only 0.61 million women were included in the agricultural labor force compared to 15.23 million men (GOB, 1980). Of 17.6 million females over the age of 14 only 0.87 million were included in the civilian labor force. Whilst seventy per cent of these were in agriculture, the vast majority of the female agricultural labor force was omitted by the census and classified as ‘housewives’ despite their substantial and empirically established contribution to value added in agriculture. The Bangladesh Census is of course no special case. As Baster (1981) and others have pointed out, census data are notoriously unreliable with respect to female labor force participation. It is a reflection of the invisibility of women – a much sought after characteristic of females if they are to act according to the dictates of *purdah.*

Despite the important contribution made by women to their families’ economic welfare through rice processing and other economic activities, there was a dearth of information about women’s economic role. There had been little field research. Available information was mainly descriptive, based on observations which were not comprehensive. Recently there have been several national organizations involved with programs for rural women which have produced reports on the importance of the economic role played by rural women. Several good field studies have been conducted recently by local and foreign researchers on different aspects of rural women's life.

Martius Von Harder (1981) described the post harvest activities performed by women. The responsibility of individual women for completion of these tasks depends to a large extent on their position within the life cycle. Cain (1978) has characterized the life cycle as having four stages: daughter, wife, mother, and mother-in-law. These stages represent different relations with men (father, husband and son) and critically, different relations with other women who are economically linked to the male head of the household. These life cycle differences relate to how *purdah* is observed and how physical tasks are divided between women in different positions in the life cycle. Descriptive profiles of Bangladeshi rural women are available in Abdullah (1974) which goes some way towards elucidating these differences. Alamgir (1977) has described in great detail the social and legal status of Bangladeshi women. Kabir et al., (1976) have protrayed the different economic activities that women in rural areas perform to contribute to their families' wealth. A detailed description of the post harvest activities performed by women is presented in Khatun and Rani (1977). McCarthy (1978) has analyzed the rigidity with which the *purdah* norm is practised by women from different socio-economic classes. Islam (1979) has portrayed how the *purdah* system restrains women from participating in economic activities outside the house as this threatens the family prestige and the prestige of its male members. A detailed description of the life style of rural women and the constraints that limit rural women's participation in development programmes is presented in Abdullah and Zeidenstein (1982). This study has also addressed the issue of how all rural women are dominated by the social ideology of the village which operates through patriarchy.

Limitations of the available literature on life cycle and *purdah* are that these issues are analyzed within a narrow perspective. Much is discussed about the nature of the mother-in-law's control over her daughter-in-law, the extent of patriarchal control, the strictness of the observance of *purdah.* There is insufficient attention to how these issues may differ by social strata. We believe that the degree of rigidity with which these norms are observed and these controls exercised depends largely on the economic condition of the household. The opportunity for a mother-in-law from a landless household to exercise control over her daughter-in-law's activities (general aactivities and maintaining the ideal norms) is much less than a mother-in-law from a richer household. The material resources which are the basis of this domination are absent in the landless households. A daughter-in-law from a wealthy household has to be very obedient to her in-laws because otherwise her husband may be forced to establish a separate household with her and may even be deprived of his father's property. The consequences of this may be very severe, even leading to divorce. On the other hand, daughters-in-law in landless households are less obliged or less willing to be very subordinate to in-laws because there is not much to lose. It is women from better-off classes who are more dominated by patriarchal control because they enjoy their current social and economic status through their relationship with the patriarch of the family. Wage earning women from poorest households have greater equality with their male members than women from better off classes who do not earn income (Hart, 1978; Seidman, 1981). Similarly, the strict observance of *purdah* and seclusion of women have to be seen as a 'luxury', a status symbol in which only the relatively wealthy can afford to indulge (Jeffery, 1979). Seclusion of women from the outside world is something that every family in rural Bangladesh desires but poor landless families cannot afford to conform to this highly desirable social norm as they need their women to participate in income earning activities outside the house to meet their subsistence requirement. For poor landless households, while it is difficult to meet the strict honour of female seclusion due to poverty, nevertheless, attainment of this status remains an ideal. Our concern here is to analyse the way in which female participation on the farm is changing as a consequence of increasing household impoverishment in rural Bangladesh.

Landlessness and rural female participation

During the last two decades in Bangladesh, an increasing number of households have become landless. Associated with this is an evolving pattern of female participation, which is in sharp contrast to traditional forms of social organization. Owing to growing rural impoverishment, increasing numbers of families are becoming dependent on female wage labor for basic family income. The particular circumstances under which rural women participate in the labor market means that wage labor women will necessarily be from the poorest landless households.

The variety of political, social, and economic circumstances which are causing increasing landlessness have been discussed elsewhere (Jannuzi and Peach, 1980; Alamgir, 1978). The evidence shows that twenty-three per cent of households do not own land. Another 19 per cent owned (1978) less than half an acre of cultivable land. These statistics actually exaggerate the number of households not cultivating a crop because they ignore the existence of tenancy. Nevertheless, there is a polarization of rural households into petty capitalist farm operators and wage laborers.

Increasing landlessness or near-landlessness has specific consequences for women. Prior to the emergence of a significant class of landless households it was only a very small percentage of women that were unable to process crops as their form of contribution to the household economic welfare. These were divorced or widowed women who were not part of any male-headed household and also did not receive a sufficient crop from land rented out to meet their income requirement. Women from these households would seek employment on farms of richer peasants in rice processing and household work; typically they would have a permanent relationship with one or more households, and typically they would receive most of their payment in kind. The characteristic common to these households was that they were female-headed – in the absence or unwillingness of a father, husband or son to include them in their household.

As economic polarization occurs women from male-headed landless households more frequently participate in the wage labor force. Landless and near-landless households are frequently unable to generate sufficient income from the little land they cultivate and the wage labor earnings of the male members of the household. Low levels of agricultural growth and high levels of population growth mean that competition on the male labor market is severe. Except at very specific peaks, the demand for labor is less than the supply. Consequently, real wage rates are very low and have been diminishing constantly for nearly twenty years (Khan, 1977). Status considerations associated with *purdah* and with women's work in front of others mean that rural women only participate in wage labor when the most stringent household poverty requires it. This very severely restricts the capacity of poor rural women to participate in the wage labor force, and the main sources of their wage income are their traditional rice-processing activities performed for other households.

An empirical survey of women's earnings in rural Bangladesh

The survey results reported here are from a three year study of the post harvest system in Bangladesh. This research was undertaken by the Institute of Development Studies, Sussex, during 1978 to 1981. The overall objectives of the research were to assess the need for and consequences of technical changes in the post harvest system. The post harvest system includes all activities after cutting (strictly the harvest). The labor used in these operations is predominantly female, and traditional rice-processing is an important source of employment for wage labor women. One of the innovations currently occurring in post harvest work is the introduction of mechanical rice milling which is highly labor displacing. To examine the effect of this new technology, the study included a year-long survey of poor rural households. The objective was to measure dependence on female wage labor earnings from traditional rice processing.

Briefly, the areas for field work had been selected to give representation of all major rice cropping patterns across the *amon* (winter), *aus* (summer) and *boro* (early summer) seasons. These account respectively for fifty-eight, twenty-four and eighteen per cent of total production. Four villages were selected in each of the two regions, Comilla and Modhupur, and a household census was undertaken to establish details on cropping patterns and labour force participation. Evidence on female participation was extremely scanty. The problem was that household heads were unwilling to report female participation in the wage labor force because in rural Bangladesh it is socially demeaning for a household, particularly for its male members, to be dependent on female wage earnings. To overcome this problem a re-survey of all households in the villages was organized, this time conducted only by the four female field staff, all Master's degree holders from Dacca University. They addressed their questions to the female members of the households. In this survey eight per cent (238) of all households in the villages reported female participation in the wage labor force, up from two per cent in the original survey. The modal characteristics of these households are given in Table 13.1.

This information suggests a clear relationship between female labor force participation and landlessness or near-landlessness. Contrary to traditional notions it is currently married middle-aged women with children who are the main participants in the labor force work.

From these 238 households, a sample of 50 was selected and followed during a full year. Another 50 households were also selected. These were also amongst the poorest households by village standards, but the women did not work. The purpose of this design was to understand the marginal conditions which prompted female labor force participation in some poor households but not in others. Willingness to cooperate was an important criterion in the selection of all sample households.

Data were collected over a complete year. and there were some changes in the sample households. Nine women dropped out of the labor force, and two joined it. This meant that 43 households did and 57 households did not have women who participated in the labor force.

Women were interviewed once a week by the female field worker. Information was collected on the type and place of women's work, their earnings and those of other household members. The reasons for not working, crop earnings and asset movements were also collected on a regular basis. The concern here was to examine women's contribution

Table 13.1 Modal characteristics of households in which women work as wage laborers (n = 238).

Characteristic	Percentage of Households	
Still Married	63.9	
Husband is a Day Laborer	86.8	
Age of Women Who Work as Laborers:		
21–30	34.0	70.2
31-40	36.1	
Number of Living Children:		
1–3	44.1	83.2
4–6	39.1	
No Crop Land	65.9	
Less than 0.30 Acre Cropland	95.0	
Nature of Women's Wage Work:		
Post Harvest Only	37.0	95.0
Post Harvest and Household Work	58.0	
Reasons Women Started Working:		
Insufficient Income of Husband	62.2	100.0
Sickness of Husband	10.5	
Widowhood, Divorced or Separated	27.3	

to total household income and how they earned it. As data were collected from two regions of the country, a brief discussion of the regional differences precedes the findings.

Regional differences

Comilla and Modhupur differ in cropping patterns, land distribution, and infrastructural development, all of which influence the availability of wage labor work and the type of income earning activities undertaken by women. The Comilla villages included large areas under deep-water broadcast *amon* with long straw and mixed broadcast *amon* and *aus* as well as areas that were less prone to flooding where both transplanted *aus* and *amon* were cultivated. Comilla villages also devoted large areas to jute. Modhupur villages included large areas under high-land *aus,* lowland *boro* and irrigated transplanted *boro* and *aus,* followed by transplanted *amon.* Modhupur villages hardly grew any jute.

The distribution of land was relatively even in Comilla compared to Modhupur villages. The percentage of households that were com-

Table 13.2 Land ownership by farm size category Comilla and Modhupur villages (n=3095) *

Size Category	Comilla	Modhupur
Landless	21.9	38.9
0.00–0.49	30.9	15.2
0.50–0.99	21.9	14.5
1.00–1.49	10.1	9.5
1.50–2.49	9.3	11.5
2.50–4.99	4.7	8.3
5.00 +	1.2	2.2
Total	100.0	100.0

* Number of Households Surveyed
Comilla, 1638
Modhupur, 1447

pletely landless was lower in Comilla than in Modhupur villages (Table 13.2). On the other hand, Modhupur villages had a higher percentage of households that owned more than one and a half acres of land. The relatively greater inequality in land distribution in Modhupur meant that there were more households in the larger land holding groups seeking to employ wage labor for rice processing. The development of the infrastructure was much more advanced in Comilla than in Modhupur. This made rice mills more accessible. Fifteen per cent of all households in Comilla used rice mills for the processing of their crop. At the time of the village census (September—December, 1978), only one per cent of all Modhupur households used rice mills. Diesel operated mills were available, but none were actually located in the villages themselves. The situation changed dramatically with electrification. Prior to electrification, (February 1979) there were four diesel powered rice mills, by September, 1980, there were twenty electrically powered rice mills. The diesel engines were sold by their owners, who bought electric motors. The old diesel engines are now being used to run mills in other villages. All of these regional differences affected the structure of female earnings.

Findings

Presentation of findings reports the general trends observed in all the study villages first and later goes into detailed discussion of the regional differences.

All households studied were poor. Nevertheless, there were important differences between those in which women did and did not work. Female wage-earning households, on average, had fewer adult male workers per household. Adult males in these households also earned less on average. Fewer households with female wage-earners operated land. Children contributed substantially more to household earnings in female wage-earning households; and finally, female children's earnings were systematically larger in those households where women participated in wage work.

There were also differences between wage-earning and non wage-earning women. The percentage of single women (widowed, divorced, or separated) was higher among the wage-earning women. Wage-earning women contributed nearly a quarter of their households' total annual income compared to slightly more than one per cent by non wage-earning women (some non wage-earning women earned some money by selling eggs, milk and fruits). One of the most important findings of the study was the importance of post harvest work as a source of female employment. Out of all post harvest activities *dheki* work was the major source of post harvest earnings. Wage-earning women earned more than fifty per cent of their total post harvest earnings from this source. Although the amount earned from pure *dheki* work is not very high there are other reasons for which it is important. First, women are sometimes hired to perform *dheki* work combined with other post harvest work. Our impression from two years' field experience is that women are less likely to be hired for other post harvest work if *dheki* work is not required. Second, in our study villages it was also observed that the daily wages for *dheki* work were higher than the average for other post harvest work. Differences were also observed in female sources of earnings between the regions.

Information on female wage-earning and non female wage-earning households demonstrated several features that are of interest (Table 13.3). First of all, there is the absolute poverty of the households whose incomes were recorded. Average household income from non crop earnings converted to US. dollars using the 1980 exchange rate (15 takas to the dollar) was approximately $200 in Comilla and $250 in Modhupur. Per capita income was approximately $56 for households in which women worked; it was $41 for households in which women did not work. These figures can be compared to the national average per capita income of $90 (World Bank, 1979).

There were substantial differences in the number of households operating land. In households in which women worked for wages, the average size of the land operated was smaller than the average size of land owned. This means that households were leasing out land, which appears to be a response to poverty, a consequence of the declining ability of these households to operate as smallholders.

Our impression is that the response to poverty is a process. Small-

Table 13.3 Background characteristics of respondents and their households (n = 100)

Characteristic	Wage-Earning Households			Non Wage-Earing Households		
	Both (n=43)	Comilla (n=l6)	Modhupur (n=27)	Both (n=57)	Comilla (n=34)	Modhupur (n=23)
Age						
20–30	27.9%	25.0%	29.6%	59.7%	58.8%	60.9%
31-40	34.9	37.5	33.3	24.6	20.6	30.4
41–50	34.8	37.5	33.3	10.5	17.7	–
50 +	2.3	–	3.7	5.3	2.9	8.7
Marital Status						
Married	60.5	56.3	63.0	98.2	100.0	95.7
Single *	39.5	43.8	37.0	1.8	–	4.3
Average household Size **	3.95	4.19	3.81	4.96	5.23	4.56
Average Adult Male Worker per Household	0.86	0.87	0.85	1.21	1.26	1.13
Average Land Owned (in acres)	0.25 (n = 16)	0.35 (n = 4)	0.22 (n = 12)	0.28 (n = 20)	0.30 (n = 15)	0.23 (n = 5)
Average Land Operated (in acres)	0.20 (n = 12)	0.25 (n = 6)	0.15 (n = 6)	0.42 (n = 33)	0.28 (n = 20)	0.69 (n = 13)

* Single women include widowed, divorced or separated.
** Household size includes all the people who live together and eat from the same pot.

holders begin to lease out and perhaps sell land. They may also sell productive assets (e.g. bullocks) or consume productive inputs (e.g. seed). They may place male children in permanent jobs where they receive food and shelter. Finally, women may perform wage labor. The involvement of rural women in wage labor seems to be the last step in a series of family adjustments to economic crises that is taken only when the alternative is the effective breakdown of the family unit.

In non wage-earning households, on the other hand, the number that operated land was greater than the number that owned land. The average size of land operated was also greater than the size owned. This was due to the higher levels of male earnings of these households (Table 13.4). It seems that males from these households achieved a higher income by working for more days in non-agricultural jobs which were more regular and generally better paid. The data showed that there were parallels between female labor participation and child labor participation. Households that had female earners were also more dependent on children's earnings. Higher rate of labor participation of

Table 13.4 Distribution of household earnings by household members

	Wage-Earning Households			Non-Wage-Earning Households		
	Both	Comilla	Modhupur	Both	Comilla	Modhupur
Average Annual Household Earning (in Takas)	3278.24 (n=43)	2741.52 (n=l6)	3596.29 (n=27)	3047.85 (n=57)	2768.06 (n=34)	3461.45 (n=23)
Average Adult Male Earning	1790.05 (n=37)	1850.98 (n=14)	1752.97 (n=23)	2055.12 (n=69)	1909.68 (n=43)	2295.66 (n=26)
Average Percent Income of‘ Adult Males	46.98	59.08	41.52	81.62	87.25	74.97
Average Adult Female Earning	676.89 (n=5l)	516.19 (n=21)	789.36 (n=30)	78.69 (n=26)	61.44 (n=20)	136.18 (n=6)
Average Percent Income of Adult Female	24.49	24.71	24.39	1.18	1.31	1.03
Average Male Children’s Earning	1068.20 (n=25)	452.08 (n=9)	1414.78 (n=16)	1016.40 (n=28)	691.07 (n=15)	1391.79 (n=l3)
Average Percent Income of Male Children	18.95	8.27	23.31	16.38	11.01	22.73
Average Female Children Earning	673.29 (n=20)	428.56 (n=7)	805.06 (n=13)	236.30 (n=6)	100.72 (n=4)	507.47 (n=2)
Average Percent Income of Female Children	9.55	6.84	10.78	0.82	0.42	1.27
Percent Days Worked by Adult Males	68.19	74.27	64.42	70.71	71.72	69.09
Percent days Worked by Adult Females	39.15	36.77	40.76	–	–	–
Percent days Worked by Male Children	82.06	13.34	86.96	75.06	74.18	76.00
Percent Days Worked by Male Children	62.83	62.05	63.05	30.10	23.44	86.09

Note: Percent days worked refers to the total number of days when people were engaged in activities that brought income to the family either in cash or in kind.

female children from female wage-earning households reveal the poverty of these households. Children participate in wage employment when incomes of adult members become grossly inadequate to meet their consumption requirements. This is particularly true for labor participation of female children. Households in rural Bangladesh enjoy higher status if their female members do not work. Households will, if at all possible, avoid sending unmarried female children to work because of subsequent difficulties they may face in arranging these girls’ weddings and because of their sexual security. Female children are hired out only when their income becomes necessary to obtain even stark minimum needs. The higher percentage of labor participation of female children from female wage-earning households reflects the acute poverty of these households.

There were differences between wage-earning women of the two regions (Table 13.5). Although in both regions women from female wage earning households contributed nearly a quarter of the total household earnings there was a significant difference in the actual amount earned by them (Table 13.4). The regions differed substantially in terms of the importance of post harvest activities as a source of female employment. While in both regions *dheki* earnings constituted more than fifty per cent of total post harvest earnings, there was a significant difference in the availability of the employment opportunity. There was also a significant difference in the amount earned from all post harvest activities.

Table 13.5 Structure of female wage-earnings (n=43)

Composition of Earnings	Comilla (n=16)	Modhupur (n=27)	Both (43)
Female earnings as percentage of total household earnings	24.7	24.4	24.5
Post harvest earnings as percentage of total female earnings	16.6	50.1	39.4
Dheki earnings as percentage of total post harvest earnings	50.4	62.5	60.9
Dheki employment as percentage of total days employed	19.4	45.7	35.8

Modhupur women earned a significantly higher income from post harvest activities, and the percentage of days worked as hired *dheki* labor was also significantly higher than Comilla women. This can be explained in terms of the regional differences in land distribution and infrastructural development as mentioned in an earlier section. In Comilla, more evenly distributed land and easier access to rice mills reduced employment opportunities for wage labor women. The majority of the households were smallholders who had sufficient female family labor for crop processing. If needed, they had access to a rice mill which was used primarily by the few larger farmers. Overall, therefore, demand in Comilla for hired female labor for crop processing was very low. In Modhupur, however, the skewed distribution of land and the relatively underdeveloped infrastructure has maintained a demand for female wage labor for post harvest work.

There were differences in the sources of female earnings between the regions (Table 13.6). There was a significant difference in the amount

Table 13.6 Sources of female earnings (n=43)

Sources of Female Earnings	Percentage of Total Female Earnings Comilla (n = 16)	Percentage of Total Female Earnings Modhupur (n=27)
Wage Labor		
Pure *Dheki* work	10.3	37.9
Dheki work and other rice processing work	6.3	12.7
Jute, Millet, Wheat, and Mustard processing	13.2	4.9
Household work	17.4	29.9
Total	47.2	85.4
Self-Employment		
Handicraft and other home based earning activities	9.7	8.2
Sale of fruits, vegetables, milk and eggs	10.5	0.3
Gleaning paddy	19.7	0.0
Begging/Charity	12.9	6.1
Total	52.8	14.6
GRAND TOTAL	100.0	100.0

of earnings that came form wage work. In Modhupur female earnings from wage work was almost twice as much of that from Comilla, reflecting regional differences in the availability of employment opportunities. One striking feature of the regional differences in the sources of female earnings was that in Comilla nearly twenty per cent of female labor earnings came from gleaning compared to zero in Modhupur. This was due to the difference in variety of rice grown. The long strawed broadcast *amon* rice grown in Comilla were less uniform in length. Consequently, some crops remained unharvested in the fields. On all land but that belonging to the poorest households, it was a perogative of the women and children from poor landless households to glean the fields. They would then obtain access to a neighbor's *dheki* to dehusk the rice. The lack of employment opportunity in Camilla villages was also reflected in the fact that Comilla women received a higher percentage from begging and charity than Modhupur wage-earning women. In Comilla nearly one-third of total female wage earning came from gleaning, begging and charity.

The foregoing discussion on the size and distribution of female wage-labor earnings leaves us in a position now to look at the impact of technical change in rice processing on female participation in the wage labor force. The argument in the next and concluding sections suggests that a reduced dependence of wage labor women on post harvest rice processing is an inevitable consequence of rural economic growth. It is evident from the analysis above that there are significant regional differences in the potential impact of this fact. However, unless policy makers are prepared for female wage laborers to adopt the Comilla 'model' of practically one-third of their earnings coming from gleaning, begging and charity, then it is critical that alternative opportunities for female participation are developed through a government organized intervention programme.

Technical change in rice processing

Currently the traditional method of rice processing by *dheki* is being slowly replaced by mechanical rice milling. Traditionally rice processing and other post harvest operations are performed by two classes of women, family farm women and wage labor women. For family farm women this is the single most important type of female economic participation in the rural economy. Female wage laborers are responsible for processing a smaller part of the total crop, but earnings from processing are often a major source of income for poor families. The change from processing rice by *dheki* to rice mills has affected family farm women and wage labor women differently. The increasing use of mechanical rice mills has lightened the work burden of family farm women but it has resulted in the displacement of that female labor whose chief source of wage earnings is *dheki* and other rice processing work.

The rice mill being introduced in Bangladesh is known as the Engelberg steel roller. The change from manual methods to simple machines is probably the first step towards large modern rice mills like those in several South East Asian countries.

The rapid introduction of mechanized rice milling in Bangladesh is related to rural electrification. Rural electrification officials were receiving applications for rice mill connections at the rate of 200 per newly electrified *thana* administrative district. Of course, they were able to grant connections to only a small fraction of this number. The electrically powered rice mill is considerably cheaper to run than its diesel operated counterpart. This means significant reductions in the cost. Of more general importance, though, is the overall problem of effective demand. In rice milling, entrepreneurs have a captive market. They do not have to create a demand for their services, which replace traditional milling practices. Entrepreneurs considering investment in other fields have to be assured that the income levels of local farmers and others are sufficient to generate demand for the goods they plan to produce. In Bangladesh widespread poverty often makes this demand problematic. Rice mills are one of the few rural industries that provide opportunity for entrepreneurial activity.

The rice mills have a significant effect upon labor productivity. The project undertook fairly detailed analyses of labor time in traditional rice processing and labor time in commercial rice milling (Shahnoor, 1980). This analysis showed that while the profitability of commercial rice milling had been grossly overestimated in earlier analysis (Harris. 1978) it was nevertheless true that they were extremely profitable. Labor hours per tonne of rice processed were reduced from 240 in the traditional system to 2.8 in the Engleberg type huller rice mill. This calculation underestimates potential efficiency because two of the three Engelberg hullers used to calculate data were the smallest and least efficient sizes. The Engleberg huller resulted in a slight reduction in food availability because it was less efficient in milling, but the overall cost reduction was significant. The average charge to users of the rice mill was 2-3 takas for husking one maund of paddy (38 kgs) according to the season, the kind of milling required, and the size of the order. By contrast, the employment of female wage labor would cost half a seer of rice (approximately 2 per cent of the volume husked) and two meals for husking the same quantity of paddy (project survey) which amounts to 7 takas approximately.

The introduction of rice mills has a different impact on women from different economic classes. Women from large/middle peasant households have benefited from this technical change because even though they did not have to do the *dheki* work themselves, they had to supervise hired labor. If they now use the rice mill they have more leisure time. Furthermore, their families have benefited economically because husking by rice mill is cheaper than by *dheki* wage labor. Women from smallholders households who previously had to do the *dheki* work themselves have also benefited from the rice mill as it has relieved them of a time consuming and physically demanding task. Although their level of mill use is restricted by their need for cash to pay milling costs and in some cases transportation costs, for family farm women overall the technical change is beneficial. For wage labor women the majority of their post harvest earnings comes from *dheki* work. With the change in rice processing technology from *dheki* to rice mill this class of women are adversely affected because of its labor displacement effect.

Conclusion

The foregoing analysis brings us finally to the two most important aspects of the discussion. Jobs created by the new rice processing technology are almost exclusively male. The small amount of labor that continues to be employed in the processing of rice now being processed by mechanical means is entirely male labor. Only in those cases where there are parboiling and drying plants attached to the rice mill, is female wage labor employed to dry the rice under the sun on the drying floor. The operation of the rice mill remains entirely in the hands of males both as drivers and as laborers. Moreover, it is only the roadside commercial rice mills that employ female laborers not the rice mills in the interior villages.

When we look at the distribution of households who adopt the use of the rice mill, we find there is a different adoption rate according to the type of female labor being displaced. In those households where rice processing was predominantly the responsibility of *family* female labor, benefits to the household from use of the rice mill can be measured by the opportunity cost of family female labor time. In households which employ female *wage* labor for rice processing, the benefits are savings of the wages previously paid to day labor. It is clear just from these statements that there are reasons for differential adoption. Households which employed female wage labor would have a strong cash motivation to adopt and would, therefore, adopt more quickly than the households which used family labor to process rice.

This was supported by project results. In Modhupur after rice mills had been introduced in the town in the centre of the *thana,* a survey of 100 households was designed to study rates of adoption (Begum and Greeley, 1980b). This survey established that 33 per cent of households used the mechanical rice mill. The vast majority (73 per cent) had previously hired female wage labor for rice processing. Not all the paddy received in these households was taken to the mill, therefore, not all female wage labor was displaced. Other rice processing activities also continued, including the dehusking of rice. These results, therefore, seem to establish that the consequence of modernising technical change was beneficial to millers, to farmers, and to women in farm households. The only group that suffered were wage labor women who were displaced by the change in technique. These women came primarily from landless households and, therefore, from the poorest households in rural Bangladesh. The modernisation of agriculture means declining female participation and the displacement of wage-earning women by rice mills. This has already happened in Indonesia when mechanized rice hullers were introduced. The mill took over work traditionally done by women. Estimates of jobs lost ranged as high as 1.2 million in Java and as many as 7.7 million in all of Indonesia (Cain, 1981).

If we return to Boserup's arguments concerning the impact of technology on women, it is apparent in this case that women at the bottom of the economic ladder who were dependent upon post harvest work were negatively affected by the technical change. However, the evidence seems to suggest also that this process is an inevitable consequence of economic growth and that the solution lies not in trying to introduce licensing or zoning to control the spread of rice mills but in finding alternative employment opportunities through planned intervention.

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14 Women laborers in rice producing villages of Bangladesh

Abdul Halim and Florence E. McCarthy

Rural women in Bangladesh are active in productive works in the household industry and even in marketing. In addition to taking care of children, and preparing and serving food to other members of the family, rural women are responsible for agricultural and non-agricultural activities. They do these as members of the family labor or as workers and laborers in addition to work in their houses (Halim and Hussain 1981). Research findings show that housewive's average productive hours of work in rice producing houses is 10.1 hours, whereas the same figure for farm operators is 8.55 hours (Halim and Hussain 1979). Several pre-harvest and almost all the post harvest activities of different crops and primarily of rice are done by the women in Bangladesh. On the whole, women's productive hours of work in Bangladesh, irrespective of whether they produce rice, vary between 10 and 14 hours which is considerably more than the productive work-hours of men, which vary between 9 and 11 hours (Farouk 1980). The Philippine study shows that the women spent 66.7 hours per week in productive work compared to 55.3 hours spent by men (Evenson, R. et al., 1980). In all such cases, the level of income, and hence of welfare, of a household will depend crucially on the degree of effective participation of women in income generating activities, the opportunities for productive employment open to women, types of work the women do, the wage rate they receive, their personal and socio-economic conditions and the various problems they face. To know the extent of involvement of rural women in improving the living standard of the family, there is a need to undertake household studies describing the activities the women perform at home as family labor and also as hired laborers. The household studies should also include the role of women in the decision making process in family affairs. However, considering the resource constraints, the present study dealt only with the status of hired women in the labor force serving in farm families on a wage basis.

The specific objectives of the study were as follows:

(a) to enumerate the selected characteristics as age, marital status, husbands' occupation, family size and size of land holdings of the laborers;
(b) to state the reasons of starting work as day laborers by the respondents;
(c) to describe the types of activities usually done by the laborers, the number of houses in which the women work at a time and the amount of time they spent per day as laborers;
(d) to estimate the wage rate of the laborers and the daily income and expenditure of the family; and
(e) to find out the relationships between some selected variables such as family size and working hours, age and working hours, marital status and other working family members, family size and other working family members, age and marital status, family size and marital status, and age and tenure of work as day laborers.

Methods of study

The study was conducted in five villages of Kotwali Thana of Mymensingh district. The villages were Kazirshimla, Panghagra, Boira, Sutiakhali and Dapunia. The major considerations in selecting the villages were that the villages were primarily producing rice, they were typical villages of Bangladesh and they were easily accessible to the women data collectors. Random sampling was used to select 150 respondents from a total of 301 laborers from the five villages. Data were collected personally by two women data collectors during January and February, 1982.

Study findings

Characteristics of the laborers

Almost 49 per cent of the women laborers belonged to the age group of 30 to 39 years. The minimum and maximum age limits of the hired laborers were 10 and 49 years. Only 12.67 per cent of the laborers were in the age group of 40 to 49 years, 15.33 per cent were in the age group of 10 to 19 years and the remaining 23 per cent belonged to 20 to 30 years age group (Table 14.1). About 45 per cent of the husbands of the respondents were also day laborers. Eighteen per cent of laborers had no husband. The occupation of the rest of the husbands were farming (12.67 per cent), rickshaw pulling (10.67 per cent), small business (6.66 per cent) and working in an office (2.0 per cent). Five per cent of husbands were unemployed (Table 14.2).

Table 14.1 Age distribution of women laborers, in five villages of Bangladesh, 1982.

Age group	Number	Percent of total
10–19	23	15.33
20–29	35	23.33
30–39	73	48.67
40–49	19	12.67
Total	150	100.00

Table 14.2 Occupational status of the husband of the women laborers in five villages of Bangladesh, 1982.

Husband's Occupation	Number	Percent of total
Day laborers	68	45.33
Died	27	18.00
Farmers	19	12.67
Rickshaw puller	16	10.67
Small business	10	6.66
Unemployed	7	4.67
Service	3	2.00
Total	150	100.00

The average family size of the respondents was 5.06, which is below the national average. Fifty-two per cent of families had 5 to 7 members and 39 per cent had 1 to 4 members. The rest of the families had 8 to 10 members (Table 14.3).

About 70 per cent of laborers possessed a homestead land of their own. Twenty seven per cent of families had neither any cultivable land nor any homestead area. The rest (3 per cent) did have some cultivable land in addition to a homestead area (Table 14.4).

Table 14.3 Family size of the women laborers, in five villages of Bangladesh, 1982.

Family size	Number	Percent of total
1–4	58	38.66
5–7	78	52.00
8–10	14	9.34
Total	150	100.00

Table 14.4 Classification of women laborers according to size of land-holdings in five villages of Bangladesh, 1982.

Size of landholdings	Average land (in acre)	Number	Percent of total
No land	0	41	27.33
Only homestead	0.043	104	69.33
Homestead and land	0.138	5	3.34
Total		150	100.00

Reasons for starting work as laborers

The respondents cited eight non-mutually exclusive reasons of starting work as day laborers by themselves. The reasons were inadequate income of the husband to maintain the family (46 per cent), the death of the husband (18 per cent), being landless (10 per cent), the death of the father (6.66 per cent), inadequate income of the father (6.66 per cent), being divorced (5.34 per cent), sickness of the husband (4.67 per cent) and the remaining 2.47 per cent started work owing to separation from the husband (Table 14.5). It is, therefore, evident that all the respondents started to work as hired laborers only when they were bound to do so owing to economic constraints which could not be solved by the income of the male members.

Table 14.5 Reasons for starting work as day laborers, by the women in five villages of Bangladesh, 1982.

Reasons for starting work	Number	Percent
Husband's income not enough	69	46.00
Death of husband	27	18.00
Selling land	15	10.00
Death of father	10	6.66
Father's income not enough	10	6.66
Divorced by husband	8	5.34
Sickness of husband	7	4.67
Separation from husband	4	2.67

Characteristics of work

About 10 different types of work were done by the women in the villages. The activities were mostly related to post harvest processing of paddy (Table 14.6), as the data were collected after the biggest rice harvest. Nevertheless, usually the type of post harvest processing activities and other household work relating to cooking and cleaning are usually available throughout the whole year in the rice producing houses. The women used to perform more than one type of work at a time in a particular house or in different houses. However, the work of paddy husking was common for all the women, indicating that the laborers were primarily hired for paddy husking.

Table 14.6 Different types of activities done by the women laborers in five villages of Bangladesh, 1982.

Work women do	Frequency	Percent
Paddy husking	150	100.00
House cleaning	138	92.00
Paddy parboiling and drying	100	66.66
Grinding spices	82	54.66
Water carrying	69	46.00
Washing of clothes and utensils	62	41.33
Paddy winnowing	44	29.33
Sewing	13	8.66
Cooking	2	1.33
Feeding the cattle	2	1.33

The number of houses in which each woman worked daily varied from 1 to 4. More than 40 per cent worked only in one house. Almost 25 per cent worked in two houses. This was followed by three houses (21.33 per cent) and four houses (10.67 per cent). On average, the women worked in two houses daily (Table 14.7).

The daily working hours of the laborers ranged from 1 to 9 hours with an average of 6.23 hours (Table 14.8). More than one-third (38 per cent) of the laborers worked for an average of 8 hours on a wage rate basis. More than 50 per cent worked for two-thirds of the day. The rest of the time they spent in their own household activities. This might be because work for the whole day was not available or they were not willing to work for the whole day as laborers. Very few women worked as casual laborers.

Table 14.7 Number of households in which the women worked per day in five villages of Bangladesh, 1982.

Number of houses	Number of women who worked	Percent of total
1	64	42.67
2	38	25.33
3	32	21.33
4	16	10.67
Total	150	100.00

Table 14.8 Daily working hours of the women laborers in five villages of Bangladesh, 1982.

Working hours	Number	Percent of total
1–4	11	7.33
5–6	82	54.67
7–9	57	38.00
Total	150	100.00

Wage rate, income and expenditure

The daily average wage rate of women laborers was taka 9.25 compared to the wage rate of husbands which was taka 9.74 at the time of data collection. The other family members together also, in more than 50 per cent of houses, did earn an amount of taka 12.25 daily (Table 14.9).

Table 14.9 Estimated daily wage rate of the family members in five villages of Bangladesh, 1982.

Earning members	Average income from wages (taka)	Number	Percent
Woman herself	9.25	150	100.00
Husband	9.74	91	60.66
Other family members	12.25	77	51.33

Daily income per family was taka 21.99 compared to expenditure of taka 21.60. The average income in large families was higher but their expenditure was also higher compared to earnings (Table 14. l0).

Table 14.10 Average daily family income and expenditure according to size of family in five villages of Bangladesh, 1982.

Family size	Average income	Average expenditure
1 –4 (small)	19.81	15.01
5–7 (medium)	22.62	24.10
8–10 (large)	27.57	35.00

Average income per head in large families ranged from taka 3 to 4, whereas in small families, it was taka 10.00 approximately. Poverty and starvation was more acute in large families. This finding empirically justifies the necessity of diffusing family planning practices in the families of day laborers.

A major portion of expenditure (97 per cent) in the respondents' families was made on food items. Only a negligible amount of money was spent on buying clothes per year. But in the case of farmers' families in the same locality, it was found that they spent about 78 per cent of their earnings on food (Halim 1982). The day laborers cannot afford to spend their earnings on other items except food, whereas the farmers can spend more than 20 per cent of their earnings in other items except food. It is important to note here that the laborers preferred to eat more rice than wheat, although wheat is cheaper than rice (Table 14.11).

Table 14.11 Itemized expenditure of the family in five villages of Bangladesh, 1982.

Items of expenditure	Average expenditure	Number
Daily expenditure on rice	11.34	145
Daily expenditure on wheat	4.01	112
Daily expenditure on vegetables, spices, salt, etc.	2.90	138
Weekly expenditure for children and others	5.47	52
Weekly expenditure on betel-nut and tobacco	3.85	113
Yearly expenditure on clothes	206.00	150

Relationship between marital status of the respondents and the number of other working members in the family

A significant relationship was found between the marital status of the women laborers and the number of other working women family members. The married workers living with their husbands had the least number of other working members in their families as about 64 per cent of them did not have any other wage earning female members in the house (Table 14.12). This indicates that the married laborers do not

Table 14.12 Relationship between marital status of the laborers and other working family members in five villages of Bangladesh, 1982*.

Marital status	Number of other working family members			Total	Mean of other working members
	0	1–2	3–5		
Married	58 (63.70)**	32 (35. 0)	1 (1.10)	91 (100)	0.60
Widow	8 (29.60)	15 (55.60)	4 (14.80)	27 (100)	1.40
Unmarried	2 (10.00)	12 (60.00)	6 (30.00)	20 (100)	2.10
Divorced & separated	4 (33.30)	6 (50.00)	2 (16.70)	12 (100)	1.40

* Computed x^2 value is 28.37. This is significant at 1% level with 6 degrees of freedom.
** Number within parenthesis indicates percentage.

usually allow their daughters or other female members to work on a wage rate basis in other houses. Simultaneously, they also might not allow other female laborers who are not members of the family to stay with them. But in the case of non-married workers it was found that most of them (67 to 80 per cent) lived together in the same house varying from 2 to 5 laborers at a time. This might have helped them in getting jobs and they might have felt more secure in that socio-economic context. This situation highlights the economic vulnerability of unmarried, widow and divorced women.

Relationship between family size and other working members

The bigger families had more of female laborers than the small families. Sixty nine per cent of the small families had no working members except the respondents themselves. The average working female members in the small, medium and big families were 0.50, 1.10 and 2.20 respectively (Table 14.13). Although the bigger families had more of female laborers, per capita income was higher (tk 10) in small families than the big families (tk 3 to 4).

Table 14.13 Relationship between family size of the laborers and other working family members in five villages of Bangladesh, 1982.*

Family size	Number of other working family members 0	1–2	3–5	Total	Mean of other working family members
1–4	40 (69.00)	17 (29.30)	1 (1.70)	58 (100)	0.50
5–7	30 (38.50)	41 (52.50)	7 (9.00)	78 (100)	1.10
8–10	2 (14.30)	7 (50.00)	5 (35.70)	14 (100)	2.20
Total				150	

* Computed x^2 value is 20.57. This is significant at 1% level with 4 degrees of freedom.

Relationship between age and marital status of the respondents

As expected, most of the young laborers (82.70 per cent) were unmarried. About 78 per cent of the medium aged laborers (20-39 years old) were married. About 53 per cent laborers belonging to 40-

49 years old were widows (Table 14.14). None belonging to 30 years and above was found unmarried.

Table 14.14 Relationship between age of the laborers and their marital status in five villages of Bangladesh, 1982.*

Age groups	Marital Status				Total
	Married	Widowed	Unmarried	Divorced & separated	
10–19	1 (4.30)	1 (4.30)	19 (82.70)	2 (8.70)	23 (100)
20–29	27 (77.10)	2 (5.70)	1 (2.90)	5 (14.30)	35 (100)
30–39	57 (78.10)	14 (19.20)	– –	2 (2.70)	73 (100)
40–49	6 (31.60)	10 (52.60)	– –	3 (15.80)	19 (100)
Total					150

* Computed x^2 value is 123.29. This is significant at 1% level of probability with 9 degrees of freedom.

Relationship between age and tenure of work as day laborers

Older women started work at a later age than the younger women. Almost 42 per cent of respondents in the older age group (40-49 years) started work ten years ago. More than 91 per cent started work only within the last 5 years or less (Table 14.15). These findings indicate that the tendency of doing work on wage earning basis by rural women has increased during the last 5 to 6 years.

No significant relationship was found between other variables such as family size and working hours, age and working hours and family size and marital status.

Problems of women laborers

The respondents cited ten different problems of their own (Table 14.16). The basic necessities – food, shelter, and clothing – were cited as the first problem. Lack of medical facilities was mentioned as the second problem. It may be mentioned here that the laborers did also realize the necessity of educating their children as it was mentioned as the fifth problem out of the ten. Nevertheless, the important problems

Table 14.15 Relationship between age of the laborers and their tenure of working as day laborers in five villages of Bangladesh, 1982.

Age group	Length of working (in years) 1–5	6–10	Above 10	Total
10–19	21	2	–	23
	(91.30)	(8.70)	–	(100)
20–29	29	5	1	35
	(82.90)	(14.30)	(2.80)	(100)
30–39	51	14	8	73
	(69.90)	(19.10)	(11.00)	(100)
40–49	6	5	8	19
	(31.60)	(26.30)	(42.10)	(100)
Total				150

* Computed x^2 value is 16.08. This is significant at 5% level of probability with 6 degrees of freedom.

Table 14.16 Problems of the women laborers shown in rank order in five villages of Bangladesh, 1982.

Problems	Frequency No.	Percent
Food, clothing and housing	150	100
Lack of medical facilities	35	23.33
Lack of job opportunities during off months	27	18.00
Marriage of daughters	27	18.00
Lack of educational facilities	25	16.66
Low wage rate	23	15.33
No land	16	15.33
Unemployment of husband	14	9.33
Death of husband/father	9	6.00
Separation from husband	6	4.00

other than the basic necessities were unemployment, lack of medical and educational facilities and low wage rates.

Conclusions

It may not be worthwhile to make any recommendation from such a micro-level study which was conducted only for two months and during the post harvest period of *aman* paddy. However, it may safely be said that scientists need to find out a suitable locality-based farming system which can employ the rural women labor force in income generating and expenditure saving activities throughout the whole year. As the economy of Bangladesh is based on agriculture and as there is potential to absorb more laborers in agricultural industry, the technologies to be generated must be labor-using and specially to utilize women's labor. Moreover, as the women of the Bangladesh villages are not yet ready to work out in the field, and as most of the families have at least a homestead area (70 per cent respondents of the present study had a homestead area without any cultivable land), the women members may easily involve themselves in some income generating and expenditure saving activities within households, such as raising fruit and vegetables, raising goats and poultry, keeping honey-bees, etc. which needs a farming system technology instead of a rice-based technology only. Simultaneously, women extension agents will also be required to diffuse the innovations to the women and bring back the information to the researchers. There is some evidence that the women are better able to make economic use of extension messages in raising both the per acre production of rice and net farm income (Halim 1977). Moreover, women have access both to men and women, whereas men have access to men only, especially in Bangladesh.

There is also an immediate need for research to find out the involvement of rural household members in different activities including the decision making process in the families. The question of how much the modern rice technologies could effectively use and will be able to use the female resources of the rural areas may be answered if some micro and macro-level studies are conducted considering the rural households as a unit using the socio-economic and anthropological methods. The study may be done by a team of researchers in different countries at different points in time to review the changes over time and space.

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15 The role of women in household production systems and rice farming in Nepal

Bina Pradhan

Introduction

The rural economy of Nepal is predominantly agricultural with its production at a subsistence level. Rice farming is one of the main components of the agricultural system. In many parts of the country rice is the main staple food and also represents a status symbol for many poor rural households. Kathmandu Valley,[1] is one of the rice growing areas which have the highest yields in Nepal. Its yield per hectare is comparable to that of Japan and China during the 1950s and early 1960s.[2]

Women have a crucial role in the rice farming system in Nepal through their performance at various stages of rice production and agricultural management and in the decisions they make. Of course, women perform all of these roles as a natural process in the family farm and their contributions are not perceived by themselves or the men as a particular feature of the household economy or of the national economy. But because their activities and functions are confined to the non-monatised household sector their contributions remain invisible, and the development planners, policy makers and programmers fail to see the link between women's problems and larger problems of development which are the problems of unemployment, hunger and poverty.

The women's role in rice farming has to be viewed as a part of their contribution in total household production, as rice production is only a part of the total production system in the family farm and the kind of activities that women perform in rice production are very closely bound up with their role in the family farm and household production system.

This paper is largely an extraction of some of the findings of CEDA (Centre for Economic Development and Administration, Tribhuvan University) status of women field studies as they related to women's role in rice farming in the context of the household production system. The presentation will be made in four sections. Firstly, a brief presentation of the household production system will be made, giving time allocation patterns and decision making processes. The next section will examine the role of women in the agricultural and rice farming system. In the third section an attempt will be made to show the effects of technological inputs on women. The fourth section will deal with women's accessibility to inputs and institutional credits for improvement of the farming system. Finally, some policy and programme implications will be set out/discussed.

The household production system

From the eight village field studies undertaken under the CEDA/status of women in Nepal project[3] it appears very clearly that the rural economy is a subsistence agricultural economy. It was found that in the sample households of all the eight villages 71 per cent to 91 per cent of the household income was derived from agriculture. Of household production 73 per cent to 96 per cent was consumed within the family that produced it. In other words, in all the eight communities the household is an important unit of production and consumption where goods and services for the household are produced within it and consumed by it. Only a very small proportion of household production (3.5 per cent to 27 per cent) goes into market sale. Agriculture is the dominant source of such household production.

Of total household income, taking an average for all the eight communities, only 18.6 per cent came from the market sector.

Taking these facts into account a conceptual model of the village economy was developed viewing it as operating in three sectors: the family farm enterprise, the local market economy sector and migration for employment. Each of these sectors offers a set of possible strategies for increasing the household income and subsistence level of the family. Most households combine various strategies within these three spheres of activities in order to maximize their family welfare. These three sectors will now be examined in more detail.

Sector I: The family farm enterprise

This is central to the household production system and is where the rural household operates as a fundamental unit of production and consumption. The family farm sector includes all these activities which are outside the market economy, such as the conventional 'economic activity'[4] which includes agriculture and animal husbandry and the 'extended economic activity'[5] called elsewhere 'new home economic activity', which includes fuel collection, water collection, hunting and gathering, home construction and food processing. In addition to these 'economic' and 'extended economic' activities are the domestic activities[6] which provide the essential services to the family within the household. It is this sector with which we are primarily concerned in this discussion.

Sector II: The local market economy

Market economy activities are mainly those that are enacted in the market outside the family farm. These activities include outside income earning activities, such as wage labor in either cash or kind, trade and manufacturing. In this sector males predominate and female contributions are limited. However, only about 20 per cent of household income is generated from this sector although development efforts tend to concentrate in this sector.

Sector III: Migration for employment

This is short term migration for employment in the wider market economy beyond the village. Any paid employment as agricultural labor, domestic labor, in road work, construction, army service, trading etc. that required a household member to spend a night outside was included in this sector.

Each of the members of the household participate in all these spheres of activities to varying degrees thereby maximizing their household income and family welfare.

Relative participation of women and men in the three sectors of the economy

Figure 15.1 shows that women in each of the eight communities participate to varying degrees in each of the three sectors of the

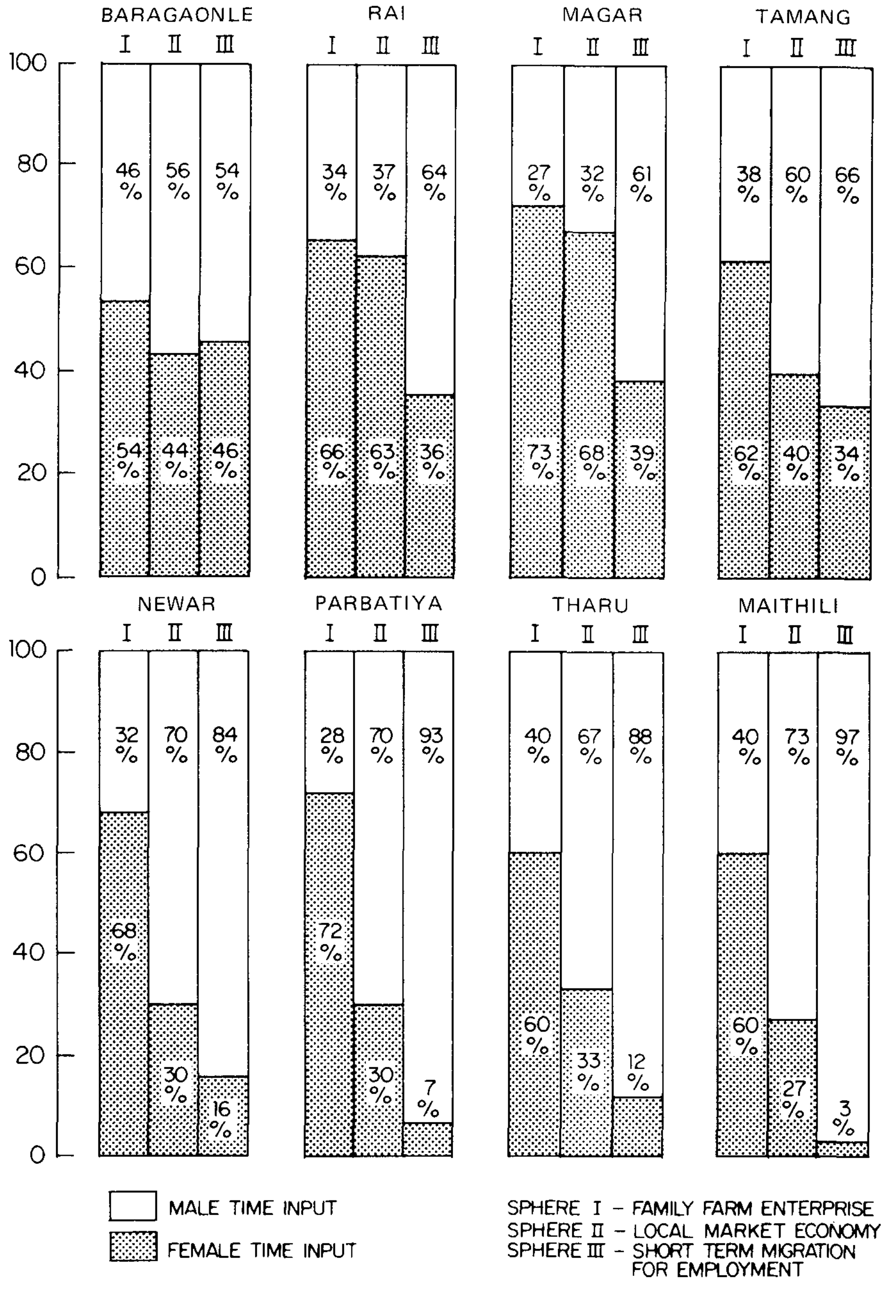

Figure 15.1: Male and female labor input in 3 sectors of the economy by village.

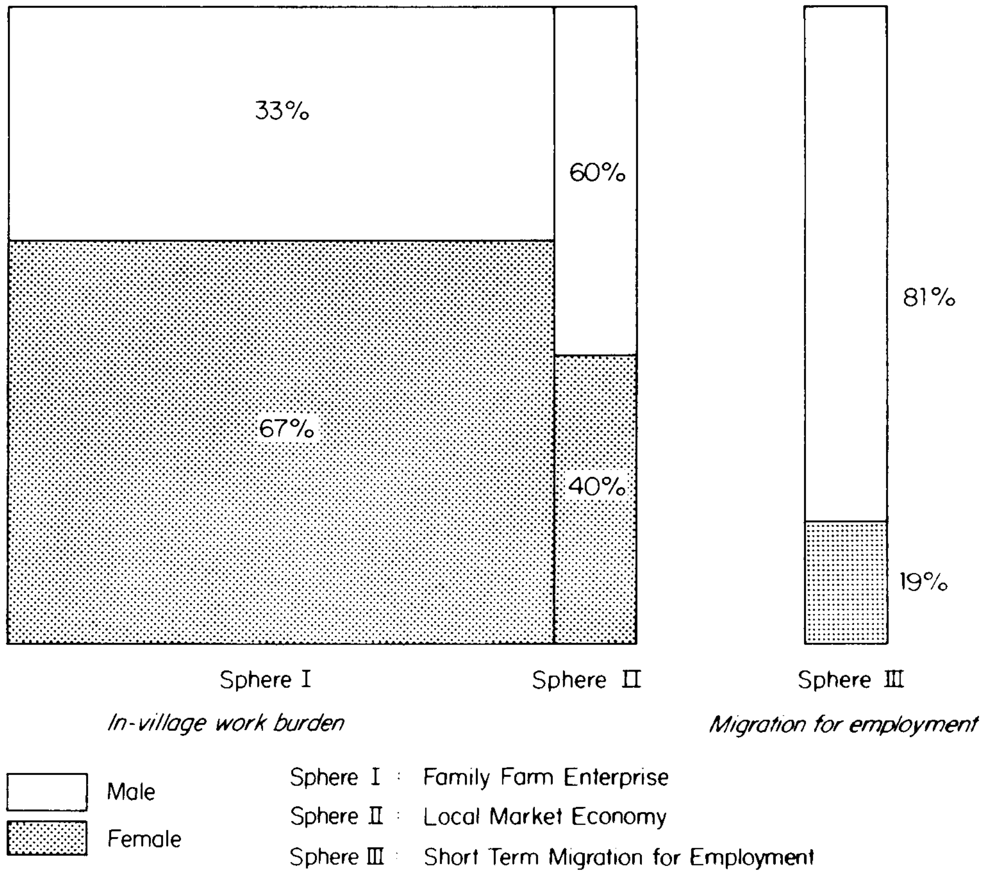

Figure 15.2: Relative participation of men and women in the three spheres of village economy.

economy. The consistent pattern that emerges is that in all communities women's participation is highest in the Sector I, family farm, activities. Their participation drops in Sector II activities and is still less in Sector III activities. The aggregate data reveal that 67 per cent of the time devoted to Sector I was put in by the women while in Sectors II and III it dropped to 40 per cent and 19 per cent respectively (Figure 15.2). Compared with women's participation, men's is much higher in Sector II and III activities. The aggregate data show that the average man spends 1.43 hours a day on animal husbandry and 2.73 hours a day on agriculture. However, the men are more likely to combine their work in the family farm enterprise with work in the market economy – either within the village on a daily basis or beyond the village on a seasonal basis. They can do both of these because of their socialization, greater mobility, greater access to education and better opportunities.

This pattern of women's activities being concentrated in the family farm sector with relatively less participation in the market sector and in migration to the outer sector of the economy was also found consistently true in many other countries of the developing world, countries in Asia, Africa, Latin America and the Middle East (Pradhan, 1983).

Variables affecting the participation of women

Although the aggregate data clearly show that women concentrated on the inside in household farm production, examination of the data for each village separately reveals significant differences in the degree to which women spend their time in the market economy in addition to their work in the family farm (Figure 15.1). One of the factors which comes out very clearly and which is discussed in the Aggregate Analysis (Acharya and Bennett; 1981) is the dichotomous nature of the community. The more pronounced the inside-outside or private/public dichotomy between the socially accorded domains of the sexes, (i.e. exclusion of women from the public spheres of politics and commerce because of their role in child rearing and domestic work), the less is the participation of women in the market economy, the public sphere of activities. The less pronounced the dichotomy between the sexes in the community the greater is women's participation in the market sector.

The mostly highly dichotomized communities among the villages studied were also the most conservative Hindu societies, i.e. the Maithali community in the Terai and the Parbatiya community (Brahman, Chetri and Sarki) in the Hills. In these communities women's participation in the local market accounted for only 25 per cent and 30 per cent respectively (Figure 15.1). In Sector III, employment outside the villages, the rate of women's participation is 3 per cent for Maithali and 7 per cent for the Parbatiya (Acharya, 1981: 152; Bennett, 1981: 160). The less dichotomized communities were also least influenced by orthodox Hindu values, i.e. the Kham Magar, Baragaonle and Lohorung Rai communities. In these communities women were found to be highly entrepreneurial, often earning cash income by brewing and selling beer, running hotels, trading, selling clothes or carpets produced at home. In these communities women contributed between 40 and 69 per cent of their time input in the local market and between 34 and 46 per cent of the person-days spent on employment outside the village. The other communities, the Newar, the Tharu and the Tamangs fall between the two extremes. The degree of participation of the women in these three communities in the market economy was 30, 40 and 33 per cent respectively. The percentage of time spent on employment outside the village was 16 per cent for the Newars, 34 per cent for the Tamangs and 12 per cent for the Tharus.

An equally significant factor which explains the different degrees of participation of women in the family farm, Sector I, and market economy, Sector II, is the subsistence level provided by the agriculture in each community. The more self-sufficient the subsistence agricultural production was to support the family the less need was there to seek outside income earning opportunities, and vice versa. The relatively non-dichotomous communities, Baragaonle of Kagbeni, the Kham Magar of Thabang and Lohorung Rai of Pangma, are also the communities who live in the high hills with poor agricultural conditions and their production is inadequate to sustain families. For instance, in Baragaonle and Kagbeni the climate is semi-arid. Barley, buck wheat and wheat, which are the main crops, can be grown only on irrigated land. Water is a limiting factor and thus prevents families from clearing new land for agriculture. Owing to high altitude and severe cold, the growing season is short and the crop yield is low. Intensive cultivation is practised only for a few months. Therefore, the long winter slack season forces many Baragaonle people to trade or seek outside employment. It is said that even those who stay in the villages remain idle which is a drain on their households' food reserves (Schuler, 1981: 8, 9). Similarly, all the land in the Magar area is *pakha,* or non-irrigated terrace land. Rice cannot be grown because of lack of water. The main crops are corn, barley and wheat. Potatoes are also grown and are intercropped in the corn or planted in marginal lands at higher altitude. The lack of water and deteriorating environmental conditions have limited agricultural expansion. It is reported that the village is poor by pan-Nepal standards, 'about a quarter could produce more than enough food for subsistence needs, a third barely subsistence and the rest, a little under half, have less than enough land to meet subsistence needs' (Molnar, 1981: 27, 29).

On the other hand the more dichotomous communities such as the Brahmin Chetri of Bankundol and the Newars of Bulu, have richer soil and better availability of water than those in the high hill areas. Similarly in Sirsia, inhabited by the Maithali community, and in Sukrawar, inhabited by the Tharus, the land is relatively richer than the high hills. In all of these communities rice is one of the main crops.

There seem to be, then, two important factors which determine women's greater or lesser participation in the market sector: the dichotomous nature of the society and the agricultural capacity of the environment to produce adequate subsistence for the family. These two variables may be in line, as amongst the Maithali who have a highly dichotomised society and productive land and where the women consequently participate minimally in the market sector, and amongst the Baragaonles who do not have a very dichotomized society and who have a poor agricultural environment and where the women participate greatly in the market economy, or they may conflict. In some of the most conservative and dichotomous societies of Asia, where female movement and female sexuality is strictly controlled by society, women from certain sections of the community do participate in the market economy. For instance, in Bangladesh, where strict female modesty is maintained under *purdah* according to the Muslim religion, women from poorer households (with less than 2 ha. of land) participate to a greater degree in the market sector (1.55 hrs) compared with those from richer households (owning more than 2 ha. of land) who spend only .13 hrs. per day in this sector (Cain et al., 1979: table 2).

It was also found that there is a close relationship between female input of time in family farm activities, the extent of her participation in the market economy sector (employment beyond the village), and her input into decision making on the family farm. Greater decision making responsibility by women is associated with their greater level of labor input into domestic work and agricultural production as well as their participation in the outside economy. It was also found that women's decision making input in a given community is related to the strength of the inside/outside dichotomy in that community. Women in highly dichotomons communities of Maithali and Parbatiya had less decision making responsibility than those non-dichotomous communities of Lohorung Rai, Baragaonle and Kham Magar. The women of the Newar, Tamang and Tharu communities were closely confined to the 'inside', and they had more control over decisions in the domestic domain. In these communities men dominated the decision making process for major capital transactions and even for minor household expenditures.

Women exercised a great deal of control and influence in the decision making in those activities or areas for which they were responsible.

Participation of women in the family farm enterprise: rice farming and their role in agricultural decision making

It has already been shown that women are responsible for the majority of the work within the family farm enterprise (67 per cent). Figure 15.3 gives a detailed breakdown of the male/female work patterns in this sector. Figure 15.3 is an aggregation of the time input, of the eight villages, into various activities. It has already been mentioned above that there is a considerable variation in the male/female work patterns in different communities but the aggregation of data shows that men's input of labor time is more in animal husbandry than women's input, whereas in agriculture women's input of labor time is higher than male input indicating the important role of women in agriculture. In overall farm production women contribute 52 per cent as compared to 48 per cent by men.

In 'expanded economic' activities women's contribution is significantly higher than that of men except in hunting and gathering and home construction. In food processing, which includes threshing, drying, seed selection, storage, grinding, cleaning and winnowing, women do 87 per cent of the work. The value added for grain processing alone in the eight villages is Rs. 146,577 which is nearly 8 per cent of total household income. If the whole range of food processing, including liquor making and the preparation of dairy products etc. is considered, the value added amounts to Rs.279,568 or 15 per cent of the total household income out of which 8.473 per cent is contributed by women (Table 15.1). To understand the role and contribution of women in rice farming it has to be taken as a system including the whole production process, right up to the finished product for consumption or outlet in the market.

Only five of the eight village communities studied grow rice: the Brahmin Chetris, Newars and Tamangs in the hills agriculture and Maithali and Tharus in the Terai agriculture. Among them the *Jyapu* (Newar) technology is the most well known. It is highly labor and land intensive: within the limitations of traditional practices the yield per unit of land has reached a maximum (as shown in the introduction to this paper).

In all these communities rice is cultivated in the *pakha* land, low land which is wet and fertile. Such low land usually has irrigation and certainty of flooding during the monsoons and hence is appropriate for

		Activity	Male	Female	Percent of total work Burden	Average hours per day Male	Average hours per day Female	Average hours per day Both
I. Family farm enterprise (Sphere I) 1. Farm production (Conventional economic)	a.	Animal husbandry	55%	45%	13%	1.43	0.97	1.17
	b.	Agriculture	45%	55%	29%	2.73	2.74	2.73
	a + b.	Farm production	48%	52%	42%	4.16	3.71	3.90
2. Expanded economic	c.	Fuel collection	34%	66%	3%	0.20	0.33	0.27
	d.	Hunting and gathering	60%	40%	1%	0.20	0.11	0.15
	e.	Food processing	13%	87%	7%	0.18	0.97	0.62
	f.	Home construction	72%	28%	2%	0.25	0.08	0.16
	g.	Water collection	8%	92%	4%	0.07	0.67	0.40
	c-g.	Expanded economic	26%	74%	17%	0.90	2.16	1.60
3. Domestic	h.	Cooking and serving	10%	90%	13%	0.27	2.05	1.25
	i.	Cleaning dishes/pots	5%	95%	2%	0.03	0.39	0.23
	j.	Cleaning house	47%	93%	3%	0.04	0.46	0.27
	k.	Laundry	10%	90%	1%	0.02	0.15	0.09
	l.	Shopping	54%	46%	2%	0.24	0.17	0.20
	m.	Domestic (other)	22%	78%	1%	0.04	0.13	0.09
	n.	Child care	16%	84%	5%	0.16	0.69	0.45
	h – n.	Domestic	14%	86%	28%	0.80	4.04	2.58
Total in-village (Sphere I)	a – n.	Family farm enterprise	33%	67%	87%	5.86	9.91	8.08
II. Local market economy (Sphere II)	o.	Outside income earning act.	69%	31%	8%	1.24	0.46	0.81
	p.	Manufacturing	43%	57%	5%	0.42	0.45	0.44
Total for sphere II	o-p.	Local market economy	60%	40%	13%	1.66	0.91	1.25
Total in-village work	a-p.		36%	64%	100%	7.52	10.82	

Scale: 0 20 40 60 80 100

Figure 15.3: Distribution of male/female in-village work burden by activity.

Table 15.1 Male/female contribution towards household income.*

(In percent)

Sex and Age Group / Sources of Income	Male (15+)	Female (15+)	Male Child (10–14)	Female Child (10–14)	Total
Animal husbandry	46.95 (69119)	34.01 (50069)	8.45 (12440)	10.59 (15590)	100.00 (147218)
Agriculture	45.79 (458271)	48.98 (490197)	1.86 (18615)	3.37 (22728)	100.00 (1000811)
Agriculture (Exclusive of Kitchen Gardening)	45.54 (343496)	49.20 (371102)	1.88 (14180)	3.38 (25495)	100.00 (754273)
Kitchen Gardening	76.24 (15999)	22.10 (4638)	0.55 (115)	1.11 (233)	100.00 (20985)
Hunting and Gathering (including fuel collection)	43.70 (40589)	48.76 (45289)	1.93 (1793)	5.61 (5211)	100.00 (92882)
Manufacturing	43.05 (15698)	54.57 (19899)	0.91 (332)	1.47 (536)	100.00 (36465)
Textile	9.09 (1744)	89.51 (17170)	–	1.40 (268)	100.00 (19182)
Rope/Basketry	51.27 (4439)	45.00 (3897)	1.77 (153)	1.96 (170)	100.00 (8659)
Tools and Utensils	55.94 (1209)	42.91 (927)	0.77 (17)	0.38 (8)	100.00 (2161)
Leather Work	97.51 (4159)	1.81 (77)	0.68 (29)	–	100.00 (4265)
Sewing	32.81 (577)	65.63 (1155)	0.78 (14)	0.78 (14)	100.00 (1760)
Others	45.04 (99)	50.45 (111)	–	4.51 (10)	100.00 (220)
Food Processing	10.75 (30054)	84.73 (236878)	0.91 (2544)	3.61 (10092)	100.00 (279568)
Husking/Drying	9.00 (9135)	86.05 (87336)	0.94 (954)	4.01 (4070)	100.00 (101495)
Roasting/Grinding	8.06 (3634)	86.39 (38946)	1.25 (564)	4.30 (1938)	100.00 (45082)
Liquor Making	11.16 (13246)	87.91 (104343)	–	0.93 (1104)	100.00 (118693)
Food Preservation	19.86 (877)	78.01 (3446)	1.42 (63)	0.71 (31)	100.00 (4417)
Dairy Products	36.36 (741)	54.55 (1111)	–	9.09 (185)	100.00 (2037)
Others	32.74 (2284)	63.72 (4445)	0.88 (61)	2.66 (186)	100.00 (6976)
I. Sub-Total for Household Production	39.42 (613731)	54.10 (842332)	2.29 (35724)	4.19 (65157)	100.00 (1556944)
II. Wage and Salary	78.04 (164171)	20.13 (42337)	0.68 (1430)	1.15 (2525)	100.00 (210350)
III. Trading	60.33 (58720)	39.67 (38283)	–	–	100.00 (96503)
IV. Total Household Income (I+II+III)	44.86 (836122)	549.52 (922952)	1.99 (37154)	3.63 (67571)	100.00 (1863799)

Figures in parentheses indicate contribution in value terms (Rs.).

* Based on the 192 sample households included in the Time Allocation Study.

the cultivation of rice. On such land farmers mostly raise at least two main crops and two subsidiary ones.

The method of cultivation is purely manual and labor intensive using very few implements. In the Mathmandu Valley the only agricultural implements used are hoes for turning the earth, a wooden mallet fixed to a long shaft for breaking up the clods of earth, and an iron weeding sickle for weeding and cutting grass.

Bullocks are usually not used for plowing in hill farming particularly in the Kathmandu Valley since it is believed that plowing by hoe penetrates the soil deeper than does the plow drawn by bullocks. This mode, though very laborious, is said to be fully as productive to the farmer as that of plowing with animals. In the Terai areas plowing is done by bullocks and cultivation is more extensive as compared to the hill areas.

Once the plowing is completed by men, women of various ages break up the clods. The cultivation of paddy involves the maximum efforts of the villagers as it is done meticulously with a larger input of labor than for other crops. June to August/September is the busiest period for the villagers when many households experience a shortage of labor and wage rates are at their highest. To overcome this the villagers have evolved their own indigenous labor supply system which will be discussed later.

The villagers take immense care of the young rice plants. The planting takes a few weeks, and after that weeding is done twice or three times during the growth of the crop. They watch carefully until the roots are strong, and in the later stages, when the plants are heavy with grains, if there is strong wind or rain, the villagers tie the plants in bundles so as to make them stand straight and not droop with the grains into the water.

After the paddy is harvested it is threshed in the traditional way by beating small bundles of paddy plants on a stone. The chaff is separated from the grains by winnowing with a large fan. Nowadays some of the farmers with larger holdings use threshing machines. The Newar community reported that these machines are not very much more efficient and labor saving than threshing by hand. But threshing by hand does not release paddy completely from the straw and hence requires double threshing whereas the advantage of the machine is that it threshes the paddy completely in one operation.

Use of fertilizer

Traditionally the villagers use mainly home made manure. Four of the eight communities, Baragaoule, Lehorung Rai, Kham Magar and Tamang, still do not use chemical fertilizers. The other four communities, Parbatiya, Newar Maithali and Tharu, use a mixture of both traditional and chemical fertilizer. In these four communities where chemical fertilizer has been introduced women's input is concentrated in the application of manure while men do most of the chemical fertilizer application. There are only a small number of households in these four communities that report that fertilizer application is shared (see Table 15.2). In the Parbatiy village 37 per cent of the households reported fertilizer application as a joint task whilst among the Japu Newars, Tharu and Maithali villages the percentages dropped to 16.7, 7.5 and 6.3 respectively.

Labor systems

Although the main source of labor in the villages is the family there are other kinds of labor. For normal household and agricultural work the household members provide their own labor. But the large supply of labor required during agriculturally active seasons of rice planting and at other special times is met by exchange labor *parma,* (labor help from families or relatives), wage labor and contract labor.

Under exchange labor family labor is exchanged on a reciprocal basis. Each year, specially during the planting and harvesting time, every household mobilizes labor from other households in addition to their own family labor, and an agreement is made between several households to work in each household in turn on a reciprocal basis. If female labor is required the female of the household mobilizes females of other households to work for her in exchange of her labor for them at other times. If male labor is required men do the same. A day's female labor is not exchangeable for a day's male labor, so they seek their own sexes for exchange. Sometimes, when one male labor day cannot be repaid in male labor, then two female labor days are given in exchange because the wage rate for males is twice that of females. Some households hire labor by paying the going wage rate.

The other type of labor is contract labor. Under this system certain kinds of operations in the field which need to be accomplished within a given period of the time are contracted to laborers for payment with money.

Division of labor in agriculture

Taking the two most intensive rice growing areas in the study, Bulu in Kathmandu Valley and Bakundol in Banepa (in close proximity to the Kathmandu Valley) the detailed breakdown of agricultural activity (Tables 15.3 and 15.4) show that women participate in all the agricultural activities, except in Bulu land preparation. The operations in

Table 15.2 Fertilizer application by sex and village.

(In numbers)

Village	Type of Fertilizer (Sex)	Male	Female	Both	Total
BARAGAONLE	Traditional	2(2.8)	9(12.7)	60(84.5)	71 (100.0)
	Chemical	–	–	–	–
	Mixture	–	–	–	–
	Total	2(2.8)	9(12.7)	60(84.5)	71 (100.0)
LOHORUNG RAI	Traditional	11(4.7)	40(17.2)	182(78.1)	233(100.0)
	Chemical	–	1(100.0)	–	l(100.0)
	Mixture	–	1(100.0)	–	l(100.0)
	Total	11(4.7)	42(17,9)	182(77.4)	235(100.0)
KHAM MAGAR	Traditional	6(2.9)	2(1.0)	200(96.1)	208(100.0)
	Chemical	–	–	–	–
	Mixture	–	–	–	–
	Total	6(2.9)	2(1.0)	200(96.1)	208(100.0)
PARBATIYA	Traditional	1(2.9)	28(82.4)	5(14.7)	34(100.0)
	Chemical	12(63.2)	5(26.3)	2(10.5)	19(100.0)
	Mixture	15(11.3)	56(42.1)	62(46.6)	133(100.0)
	Total	28(15.1)	89(47.8)	69(37.1)	186(100.0)
JYAPU NEWAR	Traditional	4(21.0)	14(73.7)	1(5.3)	19(100.0)
	Chemical	1(12.5)	7(87.5)	–	8(100.0)
	Mixture	78(44.1)	66(37.3)	33(18.6)	177(100.0)
	Total	83(40.7)	87(42.6)	34(16.7)	204(100.0)
TAMANG	Traditional	13(9.4)	37(26.8)	88(63.8)	138(100.0)
	Chemical	–	–	–	–
	Mixture	–	–	6(100.0)	6(100.0)
	Total	13(9.0)	37(25.7)	94(65.3)	144(100.0)
THARU	Traditional	5(3.9)	112(87.5)	11(8.6)	128(100.0)
	Chemical	13(92.9)	1(7.1)	–	14(100.0)
	Mixture	3(75.0)	1(25.0)	–	4(100.0)
	Total	21(14.4)	114(78.1)	11(7.5)	146(100.0)
MAITHILI	Traditional	1(10.0)	9(90.0)	–	10(100.0)
	Chemical	39(83.0)	8(17.0)	–	47(100.0)
	Mixture	13(33.3)	20(51.3)	6(15.4)	39(100.0)
	Total	53(55.2)	37(38.5)	6(6.3)	96(100.0)
ALL VILLAGES	Traditional	43(5.1)	251(29.8)	547(65.0)	841 (100.0)
	Chemical	65(73.0)	22(24.7)	2(2.3)	89(100.0)
	Mixture	109(30.3)	144(40.0)	107(29.7)	360(100.0)
	Total	217(16.8)	417(32.3)	656(50.9)	1290(100.0)

Figures in parentheses indicate row percentages.
Source: Acharya and Bennett, *The Rural Women of Nepal,* 1981.

Table 15.3 Detailed breakdown of agricultural activity by sex in Bulu (for adult population).

(In hours per day)

Activity	Sex: Male	Female	Both
Land Preparation	.05	–	.02
Terrace upkeep & repair	.41	.02	.21
Collection & preparation of organic manure	.09	.07	.08
Carrying & spreading of fertilizer	.10	.04	.07
Planting operation	.01	–	–
Weeding	.01	.02	.02
Irrigation	.10	.06	.08
Harvesting and post harvesting	.06	.12	.09
Threshing	.60	.33	.46
Horticulture	.01	.09	.05
Kitchen gardening	.01	.01	.01
Seed selection & storage	.02	.03	.02
Guarding/Protection of crops	.08	.04	.06
Other Agri. Activities	.24	.15	.20
Total for Agri.	1.77	.97	1.37
Total for In-village Activities	16.00	16.00	16.00

Source: Pradhan, *The Newar women of Bulu,* 1981.

which the women are mostly engaged are threshing, harvesting, horticulture, collection and preparation of organic manure, irrigation and miscellaneous agricultural activities (Figures 15.4 and 15.5). It is interesting to find that, although land preparation is generally considered a male task in Nepal, women actually spend more time at it than men in Bakundol. Preparation of land for wet rice planting is done mostly by men. Harvesting is mostly done by women. It was observed in Bulu that although men and women participated equally in harvesting of the main crops (rice, wheat and corn) subsidiary crops (oilseeds, potatoes and others) were mainly harvested by women and hence the higher input of women in this operation. Seed selection and storing is also mostly done by women although men help in this activity.

The collection and preparation of manure is performed by both men and women equally. However, it is interesting to note that in Bulu 71 per cent of the application of chemical fertilizer is carried out by men while the female input is only 29 per cent.

Table 15.4 Detailed breakdown of time allocation within the agricultural sector in Bakundol (For adult population by sex).

(In hours per day)

Operation	Sex Male	Female	Both
Land preparation	0.21	0.32	0.27
Terrace upkeep	0.59	0.36	0.47
Preparation and applying chemical fertilizer	0.07	0.01	0.04
Preparation and applying organic fertilizer	0.04	0.24	0.15
Planting	0.03	0.02	0.03
Weeding	0.14	0.72	0.44
Irrigation	0.19	0.29	0.24
Harvesting and post harvest operation	0.51	0.69	0.60
Horticulture/Kitchen gardening	0.01	0.01	0.01
Seed selection	0.03	0.06	0.05
Crop protection	0.01	–	0.01
Other	0.03	–	0.01
All Agricultural Activities	1.86	2.72	2.32

Source: Bennett, *The Parbatiya Women of Bakundol,* 1981.

The most time consuming agricultural tasks for women seem to be the harvesting and post harvesting operations which include threshing, drying, cleaning and storing the grain, and weeding. These two tasks absorb 67 per cent of women's labor input in Bulu and 60 per cent of Parbatiya women's.

Agricultural cycle of male/female work patterns

The time allocation data show seasonal variations in the activity patterns of men and women (Figures 15.6 and 15.7). These coincide with the rice planting, corn harvesting, rice harvesting and wheat sowing periods. In Bulu the two major peak periods are between June/July to mid-August and October to end November. The first peak is associated with rice planting, oilseed planting and corn harvesting. The second peak is associated with rice harvesting and wheat planting. In Bakundol,[7] there also appear two similar major peak periods. The first is between May and August and is associated with wheat harvesting and threshing operations, then with rice planting. The second peak period falls from October to December which is associated with rice harvesting and then with field preparation and planting of the winter wheat crop.

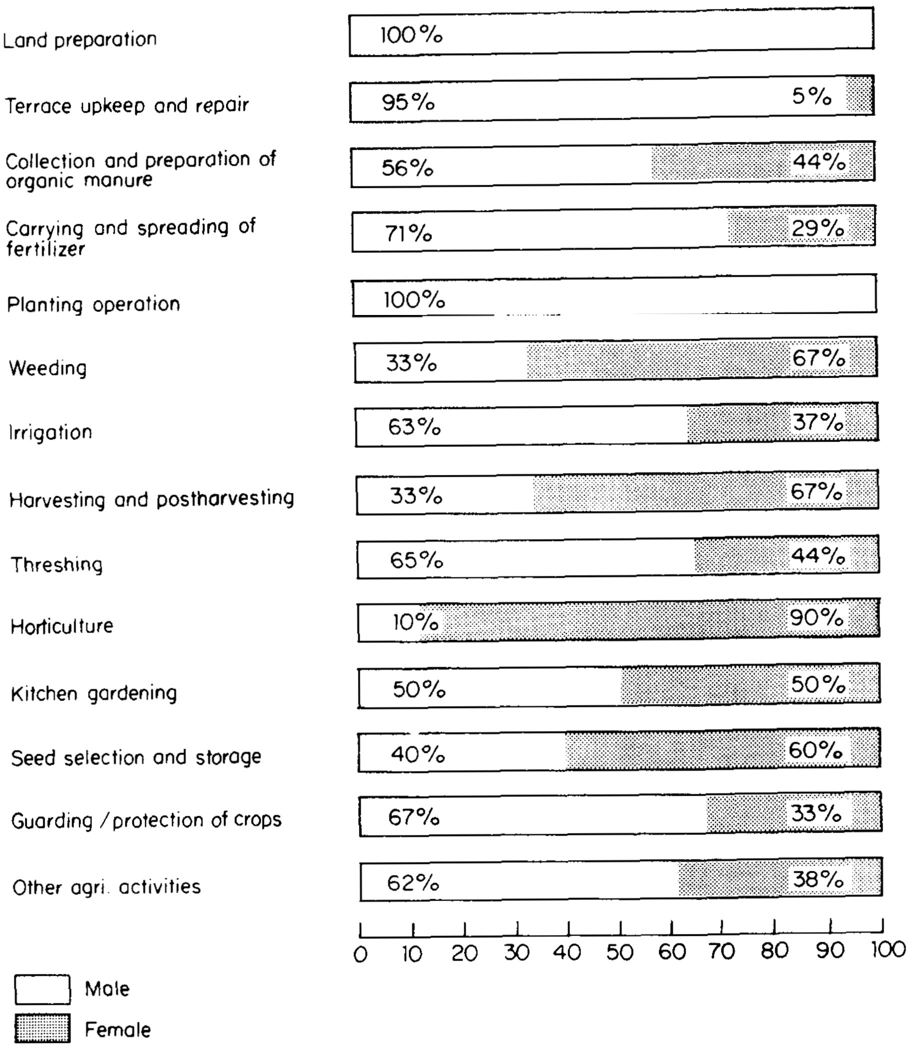

Figure 15.4: Male/female time input in various agricultural operations for unpaid family labor in Bulu.

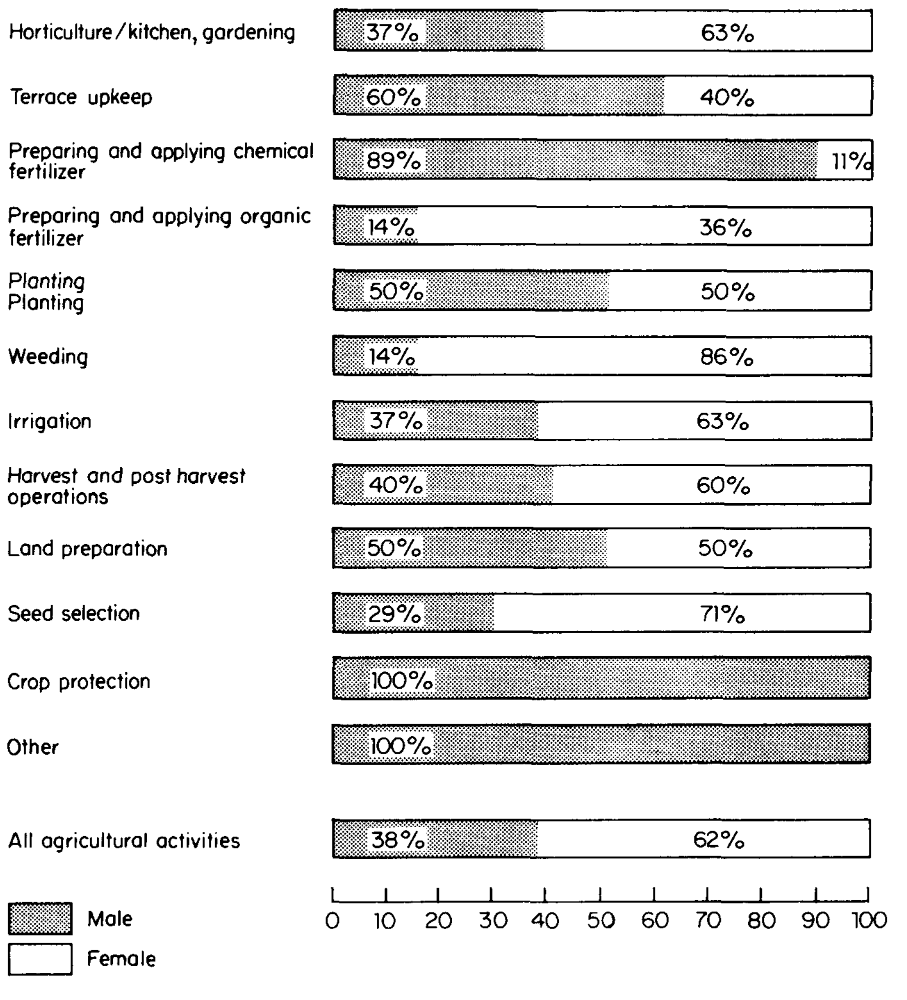

Figure 15.5: Male/female time input into various agricultural operations for unpaid labor in Bakundol.

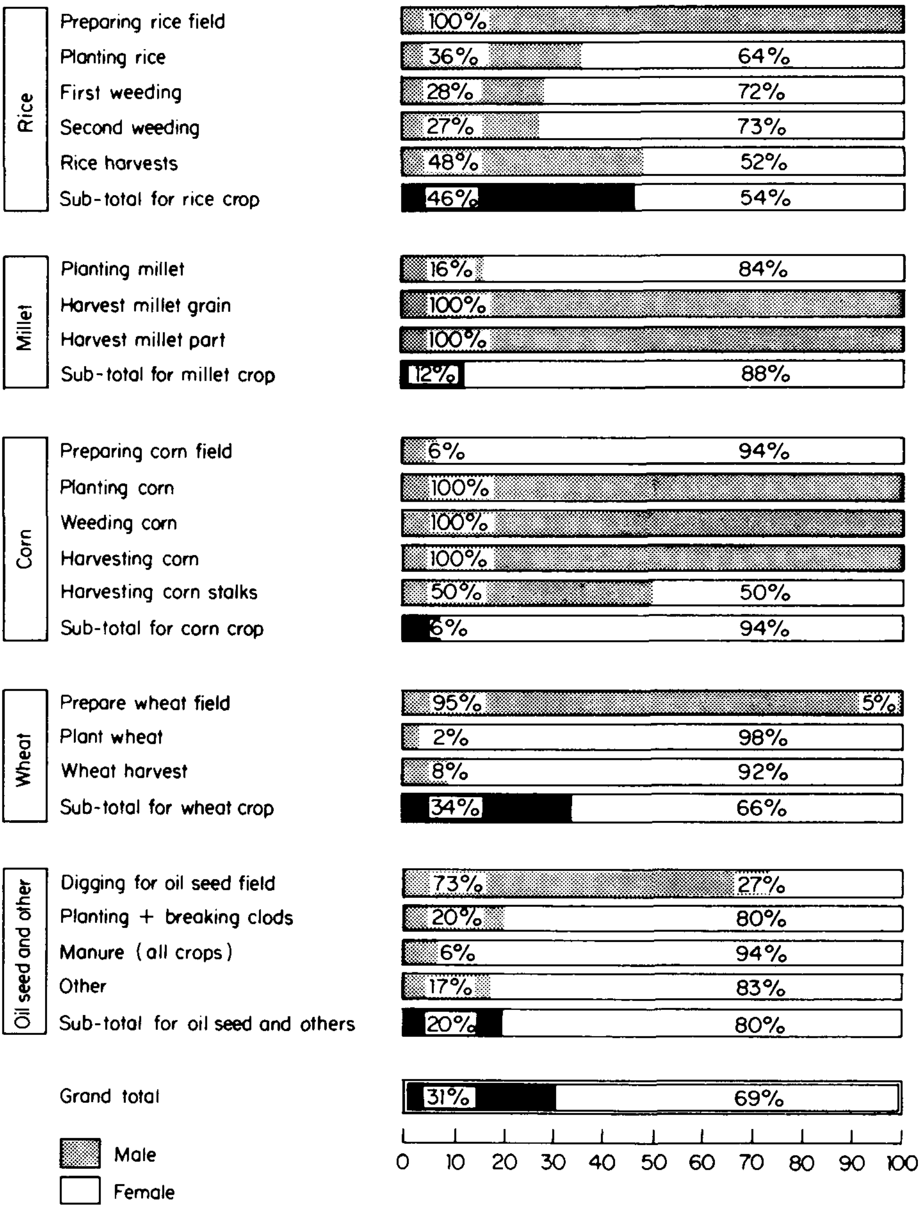

Figure 15.6: Male/female input into various agricultural operations in Bakundol for both unpaid family labor and wage labor.

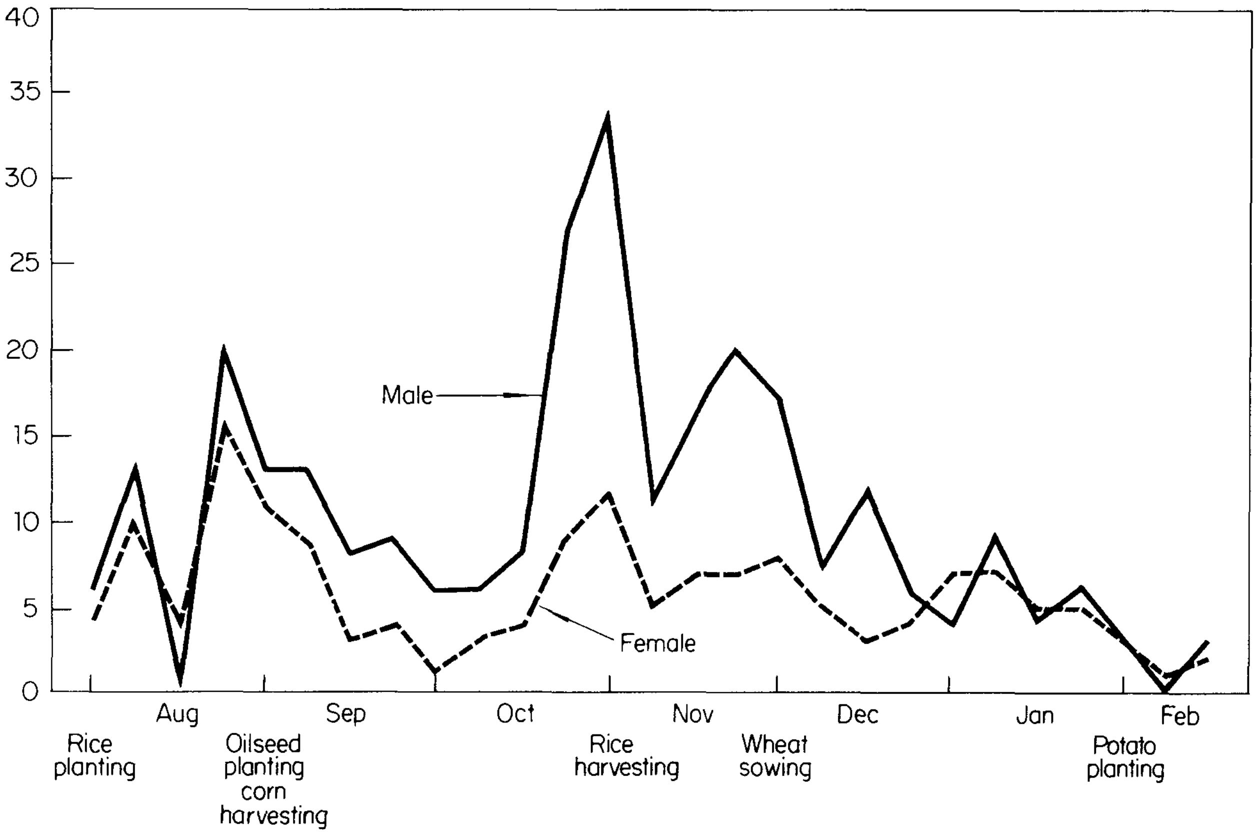

Figure 15.7: Weekly activity pattern—agriculture(for adult population in Bulu).

During these periods men and women have the highest agricultural work load.

Bakundol is the only village where data were documented for labor input into different crops and agricultural operations. Table 15.5 and Figure 15.8 are graphic representations of these data which show that only in the cultivation of rice does men's share of labor input approach that of women (46 per cent for male and 54 per cent for females). Men are responsible for one third of the labor input into the wheat crop and only 12 per cent for millet and 6 per cent for corn.

Although the data are shown only for Bakundol village, this pattern of work with the variations in the degree of labor input seems to be

Table 15.5 Labor input into different crops and agricultural operations by sex.

(In labor days)

Crop	Crop & Operation	Sex: Males	Females	Both Sexes
RICE CROP	Preparing rice field	413(100.0)	–	413(100.0)
	Planting rice	405(35.6)	733(64.4)	1138(100.0)
	First weeding	35(27.8)	91(72.2)	126(100.0)
	Second weeding	152(27.3)	404(72.7)	556(100.0)
	Rice harvests	320(48.0)	346(52.0)	666(100.0)
	Sub-total for rice crop	1325(45.7)	1574(54.3)	2899(100.0)
MILLET	Planting millet	112(16.0)	587(84.0)	699(100.0)
	Harvest millet grain	–	188(100.0)	188(100.0)
	Harvest millet plant	–	23(100.0)	23(100.0)
	Sub-total for millet crop	112(12.3)	798(87.7)	910(100.0)
CORN	Preparing corn field	33(6.3)	494(93.7)	527(100.0)
	Planting corn	–	205(100.0)	205(100.0)
	Weeding corn		154(100.0)	154(100.0)
	Harvesting corn	–	14(100.0)	14(100.0)
	Harvesting corn stalks	25(50.0)	25(50.0)	50(100.0)
	Sub-total tor corn crop	58(6.1)	892(93.9)	950(100.0)
WHEAT	Prepare wheat field	394(94.9)	21(5.1)	415(100.0)
	Plant wheat	14(2.3)	589(97.7)	603(100.0)
	Wheat harvest	21(8.4)	228(91.6)	249(100.0)
	Sub-total for wheat	429(33.9)	838(66.1)	1267(100.0)
OILSEED & OTHER	Digging for oil seed field	63(73.3)	23(26.7)	86(100.0)
	Planting & breaking clods	16(19.8)	65(80.2)	81(100.0)
	Manure (all crops)	20(6.4)	293(93.6)	313(100.0)
	Other	5(16.7)	25(83.3)	30(100.0)
	Sub-total for oil seed and other	104(20.4)	406(79.6)	510(100.0)
	Grand total	2028(31.0)	4508(69.0)	6536(100.0)

Figures in parenthesis indicate row percentages.
Source: Bennett, *The Parbatiya Women of Bakundol.* 1981.

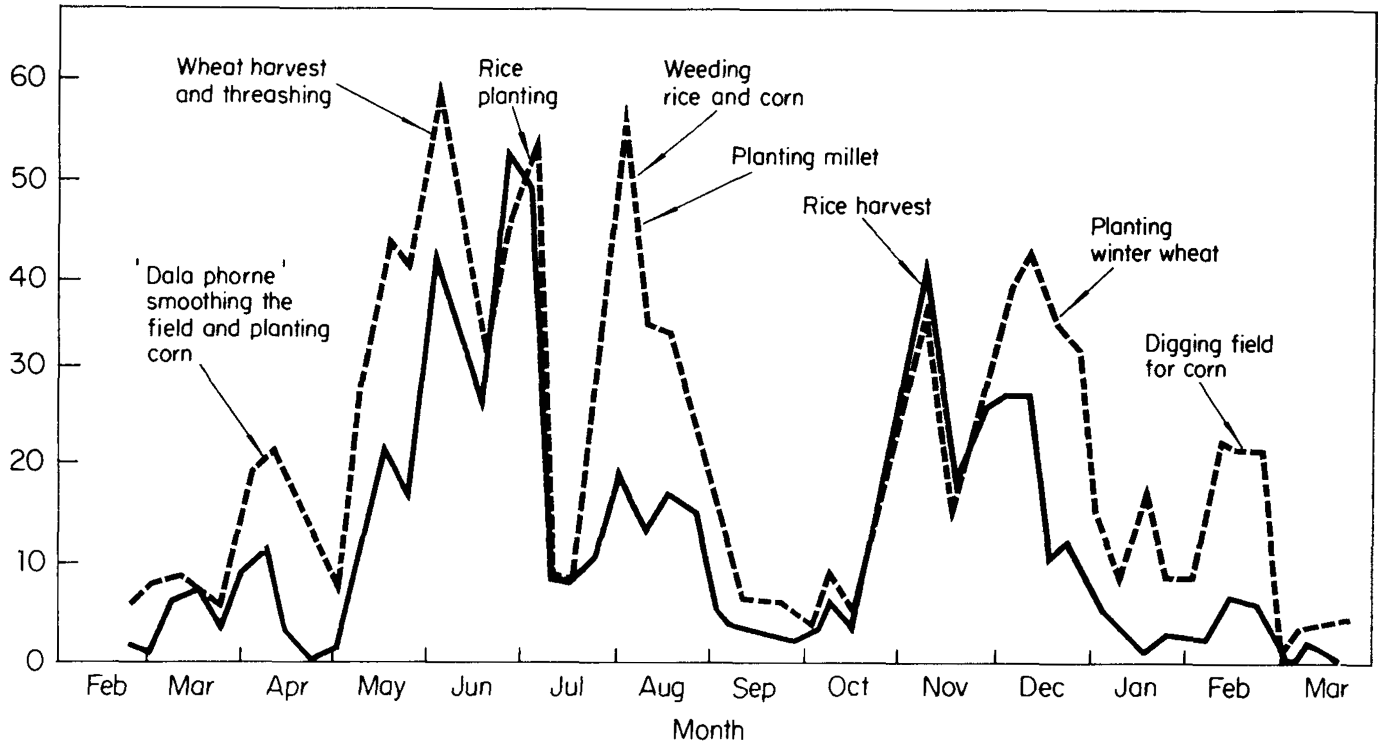

Figure 15.8: Weekly activity pattern—agriculture(for adult population in Bakundol).

true of the other rice growing areas as well: men's labor input is higher in the main crops while declining in the subsidiary crops.

Decision making role of women in agriculture

The data on decision making include overall decision making in agriculture. A breakdown of decision making for each crop is not possible. However, since rice farming is one of the main activities in the agricultural production system the data presented represent the decision making pattern for rice as well.

In most communities the women have an important role in agricultural decision making. In agriculture two types of farm management decisions are recognized: on labor allocation and on agricultural production. Table 15.6 presents the aggregate data on the male/female decision making responsibilities in the process of agricultural production. On labor allocation men take more decisions (46.2 per cent by males versus 39.4 per cent by females). In agricultural decisions women make an overwhelming majority of the decisions, particularly those concerning the use of their own or improved seeds (20.7 per cent by men and 60.4 per cent by women) and the seed selection process (81.2` per cent of the decisions are made by women). These decisions are crucial to the production yield in agriculture.

Table 15.6 Farm management decisions for 8 village sample.

Labor allocation

Type of Decision	Sex Male	Female	Both	Traditional	Total
Arranges exchange labor	35.2	35.7	18.3	10.8	100.0
Arranges wage labor	42.4	29.3	15.7	12.6	100.0
Decides others work outside home	56.2	43.8	–	–	100.0
Decides own work outside home	51.7	48.3	–	–	100.0
All labor decisions	46.2	39.4	8.6	5.8	100.0
Agricultural decisions					
What crop to plant?	18.0	30.2	12.8	39.0	100.0
Own or improved seed?	20.7	60.4	10.9	8.0	100.0
Amount & kind of fertilizer	32.5	39.7	13.4	14.4	100.0
All agricultural decisions	25.3	42.1	12.6	20.0	100.0
Seed selection					
Who does seed selection?	10.8	81.2	8.0	–	100.0

Source: Table constructed from eight village studies.

There are considerable inter-community variations in agricultural decisions. The highest female input in farm management decisions was among the Lohorung Rai (72.7 per cent) and the lowest female input (17.1 per cent) was among the Maithali community – the only group among the villages studied where women actually had less say in farm management decisions than men. This is also the community of the eight where female labor time input is the lowest in agricultural activity as compared to men (23.4 per cent input by females and 76.5 per cent by males). The labor time input in agriculture of the Lohorung Rai women is the highest of the 8 communities (52.4 per cent of males and 47.6 per cent of females). As already discussed above, the degree of decision making responsibility not only coincides with the strength of the inside/outside dichotomy in a community but also directly coincides with the level of labor time input.

Impact of new technology on women

The Status of Women Project was not specifically concerned with assessing the impact of changing agricultural technologies on women and hence this kind of data was not collected. However, the inter-community comparison of sexual division of labor in the task of fertilizer application suggests an impact of agricultural inputs, such as chemical fertilizer, on women which will be discussed presently.

Other studies (Pudasaini, 1980, Karki, 1981; Malla, 1983 and others) relating to modernization in rice farming show that there has been only a limited introduction of modern technology in Nepal. Tractors and pumpsets represent the two most dominant forms of mechanization in Nepal, in addition to the introduction of new inputs such as chemical fertilizers and new variety seeds.

One study (Padasaini, 1980; 5–7) shows that the annual per hectare human labor absorbed by machine users was much higher than that absorbed by traditional farmers. Except for land preparation annual labor input increased for other operations such as dike repair and irrigation, transplanting/planting, fertilizing and spraying, weeding and harvesting and threshing. The maximum labor input increased for weeding and harvesting and threshing. According to the Status of Women Project findings these are the operations which are almost exclusively performed by women, particularly weeding. Although the differential impact on male/female is not given, it can be safely assumed that the increase in the labor requirement due to introduction of mechanization would be for female labor. This implicitly indicates additional heavy demands on female labor. The same study showed that for these operations family or exchange labor was mostly used.

Another study (Karki, 198 1: 8–10) showed that the use of modern varieties of seed and fertilizer in paddy production resulted in a substantial increase in labor input (135 days vs. 107 days per hectare).

Most of this additional labor was required in preharvesting and harvesting operations while labor use in land preparation and crop establishment remained almost the same for both traditional and modern varieties. The reason given for this increase in family labor was that modern varieties required more careful and timely weeding spread out throughout the crop growing period. This also indicates an increase in female labor as this operation is mainly performed by women.

According to the findings of the Status of Women Project as already discussed above, men and women shared equally in the traditional use, preparation and application of manure. But in the application of chemical fertilizer men undertook the task rather than women (see Table 15.1). Most of the training on agricultural technologies and dissemination of information on new technologies have focused on men. This is an example of how the lack of participation of women outside the community and the lack of government action to consider social behaviour patterns in development planning has led to women being excluded from the dissemination of information on new technology in agriculture. If this is to continue women will soon be contributing less than they have done up to now which means of course, that the 'new technology' has had an adverse impact.

Such adverse effects of new technology in agriculture and rice farming have been amply documented in most of the developing countries. (Pradhan, 1983).

Women's access to institutional credits

Table 15.7 represents the use of credit by the villagers and their attitude towards taking such credit. This has important implications for

Table 15.7 Attitude/reasons for not taking institutional loans* (in number)

Reasons	Male	Female	Both
No need for loans	30(16.1)	68(24.1)	98(20.9)
Do not like to borrow	15(8.0)	37(13.1)	52(11.1)
Interest rate is too high	15(8.0)	12(4.3)	27(5.8)
Repayment schedule too strict	31(16.6)	32(11.3)	63(13.4)
Forms difficult to write	9(4.8)	23(8.2)	32(6.8)
Not treated with respect	3(1.6)	4(1.4)	7(1.5)
Do not know how to get credit	12(6.4)	27(13.1)	49(10.4)
No connection with institutions	6(3.2)	21(7.5)	27(5.8)
Others	66(35.3)	48(17.0)	114(24.3)
Total	187(100)	282(100)	469(100)

* The data are for the eight villages.

providing credit services for the support of agricultural development at the village level. In all 8 villages it was found that only 15 per cent of the females and 17 per cent of the males took institutional loans. Traditional money lenders and relatives and friends are still the major source of credit for the village. It shows clearly that more women than men lacked skills in dealing with credit institutions, faced bureaucratic difficulties of filling out forms, lacked connections with office personnel and lack knowledge of the procedures for getting loans.

Recommendations

The three sector model of the rural household economy is a sub-system of the national economic and social system and women's contributions can be perceived as a particular feature of the rural economy. Such a perspective provides a holistic view of women's intrafamilial and extra-familial roles as mother, family maintainer, subsistence farmer, petty traders and migrant labor. The framing of any strategies, policies or programs should be done from a systems perspective and holistic view of women. It is no longer adequate to deal only with women's specific problems and issues from the narrow perspective.

It has been rightly pointed out that institutions and bureaucratic systems limit women's access to technology, credit and extension programs. It is also pointed out in the body of this paper that the introduction of new technological inputs has had adverse effects on women because of the failure of governments to take into consideration the socio-economic realities of the rural household economy. Therefore, the transformation of rural life has to come from socio-political, economic and agricultural policies based on the dual strategies of institutional reforms and technological changes in the traditional rural economy. Institutional systems must be developed so that there is room to accommodate women and their multi-faceted roles in the rural households.

The training of female agricultural extension agents has been repeatedly suggested and it is re-emphasized here. In addition it is recommended that all extension agents, male and female, should be instructed and made aware that women farmers are equally important clients for their services. Those who supervise the extension agents should monitor the frequency and quality of contact with the rural women. Efforts should be made to ascertain the type of assistance needed by women. It has been shown that the responsibility for certain crops like rice, wheat, millet and corn is sex specific. The sexwise responsibility for particular crops, which may vary from region to region, and sex-specific nature of various agricultural operations should be considered in targeting the agricultural agents' extension approach.

In Nepal women have little access to agricultural credit, the main reasons being that women do not have collateral or lack the bureaucratic knowhow to interact with formal credit institutions. However, there are programs like the Small Farmer Development Programme (SFDP) and the more recent Priority Sector Production Credit for Rural Women. There are Women's Group Organizers (WGOs) who function in each of the SFDP program areas and Women Development Officers (WDOs) are being trained to function and guide the rural women in the program areas. It is recommended that these WGOs and WDOs assist women not only in obtaining credits but also in gaining access to improved production technologies and inputs, making women aware of the existing facilities, encouraging them to use such facilities and teaching them the process/procedures in getting access to such facilities/services.

As women play a very crucial role in the production yields of the various crops by processing the crops as well as in the overall production process, it is recommended that training programs and projects should set aside a minimum percentage for female participation and that a certain percentage of the budget be allocated specifically for women. This should happen in project such as the following:

(a) training programs for farmer leaders and contact farmers to impart knowledge of technical skills and new agricultural equipments;
(b) distribution of agricultural inputs such as fertilizers, seeds and implements and agricultural credit;
(c) all Integrated Rural Development Projects (IRDP) which are operating (there are seven such projects operating in the country in different regions); and
(d) the Rural Save Grain Project (RSGP) which focuses on imparting training and information on post harvest food grain losses.

As it is evident that the new technologies tend to have adverse effects on women, it is essential that evaluations of the differential impacts of various technologies on men and women be made to provide a guide in introducing or transfering new technology to benefit women.

Notes

1 Kathmandu Valley is one of the main rice growing areas consisting of Kathmandu, the capital, Bhaktapur and Lalitpur districts, the

oldest cities in Nepal. Newars were the original inhabitants of the Valley and to-day they form the bulk of the population. Among the Newars the *Jyapus* are the farmer class who have highly developed agricultural practices within a traditional style and who made the valley one of the most fertile areas in the world.

2 Taking an average for 1955/56 to 1960/61 the paddy per hectare of arable land in Japan was 4.56 tons and 2.54 tons in China (Ishikawa, 1967:70). Around the 18th century the paddy yield in Kathmandu Valley had already reached 4 *muris* per ropani of land which is 3.9 tons per hectare (Hamilton, 1819: 225). In recent years, taking the average for 1970/71 to 1976/77, the paddy yield per hectare is 3.46 tons in Kathmandu Valley. (HMG, 1979: 44, 45).

3 The Status of Women in Nepal was a three year research endeavour of a team of eight members, including the author, carried out by the Centre for Economic Development and Administration (CEDA), Tribhuvan University, Kirtipur, Kathmandu, under a grant from USAID. For a detailed discussion of the theoretical basis for the methodology employed see—*Field Manual: Guidelines for Collection and Analysis of Data on Status of Women in Rural Nepalese Communities,* prepared by the Status of Women Team members, (CEDA, 1979). The series of eight monographs (two yet to be published) and an aggregate analysis based on the eight individual village studies comprise *Volume II Village Study Series.*

4 As reported by Acharya (1979:45) the census definition of 'economic activity' covers 'working in agriculture, trade, industry (weaving, oil pressing, sewing and manufacture of domestic utensils and weapons), and receiving cash or kind income in the form of wage, salary of profit 'as well as working in any of these activities as' unpaid family workers'; when this definition is applied to the 12 major activity categories used in the time allocation study, the 'conventional economic activity' or 'labor force participation' include animal husbandry, agriculture, manufacturing (i.e. weaving, basket making etc.) and outside income earning activities (i.e. wages and salary work, trade and business.

5 This category includes fuel collection, hunting and gathering, water collection, household construction and food processing. All these activities are performed commercially in the industrialized/urban sectors of the economy and particularly so in the west. As such these activities are categorized as economic and are included in the labor force participation, since it would be arbitrary not to include them as 'economic' in the rural household subsistence production just because the family labor is unpaid.

6 The domestic activities include cooking, cleaning, laundry, shopping, child care and other household chores. The production model used

by scholars of 'New Home Economics' (Becker; 1965, Gronau; 1973 and Evenson, et al., 1979), as applied in the Philippines time allocation study, takes these services as economic and credits them in the household income which is the concept of full income. But in Our study in Nepal 'domestic service' has not been valued in monetary terms because of the difficulty of assigning an alternative value and also because these services are unmeasurable and cannot be classified by a market value.

7 The time allocation in Bulu was observed for 6 months of the peak agricultural season whereas in Bakundol the observation was for a whole year.

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16 Technological infusion and employment conditions of women in rice cultivation areas

Sarthi Acharya and Praveen Patkar

Introduction

Technological change and its impact on traditional under-developed societies which began modernization through external impulse rather than through an indigenous evolution, has been of intense discussion in the last two decades. This is particularly so in populous Asian countries where large numbers in the society were (perhaps) detached from the low productivity/earning equilibrium of their stable occupations and were exposed to market imperatives. It is alleged by some that women in rural labor and small farmer households have been particular targets of the adverse impact – that they have been displaced from their traditional jobs in certain cases, while in others the 'double burden' on them has intensified. They have also lost the little control they earlier possessed on the household budget. A more detailed documentation on these aspects has been provided by Agarwal (1981).

The impact of technology, which includes a transfer of a whole matrix of socio-economic coefficients, has had a different impact on different segments of the rural economy. The peasant families consider it a matter of prestige to withdraw the female labor force from work in most areas as affluence increases, which adversely influences the social status of women within a household. An inverted U shape supply curve is hypothesized for women labor (Papola and Mishra 1978, Parthasarthy and Rao 1980) in these conditions. Amongst the land tenants, share-cropper eviction in some areas has assumed significant dimensions which has forced some peasants to join the ranks of the landless laborers. This has been particularly true for women workers as reflected in the census data. Such examples are repeatedly found in the literature. The impact of technology on rural women has often tempted emotive judgement to suggest that outmoded forms should be preserved with a view to avoid women's destitution. Such temptations however need cautious judgement because the technology per se does not promote destitution, land evition or alienation. Its neutrality or non-neutrality depends upon the socio-economic environment in which it is introduced and it is the interface of social and technological factors which determines the final outcome. Instead, it is important to look into the different facets of the negative impact on women's status during transition and identify the cause. This is a macro level policy question.

Technological change in agriculture can broadly be identified as affecting a rural community through an interface of four categories. These are (a) the interlocking behavior of land, labor and capital, (b) gender specific discrimination evolved through (a) above, (c) the population density, location specificity, agro-climate and culture and (d) created linkages to the urban and global market. These four categories embed a temporal dimension and as such need 'before' and 'after' studies of the effects of technology introduction. Moreover, micro and macro analysis are necessary to incorporate the simultaneous impact of all the factors. Not all of this is being tried here. In this paper we try to compare the employment, wage and nutrition status of women in five predominantly rice producing states in India, namely, Kerala, Tamil Nadu, Andhra Pradesh, Orissa and West Bengal, temporally as well as cross-sectionally vis à vis the modernization efforts promoted. The data for this purpose have been drawn from the RLI (Rural Labor Inquiry) reports, several publications of the Ministry of Agriculture and the NSSO (National Sample Survey Organisation).[1] The period of comparison is 1964-65 through to 1977-78 which could be taken to be in the pre-modern technology and post-modern technology infusion periods. Being a macro level study, it cannot concentrate on the specific impact of each of the components of technology.

In section 2, a conceptual frame-work on women's role in agriculture is detailed and in section 3 a cornparison of the employment, wage, occupational division of labor and nutritional status of women workers is made for 1964-65 through 1974-75 (extended to 1977-78). The paper is concluded in section 4. An appendix is added to illustrate the impact of post harvest rice milling on female employment.

Conceptual framework

Modern technology in rice cultivation has been identified as somewhat similar to other crops, namely biological-chemical fertilizer and hybrid seeds application in assured irrigation areas, and the use of tractors for tilling, using mechanical energy for irrigation, threshing etc. However, a major deviation in rice technology from that of other crops has been the post harvest operation where rice mills have been introduced in some prosperous areas. Each of these is discussed in turn in respect of their impact on women's employment.

The biological-chemical technology helps in growing high yielding and short duration crops which augment labor use in two ways. The first is through the enhancement of labor use in each activity performed, i.e. soil preparation, sowing, manuring, irrigation, weeding, interculture, harvesting and post harvest operation, and the second is due to the short duration of each crop which permits the number of crops in each region to increase to 2 or even 3 in a year. The extra labor required thus owing to these two phenomena can be 75 to 100 per cent more than that used in the traditional crops (see ILO 1979, Lavania et al., 1974 and Singh et al., 1973). Some shifts however take place within the human labor use pattern between men and women. There are traditionally some 'women prone' jobs like weeding, harvesting, post harvest operations etc. in paddy, in which they acquire some 'natural' skills owing to the traditionally established division of labor. With the introduction of new technology, there is a likelihood of a rearrangement of labor in these traditional jobs. The rearrangement of jobs occurs because there is a deviation in each job, such as, in plant protection, chemicals are sprinkled by sprinkling equipment, plowing is often twice as intensive, irrigation is repeated, weeding is more intense and sometimes helped by mechanical equipment and so on.

This needs some reorientation as wel1 as alteration in the labor supply curve of men and women to avoid displacement. However, since education, training and demonstrations for the new operations are largely attended by men, the operations which require relatively fewer skills and are more irregular are left for women. This way they get lower wages and occasionally withdraw from the labor-force owing to lack of occupation — a typical syndrome termed as 'not seeking but available for additional work' (Bardhan 1978). In agricultural extension work and training schemes knowledge is imparted predominantly to men, the instructors are male and even the Government attitude until recently has been that women's primary identity is as wives, daughters and mothers or hired unskilled labor. The belief extends to identifying 'modernization' with the withdrawal of female labor from tangible and explicit economically gainful occupations (Patel 1979). The Government programmes through the last 30 years. from the Community Development Programmes of the 1950s to the Integrated Rural Development Programme (IRDP) now, have all been principally promoting women's activities in rural areas through the Mahila Mandals and Applied Nutrition Programmes whose activities are restricted to child care, nutritional requirements, hygiene, social welfare and household reform. The principal issue of women's economic independence has for the first time been recognized in the sixth Five Year Plan (1980-85), wherein there are specific women's components towards economic independence within the IRDP, including recognition for joint ownership of land. However the planning exercises do not have a separate employment target for women, nor is there a separate financial allocation for women's development.

The mechanical technology has, in isolcation, been labor displacing and land consolidating. In comparison to a tractor, manual tilling requires about 4-5 times more laborers, and 8 bullocks are replaced by each tractor. Tilling has little effect upon women's employment directly because women do not traditionally till land. The mens' labor displacement from tilling affects women's work indirectly through a rearrangement which displaces women's labor elsewhere. The tractor's negative effect on threshing is in directly displacing women's labor as this operation is 'women prone'. Indian tractors are usually more than 35 horse power in strength and economies are reaped only when the land size is large. This leads to a tendency towards land consolidation which is labor displacing. Tractor operation is a 'prestigious' job and is, without exception, controlled by men. The overall effect of the tractor is however more productive, as an optimum crop rotation and a cropping intensity of 2-3 is permissible. There is also a chance of more permanency in employment in tractor endowed farms (Binswanger 1978). The total employment effect of a tractor is however as yet inconclusive because the labor displacement effects of a tractor are compensated by the extra activity created through more intensive land use (Mehra 1976). But the division of labor becomes sharper, with the managerial operations like control of machines, land, and marketing falling within men's purview and household chores for women. Land consolidation also converts a few marginal and small farmers into landless laborers, and in this category, the women increasingly become unskilled landless laborers.

The number of tractors per one thousand hectares of land under cultivation were 1.52, 0.90, 0.44, 0.30 and 0.18 respectively in the five states, Tamil Nadu, Kerala, Andhra Pradesh, Orissa and West Bengal. This is a small number which is unlikely to have an overt impact on the absolute quantum of employment.

We will thus concentrate on modern technology as a package of biological-chemical technology, mechanization and improvement. A priori, our hypothesis is that overall employment measured in person-days is larger in crop production with the use of modern technology but the roles of men and women workers change to the relative disadvantage of women owing to existing social relations and biased interventions. Post harvest technology of rice-milling is outside this hypothesis and is to be treated separately because it completely replaces manual operations by machines (see Timmer 1974).

The whole transition has two facets. The first facet is of land alienation of the marginal farmers and share croppers which affect both men and women. It is not discussed here further. The second is gender specific. Most development theories and strategies assume the existence of a unit household welfare function. The intra-household ‘politics’ as part of the social mileu influenced by external factors, is of very recent recognition (Sen and Kynch 1983, Agarwal 1981). The Indian household is traditionally patriarchal with male domination in-built in each role and operation. Thus even if the women perform one half to two thirds of the total work, it goes unrecognized. All the jobs which assume economically tangible/superior positions, i.e. new jobs or education and technical facilities, automatically go to men. It is apparent that technology per se can be neutral and advantageous to all, but the way the changes are subsumed within the existing social relations in peasant societies, are the basis of inequity, and have stayed outside the purview of public policy.

Elsewhere (Acharya 1983), it has been argued that these relations could stay untransformed indefinitely unless a situation of labor shortage is created, for the non-socialist developing countries. This however does not mean that planned intervention cannot alter the situation. The intensification of the use of land augmenting technology can create a situation of relatively larger labor demand; and with its promotion, coupled with more women oriented extension programs for production activities and ownership of land for women, there is a distinct possibility of raising the status of women in rural households.

Comparative analysis of rural labor inquiry data: 1964-5 – 1974-5

Rice technology of the modem variety was evolved around 1967, and by the early 1970s it was gradually introduced in India. Its application was restricted to assured irrigation regions in the South and in the East.

Modern rice varieties were introduced in the Punjab region as a minor crop a little later. (Even today, the adoption of modern technology is limited in India for want of irrigation.)

Table 16.1 shows the proportions of women agricultural laborers to total agricultural laborers in the two periods. It is evident from the table that the women's participation rates have increased in all the states. The rates of change are higher in the Eastern States, while the absolute levels are high in South.

Table 16.1 Numbers of women agricultural laborers as a percentage of total agricultural laborers in agricultural labor households (1964/5 and 1974/5).

States	1964/65	1974/75
West Bengal	14.2	19.02
Orissa	27.2	34.72
Andhra Pradesh	42.3	43.58
Tamil Nadu	45.0	45.71
Kerala	37.7	41.07

Table 16.2 shows the average size of agricultural households and the average number of men and women wage workers. It is observed that not only has the size of households increased, the number of wage earners too has increased in each household. But the proportion of

Table 16.2 Average size of agricultural labor households and average number of men and women workers.

1964/5 and 1974/5

States	Average household size		Average wage earners		Average women wage earners per household	
	1964/5	1974/5	1964/5	1974/5	1964/5	1974/5
1. West Bengal	4.85	5.14	1.56	1.90	0.25	0.24
2. Orissa	4.41	4.64	1.77	2.05	0.50	0.29
3. Andhra Pradesh	4.06	4.24	2.30	2.47	0.98	0.43
4. Tamil Nadu	4.01	4.21	2.10	2.37	0.94	0.45
5. Kerala	5.54	5.63	2.08	2.28	0.82	0.42

Average Women Workers ÷ Average Total Workers

	1964/5	1974/5
1. West Bengal	0.16	0.13
2. Orissa	0.28	0.12
3. Andhra Pradesh	0.43	0.17
4. Tamil Nadu	0.45	0.19
5. Kerala	0.39	0.18

women earners per household and women earners as a proportion of total wage earners has fallen.

Table 16.3a and 16.3b shows that the intensity of employment (i.e., the number of days worked per person per year) in wage work and self-employment. The self-employment of women has increased as a ratio of self-employment of men in four out of the five states. In Orissa it has decreased by 3 per cent but the absolute magnitude is so high that this fall is insignificant. However, the overall intensity of employment per person has fallen for both men and women in all states except Andbra Pradesh where the intensity of female employment has risen. The fall in wage employment intensity has more than offset the rise in self-employment, as the magnitude of the latter is small compared to both the size and the fall in the wage employment intensity. The fall in employment intensity as shown in Table 16.3b ranges between 5 and 20 per cent for male labor and between 16 and 28 per cent for female labor. This depicts the higher sensitivity of female employment intensity compared to male labor.

Table 16.3a Average annual full days of wage and other employment of men and women in agricultural labor households.

States	Wage labor				Self-employment				Total engagement			
	1964/5		1974/5		1964/5		1974/5		1964/5		1974/5	
	M	F	M	F	M	F	M	F	M	F	M	F
West Bengal	197	246	233	157	16	3	22	25	313	249	255	182
Orissa	256	176	191	126	36	31	46	38	292	212	237	164
Andhra Pradesh	231	118	214	148	24	14	28	18	255	142	242	166
Tamil Nadu	208	149	171	126	18	9	22	14	226	167	193	140
Kerala	187	157	150	114	11	8	19	14	198	168	169	128

Table 16.3b Percentage change in the intensity of employment over the decade 1964/65 – 1974/75.

	Wage labor		Self employment		Total	
	M	F	M	F	M	F
West Bengal	(–) 21.5	(–) 36.2	(+) 37.5	(+) 733.3	(–) 18.5	(–) 28.9
Orissa	(–) 25.4	(–) 28.4	(+) 27.8	(+) 22.6	(–) 118.8	(–) 22.6
Andhra Pradesh	(–) 7.4	(+) 25.4	(+) 16.7	(+) 28.6	(–) 5.3	(+) 23.9
Tamil Nadu	(–) 17.8	(–) 15.4	(+) 22.2	(+) 55.6	(–) 14.6	(–) 16.2
Kerala	(–) 19.8	(–) 27.4	(+) 72.7	(+) 75.0	(–) 14.6	(–) 23.8

To separate the impact of technology and production organization from that of demographic factors and the effect of new lands brought under the plow, the density of workers per hectare of net sown area is calculated for the two periods under consideration, by merging data from different sources.

These figures are given in Tables 16.4a and 16.4b. It is evident that the number of workers per hectare has increased in all cases, which is the combined impact of the changes in labor force participation rates and demographic pressure. It follows from column 5 of Table 16.4a that these percentages vary from 5.5 in Andhra Pradesh to 74.2 in Kerala. Table 16.4b shows these percentages separately for male and female workers. A comparison of columns 2 and 3 of Table 16.4b with columns 6 and 7 of Table 16.3b yields very crude combined effects of cropping pattern, cropping intensity and modern variety crop adoption.

Table 16.4a Labor force per hectare of net sown area

	1964/5	1974/5	% change
West Bengal	1.25	1.42	13.6
Orissa	1.03	1.26	22.3
Andhra Pradesh	1.27	1.34	5.5
Tamil Nadu	1.64	2.01	22.6
Kerala	1.20	2.09	74.2

Table 16.4b Percentage change in labor force per net sown area for men and women.

	M	W
West Bengal	12.2	22.2
Orissa	21.9	23.2
Andhra Pradesh	11.4	(–) 3.5
Tamil Nadu	20.0	26.6
Kerala	64.6	95.12

Another index is computed to estimate directly the change in the intensity of employment. If X_1 and X_2 are the intensities of employment in the two periods, Y_1 and Y_2 are the labor force strengths and Z_1 and Z_2 are the net sown areas in the two periods, then the expression,

$$\frac{X_2 . Y_2}{Z_2} \Big/ \frac{X_1 . Y_1}{Z_1}$$

would measure the change in the labor used per hectare over the decade. This will represent the combined effects of modern technology and agricultural rationalization. The measure is separately calculated for men and women workers for 1964/5 and 1974/5 and presented in Table 16.4c.[2] This table highlights two pertinent observations. Male and

Table 16.4c Labor use (person-days) per net hectare (aggregate average) for men and women.

States	$\frac{X_1 \cdot Y_1}{Z_1}$ M	W	$\frac{X_2 \cdot Y_2}{Z_2}$ M	W	Percentage change M	W
West Bengal	334.91	44.82	306.00	40.04	(–) 8.60	(–)10.66
Orissa	213.16	63.60	210.93	60.68	(–) 1.05	(–) 4.59
Andhra Pradesh	170.50	80.94	188.76	91.30	(+)10.71	(+)12.80
Tamil Nadu	226	106.76	231.60	113.40	(+) 2.48	(+) 6.10
Kerala	156.42	68.88	219.70	102.40	(+)28.86	(+)48.66

female labor use have fallen in West Bengal and Orissa while they have risen in the other three southern states. In all cases the percentage changes show a larger variation in female labor use than in male labor use. This sensitivity is a reflection of the higher elasticity of labor supply/withdrawal of female labor from the labor market, which is a typical reflection of their being used as standby workers rather than as permanent ones. It is indicated therefore that men control land and decide the household labor time disposition. The second observation concerns the absolute size of labor input. In West Bengal, women's labor use is abysmally low. It is higher in South, and somewhat comparable to men's labor input in Kerala and Tamil Nadu only.

Table 16.5 shows the operational percentage distribution of labor use of men's and women's labor for the two periods under consideration. In this table it is important to distinguish between the labor input of agricultural laborers and cultivators because the division of labor between different occupations is a decision variable with the cultivators. These data pertain to agricultural labor and it is observed that plowing is not their dominant occupation. Moreover, except in Kerala (for men) the percentage distribution of labor time disposition has fallen in plowing, indicating that land control by the owners has risen over time. (Plowing is an operation which is normally controlled by the owner-cultivators.) The so-called 'women prone' occupations, such as transplanting, show a larger proportion of women than men in both the periods. For each state however there are differences, depending upon the prevalent labor market conditions. Harvesting is the single most important occupation for women's labor. In West Bengal and Kerala, harvesting has increased its proportionate share in time disposition for both men and women, for Orissa and Tamil Nadu it has fallen for both, and for Andhra Pradesh it has fallen for men and risen for women. It may be indicative of a possible labor intensive harvesting in the first case, larger use of mechanical threshers in the

Table 16.5 Percentage distribution of days of wage paid employment of regularly occupied men and women in different agricultural occupations.

States	Planing		Sowing		Transplanting		Weeding		Harvesting		Others		Total	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1964/5														
West Bengal	19.57	5.78	1.74	0.72	6.98	15.42	11.43	17.35	16.86	10.82	43.41	49.88	100.00	100.00
Orissa	35.66	10.76	4.43	4.43	3.73	13.31	2.57	2.85	2.85	24.01	36.07	29.60	100.00	100.00
Andhra Pradesh	21.18	3.90	2.55	3.99	5.87	10.48	5.10	10.39	25.26	33.90	40.04	37.34	100.00	100.00
Tamil Nadu	22.02	2.50	0.80	2.50	2.42	14.30	5.11	23.48	23.59	37.19	46.05	20.02	100.00	100.00
Kerala	30.15	6.39	1.51	1.42	0.60	14.47	1.21	12.77	8.44	21.99	58.09	43.92	100.00	100.00
1974/5														
West Bengal	9.52	0.68	2.38	2.72	5.24	13.61	12.38	13.61	36.19	41.50	34.29	27.89	100.00	100.00
Orissa	12.07	2.70	0.00	1.80	10.98	25.23	13.41	20.72	23.78	19.82	34.76	29.73	100.00	100.00
Andhra Pradesh	12.43	0.72	2.07	3.62	4.66	15.94	9.33	21.74	22.80	38.41	48.70	19.51	100.00	100.00
Tamil Nadu	18.92	1.69	0.68	5.08	6.08	19.49	8.78	22.88	20.95	33.05	44.59	17.80	100.00	100.00
Kerala	32.61	1.85	1.45	3.70	1.45	21.30	2.17	18.52	9.42	31.48	52.90	23.15	100.00	100.00

second and a male labor to female labor substitution in the third case.

There is a sharp decline in the proportion of female labor under the job category ‘others’. This points to the fact that the division of labor has become sharper over the period for female labor. Since ‘others’ include all kinds of not very specific jobs like transportation, some post harvest operations, guarding the farms against birds or stray cattle, buying inputs from the market, implement sharpening and so on, they are spread over the year (or at least the crop seasons). A fall in this, with a rise in the harvesting engagement indicates a shift towards an increased seasonal concentration of female employment. This aspect is partially reflected in Table 16.6. It is shown that in three out of the five states, namely West Bengal, Orissa, and Kerala, the number of idle days for want of work are larger for female labor than for male labor. Further, the number of days of idleness have gone up in all states except in Tamil Nadu where it has marginally decreased.

Table 16.6 Average number of days not worked by regularly occupied men and women workers in agricultural labor households.

States	Want of work		Other reasons		Unclassified		Total	
	M	F	M	F	M	F	M	F
				1964/5				
West Bengal	36	66	8	18	3	10	47	94
Orissa	40	101	6	8	9	32	55	141
Andhra Pradesh	16	98	7	26	7	34	30	158
Tamil Nadu	103	152	20	26	7	11	130	189
Kerala	102	106	38	39	4	18	144	163
				1974/5				
West Bengal	88	146	17	16	–	–	105	162
Orissa	92	156	21	32	–	–	113	188
Andhra Pradesh	60	101	34	64	–	–	94	165
Tamil Nadu	96	138	25	35	–	–	121	173
Kerala	122	153	57	60	–	–	179	213

Tables 16.7a, 16.7b and 16.7c contain details of the prevalent wages paid to male and female workers in 1964/5 and 1974/5 unadjusted for inflation. To begin with, the degree of monetization of remuneration is discussed. Table 16.7b shows that males get a larger proportion of cash in their pay packet than females in all states in both the periods. It may however be premature to claim that a larger cash component in mens’ wages permits them a high degree of freedom in expenditure while the wages in kind paid to women are spent on household consumption. There is no uniform reduction in the payment in kind over time in all the States. In West Bengal, Orissa and Kerala it increases for female labor while for men’s labor it increases in West Bengal and Kerala. It is

Table 16.7a Average daily earnings of men and women in agricultural occupations (rupees).

State	1964/5						1974/5					
	Cash		Kind		Total		Cash		Kind		Total	
	M	F	M	F	M	F	M	F	M	F	M	F
West Bengal	1.33	0.92	0.48	0.44	1.81	1.36	2.06	1.57	1.43	1.26	3.49	2.93
Orissa	0.73	0.42	0.60	0.47	1.33	0.89	1.50	0.78	1.15	1.05	2.64	1.83
Andhra Pradesh	0.75	0.52	0.46	0.33	1.21	0.85	1.91	1.41	0.74	0.55	2.65	1.96
Tamil Nadu	0.97	0.56	0.42	0.29	1.39	0.85	2.79	1.58	0.85	0.74	3.64	2.32
Kerala	1.77	0.81	0.34	0.42	2.11	1.23	4.53	2.59	1.09	1.69	6.02	4.28

Table 16.7b
Percentages of wages in kind to total wages

Table 16.7c
Proportion of women's wages to men's wages

Table 16.7d
Real wages of men and women working in agricultural occupations (*Base price 1964/5)

	16.7b 1964/5		16.7b 1974/5		16.7c 1964/5	16.7c 1974/5	16.7d 1964/5		16.7d 1974/5	
	M	F	M	F			M	F	M	F
West Bengal	0.27	0.32	0.41	0.45	0.75	0.81	1.81	1.36	1.85	1.50
Orissa	0.45	0.53	0.44	0.57	0.67	0.69	1.33	0.89	1.16	0.80
Andhra Pradesh	0.38	0.39	0.28	0.28	0.70	0.74	1.21	0.85	1.25	0.92
Tamil Nadu	0.30	0.34	0.23	0.31	0.61	0.64	1.39	0.85	1.64	1.04
Kerala	0.16	0.34	0.18	0.39	0.58	0.71	2.11	1.22	2.52	1.80

a common practice in rural India to pay wages in kind for the harvest operation. Since the time disposition for harvest operations is high payments in kind may be high owing to this.

Table 16.7c shows the proportion of women's wages to men's wages. It is evident that the gap has reduced in all the states. While Kerala has been the most progressive in the wage gap reduction rate, West Bengal has been able to reach the lowest wage gap level.

Table 16.7d contains estimates of real wages in agricultural occupations for men and women at base price 1964/5. There has been a marginal rise in real wages in all states for both sexes except in Orissa where it has fallen. Data on occupation specific wages (not presented here) show no inter-occupation variation but reflects inter-regional variation. The tendency towards occupational division of labor has not affected wages because the labor market has all along exhibited excess labor supply in both sexes.

The latest broad based data on the socio-economic profile of women are available from the 32nd round of the NSS (National Sample Survey) for 1977/8. Its analysis strengthens the results obtained so far as well as helping to generalize them since the NSS data covers all sections of the society (unlike the RLI). The principal observations made and reiterated are that women suffer from a higher instability in employment, their intensity of work is less than that of men, and that while more than 50 per cent of the men workers are cultivators, more than 60 per cent of women workers are agricultural laborers. There is a persistent gap in the wages of men and women workers in addition to the fact that minimum wages are not adhered to anywhere. An added observation we made concerned the gender-specific consumption pattern. More women are below the poverty line than men in all the states. Also the poverty gap is independent of the wage gap, which points to the fact that intra-household relations are inequitable for women. (See Tables 16.8 to 16.11).

Over this period, there have been efforts to introduce modernization in agriculture and to introduce technology but the effects have not been particularly successful in the rice-producing states. There has been a 0.9 per cent per capita compound agricultural growth in West Bengal with the output per capita not reaching 1000 rupees (at 1960/1 prices), a 3 per cent per capita growth in Orissa with the output at a little over 500 rupees, a less than 1 per cent per capita growth in Andhra Pradesh with output not exceeding 500 rupees, a negligible output growth in Tamil Nadu with a similar low equilibrium, and a negative growth in Kerala with output touching about 1000 rupees over 1960-1980. Most of the output growth is attributed to more land brought under cultivation rather than intensive cultivation. Rao (1983) has noted that the impact of new technology application has been so limited that its most

Table 16.8 Labor force participation rates and unemployment by usual, and current daily status (percentage) 1977/78.

		Labor force Participation		Unemployment	
		M	W	M	W
West Bengal	US	61.96	14.33	2.19	3.42
	CDS	60.23	9.89	5.61	0.98
Orissa	US	65.55	27.05	1.32	1.20
	CDS	61.44	18.95	4.60	1.83
Andhra Pradesh	US	71.13	47.90	1.46	2.50
	CDS	67.64	39.64	5.57	5.68
Tamil Nadu	US	70.74	42.09	1.94	2.64
	CDS	65.63	36.09	9.80	6.18
Kerala	US	57.11	29.74	7.74	8.68
	CDS	52.84	22.71	13.23	6.23

US = Usual status employment; CDS = Current daily status employment. For definitions of usual and current daily status, see Acharya (1983).

Table 16.9 Percentage distribution of rural males and females in agriculture by broad activity categories (1977/78). (Usual status employment).

	Self employed		Wage employed	
	M	F	M	F
West Bengal	52.27	31.01	47.74	68.98
Orissa	55.16	44.19	44.84	55.83
Andhra Pradesh	54.04	38.58	47.96	61.42
Tamil Nadu	51.37	40.14	48.62	59.87
Kerala	48.65	26.70	51.35	73.30

Table 16.10 Average earnings of casual labor per day in rural areas by type of operation and sex (rupees) 1977/78.

		Plowing	Sowing	Transplanting	Weeding	Harvesting	Other manual agric. occupa-tions	Other non-manual agric. operations
West Bengal	M	4.64	4.81	4.30	3.80	4.52	3.98	3.71
	F	3.33	4.00	3.54	2.50	4.01	3.21	3.10
Orissa	M	3.09	3.22	3.43	2.92	3.11	3.07	1.85
	F	2.91	1.50	2.56	2.18	2.14	2.31	0.99
Andhra Pradesh	M	3.74	2.82	3.83	2.92	2.63	3.50	3.18
	F	2.12	2.45	2.71	2.11	2.57	2.05	2.88
Tamil Nadu	M	4.42	4.30	4.17	3.28	3.78	3.89	3.05
	F	2.42	2.12	2.53	2.08	2.37	2.20	1.84
Kerala	M	6.58	7.37	8.77	6.35	6.66	6.05	4.00
	F	3.17	3.74	4.34	4.32	4.71	3.93	1.17

Table 16.11 Persons below poverty line in 1977/78 (rural).

State		Percentage	% Difference
West Bengal	M	55.75	(–)l.81
	F	57.56	
Orissa	M	65.30	(–)1.21
	F	66.51	
Andhra Pradesh	M	43.80	(–)0.83
	F	44.63	
Tamil Nadu	M	54.35	(–)1.07
	F	55.42	
Kerala	M	44.13	(–)1.89
	F	46.02	

noticeable effect has been the increased instability in food output from year to year.

Mitra (1979) has identified irrigation to be the binding factor in expansion of HYV seeds etc. In none of the states considered has irrigation expanded more than 30 per cent of the net sown area. Even this figure is an over-estimate, as areas declared as irrigated have more and less assured irrigation areas. The major programmes of land development and dry farming (in the SAT region), i.e. the Drought Prone Area Programme (DPAP) and the major irrigation plans, i.e. the Command Area Development (CAD), combined covered about 41 per cent of the blocks in West Bengal, 24 per cent in Orissa, 45 per cent in Andhra Pradesh, 15 per cent in Tamil Nadu and 11 per cent in Kerala, till 1978/9. The Small Farmer Development Agency (SFDA) and the Marginal Farmers and Agricultural Labors Agency (MFAL), which were the major programs for developing more than 70 per cent of the rural population covered a meagure 0.12 per cent of the rural population in West Bengal, 0.52 per cent in Orissa, 0.22 per cent in Andhra Pradesh, 0.56 per cent in Tamil Nadu and 0.34 per cent in Kerala by the end of the fourth 5 year plan. The total credit offered to the agricultural sector from the commercial banks accounts for 7.5 per cent, 13.7 per cent, 21.9 per cent, 11.9 per cent and 14.9 per cent in West Bengal, Orissa, Andhra Pradesh, Tamil Nadu, and Kerala respectively. All these figures speak for themselves about the efforts to modernize agriculture.

One school of thought claims that the introduction of modern methods in a small area would promote its diffusion through the demonstration effect. However, all this technology is more resource intensive than skill intensive. A small area or group inducted in modern methods would lead to higher disparities.

The impact of technology on women is not independent of social relations and labor market structure. Thus, unless there is an all-round and rapid technological change which would alter both the social relations and the market structure towards equity and efficiency, women are unlikely to benefit much.

The data presented so far indicates that the technological infusion has been scanty, and the changes in gender-specific occupational specialization, rising seasonality of employment, higher sensitivity of women's work, landlessness, etc., are all minor variations which cannot per se be attributed to technology. The domination of social relations of production, demographic pressures and market behaviour have so far been the determining factors of the changed conditions which have subsumed the positive effects of technology. Thus the only tangible conclusion that can be drawn for technology application in rice areas is to intensify and laterally spread the land augmenting technology across the country. Some micro level studies based on interfarm/household comparison (Sawant and Divan 1979 for example) find modern technology to be class biased and male oriented. But such comparisons lose significance when one observes that only 10-20 per cent of the area is subjected to HYV seeds and fertilizers, which is unable to create any dent in the social structure. Since the technological infusion in such limited proportions is subsumed in the social milieu it appears that the pockets of modernization augment disparities, coercion and gender specific discrimination.

Conclusion

There appears little further need to emphasize the importance of a lateral and more intensive spread of land augmenting and productivity enhancing technology in the rice cultivation areas. For strengthening the role of women in these areas, their involvement in direct production activities and control over output is necessary. The question is, would the existing division of labor permit it? The present authors feel that along with the spread of modernization, training of women for unconventional jobs, provision of land rights and more permanency in their jobs should be ensured so that the gains of technology accrue for women. Creation of training facilities for women for storage of grains is a welcome step, but this by itself does not guarantee a year-round employment, nor does it help women gain a larger share in growing food. Social relations need a tilt towards equality, and for this purpose women have to become equal partners in development and thus in crop growing. The farming systems need to accommodate women as an integral element in the production process for which the design of cropping pattern and intensity package has to be so framed. In the monitoring exercises, enumeration methods need redesigning for incorporating the benefits accrued to women and men separately.

Notes

1 The RLI covers those households whose principal occupation is agricultural labor, even though many of them possess land. Its coverage is thereby partial. But it is used owing to absence of broad data for the 1960s. (See GOI 1971, GOI, 1981, GOI 1983.)

2 The figures on labor input per area are large compared to the ones shown in micro level Farm Management Studies data. This is because (a) we have shown the workers for net sown area while FMS tabulates for gross cropped area; (b) there is a bias in large sample recall data as against cost accounting data and (c) in the RLI many non-agricultural engagements inadvertently get included in agricultural occupations under the column 'others'.

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17 Rural women and high yielding variety rice technology in India

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Summary

This paper points to the neglect of the gender dimension in most studies concerned with the socio-economic implications of the new agricultural technology in India. Seeking to fill some of the existing lacunae, it focuses on the effect of High Yielding Variety (HYV) rice technology on women's involvement in field-based work, on the farms of Andhra Pradesh, Tamil Nadu and Orissa. Labor used with HYV and traditional varieties of rice is disaggregated by gender, by type of labor (family, permanent, casual) and by farm size groups. The adoption of HYV rice is found to be significantly positively associated with total labor/ha. used on the farm in all three States. Much of this increase is accounted for by female and male casual labor. The effect on female family labor use, however, varies by State, being the net effect of two contradictory tendencies: one relating to the increased requirements for labor on the farm with HYV, and the other relating to family prestige considerations which would cause women to withdraw from manual field work as family income increases with HYV.

The paper argues that all these effects must be seen in a wider context, where women of poorer families already have high workloads,

often higher than those borne by men; where cash income is usually controlled by men and spent by them largely on their own needs; where intra-household distribution of food favours men over women; and where working in the rice fields exposes the women to many health hazards. Given this backdrop, the noted increased demand for female casual labor may not benefit the women of agricultural labor households, if firstly there is no increase in real wages (which are found to have declined in all three States), and, secondly, there are intra-household inequalities in access to income and consumption items. Also, where the women of small cultivator households now work longer hours in the field, this would imply an increase in their workloads without necessarily implying a compensatory improvement in their standard of living.

Introduction

There is today a vast body of literature on the socio- economic implications of the new agricultural technology (high yielding variety (HYV) seeds, mechanical equipment, etc.) in India.[1] However, the focus of the bulk of this literature is on inter-household differences (by socio-economic class) in the impact of the new technology, while possible gender differences have received little attention. The absence of a gender analysis in such studies reflects an uncritical acceptance of the assumption that the household is a unit of converging (perhaps even homogenous) interests, wherein the benefits or burdens of technological change will be shared equally by all members.

The present paper questions this assumption. It focuses on some of the implications of HYV rice technology on women of different socio-economic classes. Underlying the focus on women rather than on the household alone as the unit of analysis is the recognition that male and female members of a given class of household can be affected differentially by technological change. Underlying the separation by socio-economic class is the recognition that women of different classes are likely to be affected differentially. In particular, a consideration of the impact on women of the poorest households is seen as important, because many of these women are the primary or sole income earners in their families and their access to employment and income may be crucial for their own and their families' survival.

Gender differences in the impact of technological change within each socioeconomic class may be expected to stem from initial differences between women and men in:

(a) the extent and nature of their involvement in agricultural field work;

(b) the extent and nature of their involvement in non-field work, including cattle rearing, domestic work and child care, etc.; and
(c) the extent of their control over and pattern of distribution of household earnings and of consumption items.

These initial differences would themselves stem from historical, social and cultural factors which, in addition to the economic, govern the norms vis à vis the existing sexual division of labor, both within the home and outside, in any community. These norms are manifest within the home in women's primary and often sole responsibility for housework and child care, and outside the home in women being confined to certain agricultural tasks and being barred from others. Technological changes impinging on such initial differences in labor use are likely to lead to different implications for women and men in their access to employment in agricultural and non-agricultural work, and in their overall work burden. Further, to the extent that there are inequalities in the control over and distribution of household earnings and household expenditure between women and men, any income/consumption impact of technological change may be expected to vary by gender.

In the available literature for India, all three aspects, namely the implications of technological change for women in terms of their field-related work, their non-field work, and their access to income or consumption items, have largely been neglected. Among the rare exceptions are the studies of Harriss J. (1977), Chinnappa and Silva (1977), and Mencher and Saradamoni (1982). Both Harriss, and Chinnappa and Silva provide some quantitative information on the effect of HYV rice on female labor use in two districts in the state of Tamil Nadu. Mencher and Saradamoni's analysis is still in progress. So far their work provides some rich qualitative information on women's work in rice cultivation, and some useful quantitative information on the relative contributions of women and men to household income in Kerala, Tamil Nadu and W. Bengal, but specific information on the impact of HYV rice has yet to emerge from their analysis.

In the present paper, I seek to fill some of the existing lacunae in research. My primary thrust is on a quantitative assessment of the impact of HYV rice on the nature and extent of involvement in field-related work, of women and men belonging to different classes of households, in three rice-growing States of India, viz., Andhra Pradesh, Tamil Nadu and Orissa. Unfortunately, my data do not enable me to quantify the impact on women's non-field related work or on their income or consumption. At the same time these aspects cannot be ignored if we are to have a more comprehensive understanding of the implications of the new rice technology on women. A consideration of their non-field related work in conjunction with their work in the fields, for instance, is important because the two together determine the impact on women's total work burden. A consideration of the issue of income and consumption effects is important because an increase or decrease in work burden may not always be accompanied by a similar increase or decrease in women's access to the earnings from this work. Given this, I have sought to bring together related material from a variety of sources, to bear on these two aspects. In addition to studies relating to India, illustrative material from other Asian countries has also been used to provide pointers, along with *a priori* reasoning to suggest possible directions in which the effects may be expected to lie.

The paper is divided into four sections. The following section covers the empirical analysis of the impact of HYV rice on female and male labor use in field-based agricultural work. The impact is disaggregated by different categories of labor (family, permanent and casual) and by different farm size groups. This section is divided further into four sub-sections: the first sub-section gives a description of the data base; the second spells out some hypotheses relating to the likely impact of HYV rice on labor use; the third indicates the procedure used for estimating this impact; and in the fourth sub-section the empirical results are discussed. The third section brings together illustrative material to throw light on the noted or expected implications of the HYV rice technology on women's overall work burden (including the burden from non-field related agricultural and other work), and on their income and consumption. The final part contains a brief summary and concluding comments.

The impact of HYV rice on labor use in the fields: an empirical analysis

The data base

The major rice-growing areas of India lie in the southern and eastern parts of the country. For the present analysis, sample farms from three of the principal rice-growing States have been chosen, two of which – Andhra Pradesh and Tamil Nadu – fall in the southern belt and the third – Orissa – in the east.[2] Andhra Pradesh (AP) and Tamil Nadu (TN) represent the relatively more agriculturally advanced States: much of the rice cultivation here is under irrigated conditions; they are also among the principal adoptors of HYV rice in the country.[3] Orissa provides an interesting contrast. It represents an agriculturally backward part of the country with a low adoption of HYV rice and with rice cultivation being undertaken primarily under rainfed conditions. Together, the three States provide a broad picture of the conditions under which rice is grown in the country and of the likely impact of HYV rice on labor in general, and on female labor use in particular.

The data used for the analysis were collected under the ‘Comprehensive Scheme for Studying the Cost of Cultivation of Principal Crops’ by the Agricultural Universities of the three States respectively, for the Directorate of Economics and Statistics, New Delhi. The AP sample consists of 99 farms and relates to the crop-year 1974/5; the TN sample has 87 farms and relates to 1976/7, while the Orissa sample has 168 farms and relates to 1977/8.[4]

The average percentages of gross cropped area irrigated in the AP, TN and Orissa samples come to 67.4 per cent, 78.8 per cent and 27.6 per cent respectively. While in AP and TN, 89 per cent and 97 per cent of the farms have irrigation at least for some part of the year, in Orissa 64 per cent of the farms are totally unirrigated. In all three States, irrigation is primarily through canals and tanks: 81 per cent of the irrigated sample farms in AP, 68 per cent in TN and 80 per cent in Orissa are so irrigated.

Some hypotheses

On *a priori* grounds we would expect the adoption of HYV rice to increase the overall requirements of labor in the field, relative to the traditional rice varieties, for a number of reasons. Firstly, HYV cultivation is usually accompanied by a new ‘package’ of practices requiring greater care and more intensive use of labor. For instance, HYVs are usually transplanted, while traditional varieties are often sown through the broadcast method[5] ; HYVs usually require more intensive weeding especially where there is a greater associated use of fertilizers and manure; and they would need greater care and time for irrigation and water management. Secondly, owing to their positive crop-yield effects, relatively more labor would be needed with HYVs for harvesting and threshing. Thirdly, many (though not all) HYVs of rice are of shorter duration than the traditional varieties: this would enable the farmer to increase cropping intensity which would then increase labor requirements over the crop-year. (Of course, to the extent that weedicides and mechanical equipment accompany the introduction of HYV rice, some of the positive labor demand effects would tend to get negated.)

However, in what ways this overall increase in labor requirements will affect the demand for different types of labor is a more complex and largely neglected issue. In broad terms we may divide labor into three types: family, casual (viz., that hired for specific tasks on a seasonal or even a daily basis), and permanent (viz., that hired on a long term contract, usually extending over a year or more). Each type of labor may be divided into male, female and child categories.

By and large, we would expect the introduction of HYV rice to increase the requirements of casually hired labor, because of higher peak labor needs for transplanting, weeding and harvesting. In so far as these are also the operations in which female labor is primarily used, we would expect an increase in the use of female casually hired labor with HYV, although whether or not this increase is equivalent to, greater than, or less than that for male casual labor would depend on the degree to which women are preferred over men for these tasks, and on the supply of female casual labor in the region.

The impact of HYV rice on female *family* labor use is much more difficult to predict. This is because while HYV rice is likely to increase the overall requirements for labor on the farm, it is also likely to increase family income. On the one hand, the increase in labor needs would act as an inducement for more intensive use of the labor of family women on the farm. On the other hand, there would be a tendency for the women to withdraw from manual work in the fields owing to family prestige considerations, if the family can now afford to use hired help instead. (A negative association between the family's socio-economic status and the involvement of family women in manual field work has been noted, for instance, by Epstein (1962, 1973) in Karnataka, and by Vanamala (1982) in Andhra Pradesh.) The final outcome would be the net results of the two contradictory tendencies: the positive labor requirement effect and the negative effect of a rise in income on female family labor supply.

Finally, the demand for permanent labor may be expected to rise with the adoption of HYV rice for a number of reasons: because of the higher peak requirements under HYV cultivation, it would be important to ensure a certain minimum availability of labor on the farm and to reduce the risk of labor not being available on a casual basis, when required, during the peak season; any increase in cropping intensity accompanying HYV cultivation would raise the overall demand for labor over the year, and make it more worthwhile to employ the services of permanent workers; there would be an increased need for close supervision and management, both in specific operations such as irrigation, and in general, for the larger numbers of casually hired laborers that would usually be employed under HYV cultivation.

However, in order to identify clearly these possible effects of HYV rice on the level and pattern of labor use on the farm, we need to separate out the effects of any additional factors which might impinge on this aspect, such as farm size, the percentage of cropped area irrigated, the cropping pattern and the level of farm mechanization. Among these, controlling for farm size is especially important since farm size has been noted to be related negatively to total labor use in general and family labor use in particular, but related positively to hired labor use (casual and permanent)[6]. In other words, many of the effects of farm size and HYV adoption would tend to lie in opposite directions, and if we do not control for farm size effects, they are likely to be confused with, and may mask, the HYV effects. Taking account of farm size is also of interest in the instance of female family labor since size would be a broad proxy for the family's socio-economic status. In a social setting where women doing manual work outside the home is considered a sign of low family status, we would expect farm size to be inversely related to female family labor use.

The impact of irrigation may usually be expected to lie in the same direction as that of HYVs in so far as it too would tend to increase the requirements for labor time[7] at the crop-level and for the farm as a whole (the latter by enabling a higher cropping intensity[8]). It is possible, however, that the impact of the irrigation variable, over and above the impact of HYV rice (which would usually be grown under irrigated conditions), may be slight.

The effect of cropping patterns on labor use would be important to consider where there are significant differences between farms in the crops grown over the year. This is because certain crops are more labor intensive than others and likely to use more of certain types of labor than others. The level of mechanization on the farm, especially the use of tractors, is again a factor that can affect the level and pattern of labor use.[9]

In the analysis undertaken here, I have looked at the impact of HYV rice on the use of different types of labor after taking account of farm size and the percentage area irrigated. There were few noteworthy cropping pattern differences among the sample farms for any of the three States studied, rice being the predominant crop in all the farms, and on average accounting for 69.4 per cent of gross cropped area in AP, 67.6 per cent in TN and 76.1 per cent in Orissa. Also the percentage area under *all* rice was found to be correlated rather highly with the percentage area under HYV rice in all three samples. Hence, this variable was not separately considered. The mechanization variable again is of limited importance in the present context, because of the low levels of machine use among the sample farms. The Orissa sample, for instance, has no tractor users, while in AP and TN only 25 per cent and 10 per cent of the sample farms, respectively, use tractors, usually solely for plowing. Irrigation pumpsets are the only other type of machine used, again only on a few farms. Also, when included as an explanatory variable, tractor use was found to have insignificant explanatory power. Hence it was dropped from the final analysis.

Finally, it may be mentioned here that in the choice of explanatory variables, the emphasis is on demand factors, on the assumption that a higher quantum of labor, especially of hired labor, would generally be forthcoming if there were a higher demand. Also, information on factors such as caste, which may affect the supply of labor, is not available from my data source. One other limitation of the data is the absence of information on the *number* of hired laborers employed on the farms, hence the measurements have to be confined to labor *time* effects.

Estimation procedure

A comparison has first been made of the mean use of labor time per ha., disaggregated by different types of labor, on the land under traditional varieties (TV) of rice and that under HYV rice varieties, for farms divided into four different size groups (specified later), and the statistical significance of observed differences in means tested.

Subsequently, a multiple regression analysis has been undertaken. In this a series of equations has been specified in the log-linear form, with each type of labor (measured in hours per ha. of net sown area) in turn being the dependent variable. The explanatory variables for the equations relating to AP and TN are percentage of gross cropped area under HYV rice, farm size and the percentage of gross cropped area irrigated. For Orissa, irrigation has not been included as an explanatory variable because of the high correlation (0.70) found between this variable and the percentage area under HYV rice. As noted earlier, the overall availability of irrigation in this State is quite low. Hence, in the sample farms with some irrigation, often the only crop irrigated is HYV rice. In the case of AP and TN, however, a good deal of the traditional rice and some of the minor crops are also grown under irrigated conditions.

Farm size has been defined in terms of net operated area (namely, net sown area plus uncultivated area minus area under orchards or gardens). In the regression equations, farm size has been treated as a continuous variable. For the presentation of mean values, however, the farms in each State have been divided into four size groups. The first size group of farms less than or equal to (LE) 1.00 ha. could be termed the marginal farms; most of these would be too small to provide adequately for the household's subsistence needs, and the household members would have to work in the fields of others or to undertake some non-agricultural work to supplement farm income. Those in the next three size groups (viz., greater than (GT) 1.00 ha. and LE 2.00 ha.; GT 2.00 ha. and LE 4.00 ha.; and GT 4.00 ha.) may be termed the small, medium and large sized farm. From Table 17.1 it can be seen that in AP about a third, and for TN and Orissa about half of the sample farms would fall under the categories of marginal and small farms. In the Orissa and Tamil Nadu samples the largest farm is approximately 7 ha. in size, while in the AP sample it is 24 ha. in size. In all three States (as seen in Table 17.1) a fairly large percentage of the sample farms have at least some portion of their cropped area under HYV rice.

Table 17.1 Number and percentage of farms by farm size groups and by adoption of HYV rice

Farm size	No. and percentage of farms AP 1974-75	TN 1976-77	Orissa 1977-78
LE 1.00	14 (14.1)	23 (26.4)	24 (14.3)
GT 1.00 – LE 2.00	14 (14.1)	23 (26.4)	61 (36.3)
GT 2.00 – LE 4.00	26 (26.3)	26 (29.9)	59 (35.1)
GT 4.00	45 (45.4)	15 (17.2)	24 (14.3)
All farms	99 (100.0)	87 (100.0)	168 (100.0)
Farms with some area under HYV rice	62 (62.6)	69 (79.3)	73 (43.4)

Note: Figures in brackets give the percentages to total farms in the sample.

Results and interpretation

Labor use by operations: Table 17.2 gives an idea of the relative importance of different types of labor in the three States. We note that in all three States, casual labor (male plus female) provides the largest proportion of total labor time: 71.2 per cent in AP, 73.4 per cent in TN and 49.5 per cent in Orissa. It is also striking that in AP and TN, female casual labor is the most important type of labor in use, providing close to half of total labor time on the farm.[12]

However, the involvement of women in agricultural operations is found to be distinctly task-specific. While the tables relating to the operation-wide breakdown of labor use are not presented here, an earlier study by the author (see Agarwal, 1981 b) based on the sample of farms as used here, found that in AP, on average, 30.7 per cent of total female labor time used over the year was in sowing/transplanting; another 31.0 per cent was in interculture (mainly weeding) and 27.7 per cent in harvesting. In other words, these three operations accounted for 89.4 per cent of total female labor time on the farm. Threshing was the only additional operation of any significance using 8.3 per cent of female labor time. Further, 95.6 per cent of total female labor was accounted for by female casual labor. In TN, likewise, the percentage of female labor in these four operations was found to be 18.4 per cent,

Table 17.2 Labor use by type of labor: Andhra Pradesh (1974-75), Tamil Nadu (1976-77) and Orissa (1977-78).

	Mean labor time (hours per sown hectare)			Percentage labor time		
	AP	TN	Orissa	AP	TN	Orissa
Female family labor	37.7	87.8	13.7	2.1	4.5	0.9
Female casual labor	811.8	968.9	266.4	45.9	49.5	17.1
Male family labor	314.0	294.9	600.0	17.8	15.1	38.5
Male casual labor	447.4	464.3	504.0	25.3	23.7	32.4
Male permanent labor	140.7	125.5	151.9	8.0	6.4	9.8
Exchange labor*	–	14.2	18.4	–	0.7	1.2
Gift labor	–	–	1.1	–	–	0.1
Child labor	16.5	2.9	1.1	0.9	0.1	0.1
All labor	1768.1	1958.5	1556.6	100.0	100.0	100.0

* This includes both male and female exchange labor.

39.1 per cent, 31.5 per cent and 8.0 per cent respectively, with female casual labor accounting for 90.9 per cent of total female labor. In Orissa the pattern of female labor use was again found to be distinctly task-specific. Further, in all three States, women do not undertake plowing (though they may be involved with marginal functions relating to seedbed preparation), and there were no women employed as permanent laborers.

The task-specific nature of women's involvement in agricultural work means that women dependent on such work for their livelihood (as would be the women of agricultural labor households) are likely to be especially vulnerable to the introduction of technologies such as rice transplanters, weedicides, power-operated paddy processing mills etc., which would decrease the total demand for female labor in such operations. In fact, this is already seen to be happening on a significant scale in many parts of the country with the introduction of modern rice mills which employ virtually no female labor (see e.g. B. Harriss, 1977: Acharya and Patkar, 1983).

Labor use by rice variety: Tables 17.3a, 17.3b and 17.3c give the mean values of labor time for the different types of labor as used under TV and HYV rice, on farms of different size groups, in AP, TN and Orissa respectively.

In the Andhra Pradesh sample (Table 17.3a) a comparison of the labor time per ha. used for TV rice relative to HYV rice indicates that with HYV, for all farm sizes taken together, there is a significantly lesser use of both female and male family labor and a higher use of male

Table 17.3a Andhra Pradesh mean use of labor by rice variety, farm size and type of labor (1974–75).

(hrs/ha.)

Farm Size (ha.)	No. of farms	Female labor: Family	Female labor: Casual	Female labor: Total	Male labor: Family	Male labor: Casual	Male labor: Perma-nent	Male labor: Total	Child labor: Family	Child labor: Casual	Child labor: Total	Exchange labor	Total labor	Bullock pair	Tractor
Labor use on area under traditional rice															
LE 1.00	10	121.0	600.4	721.4	422.1	329.3	0.0	751.4	4.2	0.0	4.2	–	1477.0	248.6	0.0
GT 1.00– LE 2.00	9	38.4	577.7	616.1	468.4	387.6	0.0	856.0	0.3	17.6	17.9	–	1490.0	273.1	0.9
GT 2.00– LE 4.00	19	59.1	658.2	717.3	401.2	300.1	41.0	742.3	1.3	14.0	15.3	–	1474.9	193.7	0.1
GT 4.00	29	28.7	589.6	618.3	271.1	273.3	184.4	728.8	3.0	24.5	27.5	–	1374.6	255.4	0.3
All	67	52.4	609.1	661.5	357.0	304.6	91.5	753.1	2.3	16.9	19.2	–	1433.8	239.3	0.3
Labor use on area under HYV rice															
LE 1.00	7	20.3	486.8	507.1	365.5	264.2	2.1	631.8	0.0	2.5	2.5		1141.4	167.9	1.1
GT 1.00– LE 2.00	9	35.0	576.3	611.3	291.0	396.1	15.3	702.4	1.5	18.5	20.0	–	1333.7	144.8	1.2
GT 2.00– LE 4.00	16	26.2	675.2	701.4	254.9	310.4	129.6	694.9	0.4	2.8	3.2	–	1399.5	201.1	0.7
GT 4.00	30	11.0	805.0	816.0	120.9	295.8	230.9	647.6	0.0	14.7	14.7	–	1478.3	151.7	2.7
All	62	19.4	702.4	721.8	207.8	310.6	147.6	666.0	0.3	10.8	11.1	–	1398.9	165.3	1.8
Difference @ (all farms)	–	–33.0*	+93.3	+60.3	–149.2**	+ 6.0	+ 56.1*	–87.1	–2.0	– 6.1	– 8.1	–	34.9	74.0*	+1.5**

Note: *In this and in tables 17.3b and 17.3c*
LE = less than or equal to; GT = greater than
@ Labor use under HYV rice minus labor use under traditional rice
In accordance with the two tailed test: *significant at the 5% level; **significant at the 1% level
One female labor unit has been taken a equivalent to one male labor unit, while one child labor unit has been taken as equivalent to ½ a male labor unit.

Table 17.3b Tamil Nadu: mean use of labor by rice variety, farm size and type of labor (1976-77).

(hrs/ha.)

Farm size (ha.)	No. of farms	Female labor: Family	Female labor: Casual	Female labor: Total	Male labor: Family	Male labor: Casual	Male labor: Permanent	Male labor: Total	Child labor: Family	Child labor: Casual	Child labor: Total	Exchange labor	Total labor	Bullock pair	Tractor
Labor use on area under traditional rice															
LE 1.00	12	63.0	786.4	849.4	320.0	360.6	12.8	693.4	0.0	0.0	0.0	50.0	1592.8	325.6	0.0
GT 1.00– LE 2.00	17	78.6	641.6	720.2	313.8	257.8	90.5	662.1	4.8	3.4	8.2	45.3	1435.8	253.3	0.2
GT 2.00– LE 4.00	22	50.8	644.5	695.3	244.6	275.7	130.9	651.2	0.8	0.0	0.8	0.9	1348.2	301.7	0.1
GT 4.00	8	1.3	501.0	502.3	21.4	308.2	247.7	577.3	0.0	0.0	0.0	0.0	1079.6	186.4	4.0
All	59	54.6	653.1	707.7	249.6	292.2	111.1	652.9	1.7	1.0	2.7	23.6	1386.9	277.0	0.6
Labor use on area under HYV rice															
LE 1.00	20	95.1	754.1	849.2	270.3	390.0	0.0	660.3	0.5	0.0	0.5	1.8	1511.8	296.3	0.0
GT 1.00– LE 2.00	17	61.0	650.9	711.9	348.6	350.2	121.5	820.3	7.4	0.0	7.4	15.6	1555.2	286.2	0.1
GT 2.00– LE 4.00	20	73.7	666.6	740.3	282.6	343.8	133.9	760.3	1.2	0.5	1.7	3.5	1505.8	325.3	0.1
GT 4.00	12	0.8	552.4	553.2	51.2	354.4	241.3	646.9	0.0	0.0	0.0	1.1	1201.2	210.6	0.4
All	69	64.1	668.2	732.3	255.0	360.6	110.7	726.3	2.3	0.1	2.4	5.6	1466.6	287.3	0.1
Difference @; (all farms)	–	+9.5	+15.1	+24.6	+ 5.4	+68.4	–0.4	+73.4	+0.6	–0.9	–0.3	–18.0	+ 79.7	+10.3	–0.5

Table 17.3c Orissa: Mean use of labor by rice variety, farm size and type of labor (1977-78).

(hrs/ha.)

Farms Size (ha.)	No. of farms	Female labor: Family	Female labor: Casual	Female labor: Total	Male labor: Family	Male labor: Casual	Male labor: Perma-nent	Male labor: Total	Child labor: Family	Child labor: Casual	Exchange labor	Gift labor	Total labor	Bullock pair	Tractor
							Labor use on area under traditional rice								
LE 1.00	24	10.8	186.2	197.0	810.6	202.4	0.0	1013.0	1.6	–	11.8	3.2	1226.8	294.6	–
GT 1.00– LE 2.00	61	16.0	175.8	191.8	490.9	413.6	52.5	957.0	0.3	–	12.9	0.4	1162.4	276.8	–
GT 2.00– LE 4.00	59	1.7	190.9	192.6	358.5	353.9	172.0	884.4	0.6	–	16.0	0.0	1093.6	246.2	–
GT 4.00	24	0.2	135.4	135.6	275.4	402.5	203.0	880.9	0.0	–	4.2	0.0	1020.7	263.3	–
All	168	8.0	176.8	184.8	459.3	360.8	108.5	928.6	0.6	–	12.6	0.6	1127.2	266.7	–
							Labor use on area under HYV rice								
LE 1.00	6	66.7	119.2	185.9	1122.0	907.0	0.0	2029.0	0.0	–	0.0	8.7	2223.6	360.4	–
GT 1.00– LE 2.00	28	26.3	351.9	378.2	596.2	706.3	58.9	1361.4	0.0	–	18.1	2.8	1760.5	275.8	–
GT 2.00– LE 4.00	30	8.9	346.6	355.5	665.7	644.5	226.4	1536.6	3.1	–	5.3	0.0	1900.5	253.5	–
GT 4.00	9	0.0	281.4	281.4	209.0	642.3	292.0	1143.3	0.0	–	0.0	0.0	1424.7	227.5	–
All	73	19.2	321.9	341.1	620.2	689.5	151.7	1461.4	1.3	–	9.1	1.8	1814.7	267.6	–
Differ- * (all farms)	–	+11.2	+145.1**	+156.3**	+160.9	+328.7**	+43.2	+532.8**	+0.7	–	–3.5	+1.2	+687.5**	+0.9	–

permanent labor. While a higher use of male and female casual labor is also noted (and much more so for female than male labor) these differences are not statistically significant. Other noteworthy features are the significantly lower use of bullock labor and the significantly higher use of tractor power with the adoption of HYV rice. Within size groups too this pattern broadly holds: for instance, the lower use of female family labor with HYV is noted in all size groups.

In the case of Tamil Nadu (Table 17.3b), for all farm sizes taken together, there is a higher use with HYVs of virtually all categories of labor (including female family labor) but none of these differences are statistically significant. Within size groups again, the pattern is broadly consistent, there being a greater use of almost all types of labor with HYV rice relative to TV rice.

Again, for Orissa (Table 17.3c), the higher use of labor under HYV rice cultivation is noticeable for all categories of labor other than exchange labor. Further, the differences are statistically significant in the case of female and male casual labor as well as for total labor. The increase is however more for male than female casual labor.

Finally, in all three States, as farm size increases there is an overall decrease in the use of total labor and especially of family labor, and an increase in the use of permanent labor, for areas under TV rice. These results (although with less consistency, and with the exception of total labor use in Andhra Pradesh) hold true too for area under HYV rice.

The regression results: The regression results help us to see to what extent there are statistically significant differences in the level and pattern of labor use with HYV rice, after allowing for differences due to farm size and irrigation. To begin with, the results pertaining to each State will be discussed in turn, subsequently, the broad conclusions for all three States taken together will be highlighted.

Andhra Pradesh (see Table 17.4a): As had been hypothesized, the adoption of HYV rice is found to be significantly positively associated with total labor use and with female casual, male casual and male permanent labor use. Female family labor use, by contrast, is found to have a significant negative association with the percentage area under HYV rice. This suggests that any positive effect of HYV on the requirement of female family labor has been offset by the negative effect of a rise in income on the supply of such labor. It is consistent with the view that family women tend to withdraw from manual work in the fields with a rise in the economic status of the family. This is further supported by the significant negative association of female family labor use with farm size and with percentage area irrigated. A larger farm size,

Table 17.4a Andhra Pradesh: HYV rice and labor use per sown hectare regression results (1974-75)

Equation No.	Dependent variable	Constant term	Explanatory variables: % HYV rice area	Farm size	% irrigated area	$\bar{R}^2$	'F' ratios
1.1	Total labor	3.05	0.13** (5.53)	–0.10* (2.16)	0.03 (0.89)	0.25	11.62
1.2	Female family	1.76	–0.26** (2.90)	–4.88** (4.97)	–0.24 (1.70)	0.30	14.52
1.3	Female casual	2.72	0.12** (4.23)	–0.06 (1.07)	0.02 (0.40)	0.14	6.32
1.4	Total female	2.82	0.10** (3.80)	0.08 (1.57)	–0.01 (0.22)	0.11	5.16
1.5	Male family	2.27	0.03 (0.69)	–0.75** (9.10)	0.23** (3.47)	0.48	31.28
1.6	Male casual	1.84	0.33** (4.02)	–0.22 (1.37)	0.17 (1.32)	0.14	6.69
1.7	Male permanent	0.42	0.22* (2.03)	1.69** (8.08)	–0.19 (1.12)	0.43	25.50

Notes: I) Figures in bracket give the 't' values of the respective coefficients
2) In accordance with the 2-tailed test:
* denotes significance at the 5% level
** denotes significance at the 1% level
3) The 'F' ratios for all the equations arc significant at the 1% level.

a higher percentage of area under HYV rice would all be indicative of the better economic status of the family.

Male permanent labor, as might be expected, is seen to have a strong positive association with farm size: large farms tend to employ more permanent laborers than small ones, not only because they can better afford to do so but also to ensure a certain minimum availability of labor during peak seasons, and to provide supervision labor to supplement or perhaps even substitute for family labor. The irrigation variable, however, is found to have a neutral association with most types of labor, other than male family labor.

Tamil Nadu (see Table 17.4b): As in AP, so in TN, the adoption of HYV rice is seen to have the expected significant positive association with the use of total labor and male casual labor. However, unlike AP, no significant relationship is found with female casual labor.

Also in contrast to AP, a *positive* association is observed between female family labor and HYV adoption, which suggests that whatever may have been the negative labor supply effect of a rise in income with HYVs, the positive labor requirement effect has offset it. This is perhaps not surprising given that a much larger proportion of the TN

Table 17.4b Tamil Nadu: HYV rice and labor use per sown hectare regression results (1976–77)

Equation No.	Dependent variable	Explanatory variables: Constant term	% HYV rice area	Farm size	% area irrigated	$\bar{R}^2$	'F' ratios
2.1	Total labor	2.81	0.06* (2.02)	–0.17** (3.64)	0.21** (3.44)	0.30	13.21
2.2	Female family	1.20	0.32* (2.08)	–0.82** (3.19)	–0.30 (0.87)	0.15	5.96
2.3	Female casual	2.21	0.03 (0.84)	–0.10 (1.54)	0.36** (4.23)	0.20	8.42
2.4	Total female	2.30	0.04 (1.03)	–0.13* (1.96)	0.33** (3.83)	0.20	8.20
2.5	Male family	2.98	0.17 (1.17)	–1.21** (4.94)	–0.63 (1.91)	0.24	10.21
2.6	Male casual	2.05	0.16** (3.22)	–0.03 (0.36)	0.16 (1.47)	0.13	5.31
2.7	Male permanent	–0.49	0.06 (0.38)	1.68** (6.76)	0.62 (1.86)	0.35	16.03

Notes: 1) Figures in brackets give the 't' values of the respective coefficients
2) In accordance with the 2-tailed test:
* denotes significance at the 5% level
** denotes significance at the 1% level
3) The 'F' ratios for all the equations are significant at the 1% level.

farms, relative to the AP sample, fall in the marginal and small size groups (viz. LE 2.00 ha.) and would, therefore, be much less in a position to substitute hired labor for female family labor. The expected negative association between female family labor and farm size is, however, found in the Tamil Nadu equations as well, in keeping with our hypothesis that women of better-off families tend not to work in the fields. Permanent labor is found once more, as hypothesized, to be related positively with farm size.

Further, in most of the equations in this sample the irrigation variable has the expected sign and is found to be associated positively with total labor and with female casual labor use.

Orissa (see Table 17.4c): The Orissa results are consistent with the hypothesis that HYVs tend to increase the use of total labor and especially of casual labor — female and male. However, female family labor has no significant association with HYV adoption in either set of equations.

In keeping with the results of AP and TN, farm size is positively associated with the use of male permanent labor. The negative association of male family labor and farm size is also consistent with the observations of AP and TN. However, one contrasting feature is

Table 17.4c Orissa: HYV rice and labor use per sown hectare regression results (1977-78)

Equation No.	Dependent variable	Constant term	Explanatory variables: % HYV rice area	Explanatory variables: Farm size	$\bar{R}^2$	'F' ratios
3.1	Total labor	3.10	0.16** (11.60)	–0.09** (2.73)	0.45	69.94
3.2	Female family	0.33	–0.07 (1.05)	–0.14 (0.88)	0.01	0.98
3.3	Female casual	0.93	0.75** (6.14)	0.72* (2.55)	0.21	22.77
3.4	Total female	1.06	0.70** (5.71)	0.53 (1.87)	0.17	18.49
3.5	Male family	2.82	–0.16 (1.89)	–1.11** (5.51)	0.16	17.42
3.6	Male casual	1.76	0.48** (5.20)	0.94** (4.42)	0.22	24.21
3.7	Male permanent	0.21	0.08 (0.64)	1.95** (6.84)	0.21	23.83

Notes: 1) Figures in brackets give the 't' values of the respective coefficients
2) In accordance with the 2-tailed test:
* denotes significance at the 5% level
** denotes significance at the 1% level
3) The 'F' ratios for all the equations are significant at the 1% level, other than for equation 3.2, where it is insignificant at the 5% level.

that both male and female casual labor are positively associated with farm size, unlike AP and TN where the association was found to be neutral in most equations.

Main conclusions, for all three States taken together

Taking the results of all three States together, the following broad conclusions emerge:

(a) The adoption of HYV rice tends to increase the use of total labor time per sown ha. on the farm, in all three states.
(b) Most of this increase is accounted for by female and male casual labor time; and in the case of one State also by a higher use of male permanent labor time.
(c) The impact of HYV rice on the use of female family labor is not clearly predictable, being the net result of two diverging effects. Hence HYVs may decrease the use of female family labor, as found in AP; increase its use, as in TN; or leave it unchanged, as in Orissa.

(d) Farm size tends to be related negatively to the per ha. use of total labor as well as to the per ha. use of family labor — female and male. It is positively associated with the per ha. use of hired labor, especially of male labor hired on a permanent basis.

The wider implications of HYV rice technology for women

So far we have considered only the impact of HYV rice on women's involvement in field-related work. This is a step forward in filling one significant lacuna in existing India-related literature on this aspect. However, as mentioned earlier, for a more comprehensive understanding of the implications of HYV rice technology for women we also need to take into account the impact on their overall work burden (including their non-field related work), on their access to any increase in household earnings, on their consumption, and on their health. Unfortunately there is no study in the Indian context that has gone into all these aspects. My own data do not cover these dimensions either. Nevertheless, some broad pointers can be provided and inferences drawn from more general information on the status of women in different socio-economic classes of rural households. In this section, I shall attempt to pool some of this information.

To pinpoint the issues, it is useful to divide the women into three socio-economic classes (classes admittedly drawn on very broad criteria but which would suffice for purposes of illustration) as below:

(a) Women of agricultural labor households who have to hire themselves out to work on the fields of others. These would be women belonging either to landless households or to households with insufficient land to provide basic subsistence from self-cultivation alone. Most of the women working as casual labor in my sample of farms would fall under this category.

(b) Women of small cultivator households, who would not usually have to hire themselves out to work as wage labor but who would usually need to put in some manual work on the family farm. Most of the women providing family labor on the farms of LE 2.00 ha. in size in my samples, would fall under this category.[11]

(c) Women of medium and large cultivator households who would not usually have to hire themselves out or to undertake manual work in the fields, but who might be doing more supervision work in the fields or non-field related agricultural work.

Our primary concern here is for the women belonging to the agricultural labor and the small cultivator households, most of whom would be living at subsistence levels or below subsistence levels. Among these would also be women who are the sole or main income earners in their families. The backdrop against which the impact of technical change on any field-related work must be judged, for these classes of women, is a complex one, in which it is necessary to take into account several aspects such as those outlined below:

(a) In both these classes of households, women are found. in virtually all parts of the Third World, to work long hours, often longer than those worked by the men. In addition to their work contribution in the fields, the entire burden of childcare and a substantial burden of housework such as cooking, water fetching, fuel gathering, grain grinding, fodder collection and caring for animals (if any) tends to fall on the women. Although studies on the pattern of time allocation by women and men among rural households in India are rare, two studies, one by the Institute of Social Studies (ISS), Delhi (1981) for Rajasthan and West Bengal, and the other by Batliwala (1982) for Karnataka, support this view, as does literature relating to other Asian countries (e.g. see White (1976) for Java; Quizon and Evenson (1978), and King (1976) for the Philippines, and Khan and Bilquees (1 976) for Pakistan Punjab).

(b) Among the landless or near-landless households, the women's earnings are often crucial for the family's survival. This is true not merely in female-headed households (a point I shall take up later) but also in households with both male and female adult earning members. Mencher and Saradamoni (1982) in their study relating to Kerala, TN and W. Bengal found, for instance, that in households with no land, where both women and men were earners, the woman's contribution to the household's earnings was almost always more than the man's Among marginal landowning households too, female earnings from outside work contributed a little under half to well over half of the household's total earnings from outside employment. Further, the minimum contribution by the woman was higher than the minimum contribution by the man, in almost all cases, in both classes of households.

(c) Undertaking a large, and often a disproportionately large, share of the household's workload, or making a significant contribution to household, income, does not necessarily give these women greater access to cash income or to food and other consumption items, or lead to their greater participation in the family's decision-making process. For instance, Chakravarty (c. 1977) on the basis of his study of 5 villages in 3 Indian

States observed that even where the wages were paid to the women, these were taken over and controlled by the household men. (Similar observations are made by Heyzer (1981) in the context of landless plantation laborers in Malaysia, and by Palmer (1980) in the context of rice cultivating small peasant households in South Korea.) It is important to take into account women's access to cash income because evidence indicates that where women have some discretion over cash expenditure, they usually spend the money on family needs, while men often spend a good deal of what they earn on their personal needs such as liquor, cigarettes, etc. (see Gulati (1978), and Mencher and Saradamoni (1982) for India, and Arens and Van Beurden (1977) for Bangladesh).

(d) The sharing of consumption items, especially food, within the household generally tends to favour men over women. Gulati (1978) in her Kerala based case-study of a typical agricultural labor household noted that on working days the women's caloric intake fell short of ICMR (Indian Council for Medical Research) recommendations by 20 per cent while the man's fell short by 11 per cent; on unemployed days the respective shortfalls were 50 per cent for the woman and 26 per cent for the man. Again, Batliwala (1983) in a study based on a sample of villages in Karnataka found, on comparing female and male daily caloric intake with the energy expended by them during the day, that women had an intake deficit of about 100 calories per day, while the men had an intake surplus of nearly 800 calories per day. Schofield (1979) on the basis of an extensive survey of quantitative and qualitative information, taken from a few hundred village studies on intra-household sharing of food in Asia and other parts of the Third World, also notes the unfair sharing of family food in favour of male members.

(e) In a large number of rural households women are the sole adult income earners. According to an estimate by Buvinic and Youssef (1978), about 18.7 per cent of households in India are *de facto* female headed, and the incidence of povery among female headed households is noted to be higher than among male headed households. Visaria and Visaria (1983) note that by the 1971 census 9.6 per cent of all rural households were female-headed but emphasize that there is likely to have been under reporting. They further find, on the basis of the National Sample Survey data, that the proportion of those unable to find work on any day when they have sought work or were available for work is much higher among female headed households.

All these aspects indicate that the implications of technological change for women are likely to be mediated not merely through class-related factors but also through gender-related factors. And these gender-related factors may even offset some of the class-related benefits or aggravate some of the class-related adverse effects which a given technology may bring about.

Using the above discussion as a backdrop let us now consider the wider implications of the effect of HYV rice on women's field-related work that we noted in our results in the last section.

For agricultural labor households we noted that HYV rice tends to increase the demand for both female and male casual labor time.[12] However, whether or not the women benefit by this will depend on a number of complex factors. To begin with, we would need to know what has been the change in real wages. Data taken from the Rural Labor Enquiry Reports of 1964/5 and 1974/5 (and presented in Table 17.5) indicate that daily money wage earnings have increased during this period (i.e. the period over which a major increase in area under HYV rice occurred) for both women and men, in all three States. However, when these figures are deflated by the consumer price index for these households to give the daily *real* wage earnings we find that there has, in fact, been a decline. In other words, while the demand for casual labor may have increased with HYV rice, real wages have not increased simultaneously.[13] For many of the households under consideration, the net impact on the earnings from agricultural wage work may well therefore have been negative.

To the extent that there may have been a decline in female earnings, the implications for women's wellbeing are likely to be much more

Table 17.5 Money and real daily wage earnings for women and men of rural agricultural labor households.

Daily wage earnings	AP Women	AP Men	TN Women	TN Men	Orissa Women	Orissa Men
Money wages (1964-65)	0.85	1.21	0.85	1.39	0.89	1.33
Money wages (1974-75)	1.96	2.65	2.32	3.64	1.83	2.64
Agricultural consumer price index (1964-65 = 100)*	258		293		278	
Real wages (1974-75)	0.76	1.03	0.79	1.24	0.65	0.95

Sources: Government of India (1979): *Rural Labor Enquiry 1974-75: Final Report on Wages and Earnings of Rural Labor Households,* Labor Bureau, Ministry of Labor, Chardigarn, pp, 102–3, 162.

* Computed by the Labor Bureau on the basis of changes in the price level of a fixed basket of goods and services consumed by the agricultural labor households.

severe than for the men, both in male-headed households in the context of the noted unequal distribution, especially of food, in favour of male members, and in female-headed households, since women's wages even in the same agricultural operations are usually lower than men's. In short, the noted employment advantages which HYV rice offers cannot be assumed necessarily to benefit the women, where there is no simultaneous increase or even constancy in real wages, and when there is the noted unequal sharing of income, consumption and work burden between women and men.

For the cultivator households we noted that in TN and Orissa family women worked more than before in the fields with the introduction of HYV rice, and in AP they worked less. Where women are working more it is first of all likely to imply an overall increase in their workloads, since the women would continue to be responsible for non-field related work, including housework and child care.

Secondly, although the introduction of HYV rice may be assumed to increase the overall crop production and income of these households, this may not benefit the women in so far as the additional income is likely to be controlled by the men and, as noted, they are more likely to spend much of it on personal needs or perhaps on farm production items, rather than on the needs of the women. It is noteworthy that in the heart of the green revolution, viz. Punjab, while there have been considerable improvements in technology handled by men in the form of tractors, threshers, combines, etc. there has been little improvement in the women's kitchen apparatus, even in the economically well-off households.[14] In other words, the extra effort put in by family women in the field with the introduction of HYV rice, cannot automatically be assumed to bring benefits to them in terms of improved standards of living.

Thirdly, working in the paddy fields in operations such as transplanting exposes the women to a number of health hazards such as increased susceptibility to intestinal and parasitic infections, splitting heels, pain from leech bites, rheumatic joints, and arthritis (see Mencher and Saradamoni (1982) for documentation in the Indian context). A UNDP report (1980) also notes that in Asia there appears to be an association between working in paddy fields and gynaecological infections. This is an additional cost which both the farm family women working in the fields and the women agricultural laborers employed on a casual basis, have to pay.

Where the family women are found to withdraw from field work, as noted in AP, it may be seen as a benefit in terms of saving them from the noted health hazards; but whether or not it reduces their overall burden of work would depend on the effect on their non-field related work. In certain areas, as for instance in the Punjab, it has been noted that with the greater employment of casual labor with the green revolution, women, even of economically well-off families, have an additional work burden as they now have to put in long hours cooking for the hired labor, where providing at least one meal is customary, especially during the peak season (see e.g. Randhawa, 1975: and Mencher and Saradamoni, 1982). In other words, it is possible that while women withdraw from field related work they are forced to spend more time on non-field related work. It is noteworthy that while women's labor in the field may be substituted by hired labor for family prestige considerations when family income rises, hired labor rarely substitutes for women's work in cooking, etc. even in the economically well-off rural households.

All in all what it is sought to highlight in the above discussion is the fact that the issue of the implications of HYV rice on women is a complex one, which needs to be considered in the light of the existing sexual division of labor both in the field and in the home, and in relation to which aspects such as the intra-household distribution of cash and consumption items cannot be ignored. [15]

When we consider the implications of HYV rice for men, many of the noted complexities do not arise. Firstly, it can realisticially be assumed that any increase in the household income will benefit the men, while as noted for women no such assumption can be made a *priori.* Secondly, in the agricultural operations that men primarily perform there are few of the noted health hazards. Thirdly, for households where the members have to sell their labor power for a livelihood, the chances of a man finding employment would, in general, be higher because men can be hired for a wider range of agricultural tasks, they have the possibility of finding employment as permanent laborers and they have a greater geographic mobility.

It may further be added here that a study of the implications of HYV rice technology when viewed in a dynamic and long term context would also need to cover any resultant changes in the pattern of land ownership and control. For instance, in some of the wheat-growing regions it has been observed that with the introduction of HYV wheat and the associated higher profitability in cultivation, many land owners have evicted their tenants and resumed land for self cultivation (see e.g. Bhalla (1976) on Haryana). There is also some direct evidence for the rice regions where similar forces are at work (Bardhan and Rudra, 1978). This would mean that former small cultivator households may be pushed to the ranks of agricultural laborers. While both the men and women of such households would be left worse off as a result, the greater burden of any such effects is likely to fall on the women for reasons already spelt out.

Summary and concluding comments

From the results presented in the body of the paper we have noted that women, especially those employed as casual labor, contribute a substantial and often a major proportion of the total labor used in rice cultivation. The adoption of HYV rice increases the use of total labor/ha. on the farm; and much of this increase is accounted for by female and male casual labor, implying an increase in employment opportunities for those seeking agricultural wage work. The effect on female family labor use on the farm is found to vary by State, being the net effect of two contradictory tendencies; one relating to the increased requirements for labor on the farm with HYVs and the other relating to family prestige considerations which cause women to withdraw from manual field work as family income increases with HYVs.

However, as noted in the third section of the paper, all these effects must be seen in a wider context, where women of the poorer households already have high workloads, often higher than those borne by men, where cash income is usually controlled by men and often spent by them largely on their own needs; where the intra-household distribution of food favours men over women; and where working in the rice fields exposes the women to many health hazards which men working largely in a different set of agricultural operations are not exposed to. Given this backdrop, the noted increased demand for female casual labor may not benefit the women of agricultural labor households if, firstly, there is no increase in daily real wages (which are found to have declined in all three States) and, secondly, there are intra-household inequalities in access to income and consumption items. Also, where the women of small cultivator households now work longer hours in the fields, this would imply an increase in their workloads, without necessarily implying a compensatory improvement in their standard of living.

The discussion in the paper also points to the significance of women's work and contribution to the family' survival, in landless or near landless households, where women are often the main or the sole income earners. It underlines the need for a special focus in policy on the employment and income requirements of such women; and a special consideration of the gender implications of any income and employment impact of technological change.

Notes

1 For some excellent reviews of existing studies see Dasgupta, 1977; Byres, 1972, 1981.

2 Andhra Pradesh, Tamil Nadu and Orissa account for 12 per cent, 10.8 per cent and 8 per cent, respectively of total rice production in the country (based on the average for three years, 1976-77 to 1978-79) and count among the top six rice producing States in India.

3 At the State-level, AP and TN, respectively have 65.9 per cent and 87.6 per cent of their rice area under HYVs (as in 1977-78). The all-India average of percentage rice area under HYVs is 40.0 per cent. In Orissa, by contrast, the percentage is only 14.7. Sources: Government of India (1982): Fertilizer Statistics of India, 1981-82, p. II–90, and Government of India (1980): Estimates of Area, Production and Yield of Principal Crops, 1978-79.

4 The original samples for AP and TN consisted of 100 farms and 90 farms, respectively. One farm from AP and 3 from TN were dropped from the analysis since the data pertaining to these were incomplete. For Orissa, the original sample was much larger, covering all the districts of the State. However, because of the limited adoption of HYV rice in most parts of the State, only the cultivators located in 6 districts were selected for the present analysis. These districts (Balasore, Cuttack, Gunjan, Puri, Sambalpur and Dhenkalam) constitute the belt in which most of the HYV rice adoption has occurred. An additional advantage is that these districts are broadly homogeneous in terms of agro-climatic conditions.

5 Of course where traditional varieties too are transplanted, the shift to HYVs may well decrease labor needs for this operation because the plants are usually spaced farther apart.

6 See e.g., Agarwal, 1983.

7 See e.g., Agarwal, 1983.

8 The positive association of irrigation and cropping intensity has been noted in several studies, e.g., Johl (1972); Rao (1976); Agarwal (l983).

9 For the implications of mechanization on labor use in the context of Punjab, see Agarwal, 1981 a.

10 This is in keeping with the State-level picture as well. AP, for instance, by the 1981 census data (main workers classification) has a rural female labor force participation rate of 32.8 per cent – one of the highest in the country; while TN is close behind with 28.1 per cent. The all India figure is 16.5 per cent. In addition, AP has the highest concentration of rural female agricultural laborers in the country, viz. 20.2 per cent of the all-India total, even though it has only 8.3 per cent of the all-India rural female population.

11 Except in the case of 1 farm in AP and 1 in Orissa, in none of the other farms in the samples were family women reported as hiring themselves out to work on the fields of others for a wage, although

in many instances male members did hire themselves out for some part of the year. It is possible of course that in the case of family women there is some under-reporting due to family prestige considerations (e.g. see Agarwal, 1979).

12 Unfortunately, as noted earlier, the data do not permit us to assess the *numbers* of agricultural laborers that get additional employment as a result.

13 This conclusion is supported by other studies. For instance, Parthasarthy and Adiseshu (1982) have analyzed the trends in real wages in AP, from 1958-9 to 1967-8 and 1968-9 to 1978-9 based on crop and season reports. They find that in both periods, real wages of agricultural laborers have stagnated. A further district-level analysis indicates that this holds even for the agriculturally most advanced districts in the State.

14 For instance, Pathak (1983) notes, on the basis of a three village study for Punjab, that despite the increasing importance of commercial energy inputs in production agriculture, households of all classes depend almost entirely on non-commercial fuels for meeting cooking energy needs. And from Sarin's work (1983) on cooking stoves it is seen that usually associated with non-commercial fuels for cooking is a smoky, primitive stove.

15 An additional dimension of relevance here is the economic vulnerability of all women (even women of rich households) because they do not usually hold land titles or own property. Omvedt (1981) in her study on rural Maharashtra notes instances where women of rich peasant households divorced or deserted by their husbands are now working as agricultural laborers in the farms of their brothers who are substantial land owners. As she emphasizes (p. 21): 'Perhaps this fact more than any other shows the essential propertylessness of women *as* women'.

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18 Experiment of the Working Women's Forum in India: alternative employment options for Indian rural women

Jaya Arunachalam

Introduction

Existing conditions of rural women

The female labor force in the rural sectors of all developing countries face the oppressive double drudgery of being both the major provider to family income in addition to being responsible for household and family maintenance. These rural women's problems are further accentuated by problems of underdevelopment, unemployment, and family poverty. Despite the productive force these women represent, rural development policies rarely take into account their needs and problems. In short, one wonders whether their productive role to the community and nation is seriously considered by planners. Poor rural women have not participated in identifying issues, in planning development programs, nor in implementing projects. Consistently, this target group has been ignored by development planners.

Women's economic participation

In India, 76 per cent of the rural population is engaged in agricultural production, and rural women comprise 50 per cent of the agricultural labor force. There are more than 30 million women working in the rural sector: 20 million in agricultural wage labor and approximately 10 million employed in animal husbandry, handicrafts, or related activities. In the hill regions of northeastern India and Assam, female laborers outnumber male workers. This is also true of many parts of Tamil Nadu and Andhra Pradesh. In family farm labor, rural women play an important role in all stages of crop production, from land preparation through harvesting and post-harvest processing.

However, the most serious problems and oppression are faced by the female agricultural wage laborer. Working women face low wages, forced labor, long working hours, harsh working conditions, and sexual harassment. Government institutions and the public have failed to provide protective legislation, the result of both apathy and vested interests in perpetuating this system. Lacking awareness of their political and natural rights, these women continue the drudgery of their daily labor. After a long work day, most of these women must then haul drinking water and fuel for their own household's use. Additionally, they suffer physically from the harsh working conditions, lack of proper nutrition, and frequent pregnancies.

Government legislation and reform

The Indian parliament has legislated reforms, such as land redistribution, a national minimum wage act, and an equal renumeration law. Yet most of this legislation has not been implemented. Government agencies' apathy and local landlords' control have prevented the enforcement of reform legislation. Even in instances where land transfers are recorded on paper, the regional program has often failed to transfer property rights in practice. Poor rural households have not benefited significantly from the government's expressed intentions.

Additionally, poor rural women are essentially excluded from the government land reform programs. Not only does the husband alone receive the land title; the woman has no legal rights over land use, property disposal, or access to benefits from land's use.

The role of the Working Women's Forum

The Working Women's Forum recognizes that poor rural women have little access to or control over land resources. Additionally, agricultural wage labor provides low economic returns to these women, despite long hours under harsh working conditions.

Recognizing this, the Working Women's Forum aims to provide alternative employment opportunities for these women, either by increasing the economic returns to existing activities or by introducing new types of activities. Project areas identified are the following communities: 1) Adiramapattinam, Tamil Nadu, 2) Narasapur, West Godavari district, Andhra Pradesh, and 3) Dindigul, Madurai district, Tamil Nadu. The agricultural working conditions and employment opportunities vary in each community. The Working Women's Forum's efforts to organize women have been in response to local specific needs and problems.

Agricultural working conditions in three project areas

In all three areas of the Working Women's Forum's projects, poor rural women participate in agricultural wage labor. The working conditions are harsh, the hours long, and the pay low. The following discussion presents an overview of women's working conditions in the three areas. The Working Women's Forum surveyed thirty women in each of the three project areas, collecting data on household composition, socio-economic characteristics, female participation in different types of rice production activities, and wages received. Table 18.1 provides a comparison of conditions and socio-economic characteristics of the female members in each of the three project areas. Table 18.2 details male/female wage differences for different types of rice production activities in the three areas. Table 18.3 summarizes alternative employment opportunities and their returns.

Table 18.1 General socio-economic characteristics of households in three project areas.

	Adiramapattinam	Narasapur	Dindingul
% of women household head	100	27	94
Literacy (%)			
illiterate	90	80	83
literate	10	20	17
Land ownership (%)			
owner	7	0	30
tenant	23	0	17
landless	70	100	53

Table 18.2 Agricultural employment in three project areas.

	Adiramapattinam	Narasapur	Dindingul
Type of labor			
Wage	70	100	80
tenant (family)	23	0	20
Months/year work available	2	2	3
Ave. Annual income from wage labor (RS)			
Male	300–400	480	90–120
female	150	360	90–120
Specific activities (Rs/day)			
1. Plowing (male)	n.a.	n.a.	15–20
2. Transplanting	n.a.	6–8	n.a.
3. Weeding	n.a.	6–8	n.a.
4. Harvesting			
male	10	8–10	n.a.
female	5	6–8	n.a.
5. Threshing			
male	10	8–10	n.a.
female	5	6–8	n.a.
6. Winnowing	n.a.		
male		10	n.a.
female		6–8	n.a.

Adiramapattinam

In Adiramapattinam, located on the coast, fish marketing provides better returns and a more reliable income source than agricultural wage labor. During the two months of the year when there is wage labor, women consistently receive lower wages than men for the same activity. For the remaining ten months of the year, the women support the households through fish market trading, while the men have little employment opportunities. Women's work in and access to fish market trading is acquired through caste membership. 66 per cent of the women surveyed responded that only fish marketing provided them with real profits. Additionally, the women felt that independent access to and control over earnings increased their decision making power in the household. 93 per cent of those surveyed responded that they were

Table 18.3 Average monthly earnings from alternative employment in three project areas.

	5%earning	Rs/month
Adiramapattinam		
female (fish market)	52	200–250
	27	150–200
	16	100–150
male	n.a.	n.a.
Narasapur		
female (lacemaking)	63	40
	20	20
	17	less than 20
male (carpentry, construction etc.)	80	200–300
	20	100–200
Dindingul		
female (dairy)	100	90–300
male	17	200–400
	33	100–200
	27	0–100
	23	0

responsible for household decision making. Work in rice production provides inadequate financial compensation, but women continue when work is available because they can have access to grain for food.

Narasapur

In Narasapur, the majority of women involved in contract lace making are illiterate members of the scheduled castes. All of the households are landless, and all of the women surveyed worked in agricultural wage labor in addition to traditional lace making. Again, as in Adiramapattinam, work in rice production activities is available for only two months of the year. In contrast, the data in Table 18.1 indicate that Narasapur women earn very little through traditional lace making (30-40 Rs/month). For the majority of Narasapur, seasonal agricultural wage labor is more renumerative than handicrafts. 26 of the 30 respondents noted that there was no profit in lace work. Still, lace production in the home provides small amounts of cash income throughout the year, while agricultural work only provides 2-3 months total employment.

Dindigul

Surveys were conducted on 30 women, out of 600 landless cooperative members, in Dindigul. The majority of households are Harijan, and 93 per cent of the women identified themselves as the household head. Rice production provides wage employment opportunities for 3 months/year; in the remaining months, women also work in dry farming production of onions, peanuts, and other fodder crops. Out of the 30 members surveyed, 24 relied solely on agricultural wage labor and 6 were members of tenant households.

General summary

In general, women described harsh working conditions in agricultural labor, characterized by long hours and low wages (see Table 18.2). The respondents described health hazards and job insecurity. During transplanting, women developed back, neck and shoulder pains from long hours of working bent over. Many women complained of ulcers and infected cuts on legs and arms from working barefoot in wet fields. Respondents also noted the presence of thorns, broken pieces of glass, spiders, and snakes as other potential health hazards. As a rule, women in transplanting and weeding suffer from constant general body pain and frequent fevers and respiratory ailments from working in the rain.

Their health is of extreme importance to them owing to the insecurity of their work. Work is generally available only on a day-to-day basis. Women workers often do not know whether they will have work for the day, or even half day, until they show up in the field. If they are late or their work doesn't satisfy the field supervisor, the overseer may dismiss them without pay. The women may start working, only to have the field supervisor quote a low rate of payment. Consistently, women are paid a lower wage rate than men even for the same activities. Women have no control over their labor and abide by these conditions in order to support their families.

Methodology and case examples

The general methodology employed was initially to organize the women laborers into an informal union. As an organized group, these women often have greater access to credit and control over their earnings than they would have as individual workers. Denied access to formal credit, the women established a credit cooperative society with 5000 share holders, which has a 97.6 per cent collection rate. The treasurer, directors, and credit collection workers all come from the membership ranks. The Working Women's Forum believes that through unionization and credit societies, these women can improve their material conditions, in terms of cash income, housing, clothes, food and nutrition. See Fig. 18.1.

In addition, the Working Women's Forum has provided training in managerial and social leadership skills. The groups has also provided support services in order to release women members for more remunerative employment. The forum has organized health, family planning, and nutrition programs. Day care and legal services are provided.

This paper documents the specific projects and achievements of the Working Women's Forum in the three communities of Adiramapattinam, Narasapur, and Dindigul. See Fig. 18.2. In Adiramapattinam, where women are already engaged in fish market trading, the Working Women's Forum worked to raise the productivity of existing activities. The group organized the market traders to acquire credit and to establish a permanent trading location for business transactions. In Narasapur, women provide a cheap, exploitable labor force for the traditional lacemaking enterprises. The Working Women's Forum helped unionize these women for more effective collective bargaining and for higher wages. In Dindigul, 600 women were organized in an alternative employment program for livestock and dairy production. The following discussion presents the specific methodology the group applied in each case example and the project's results. The conclusion presents a general summary of the problems encountered and insights for similar efforts in other situations.

Adiramapattinam

In Adiramapattinam, fish marketing women must contend with lack of credit, harassment, and job insecurity. Still, as noted in the previous section, fish marketing provided a higher and more steady income than agricultural wage labor. The Working Women's Forum has organized these women to obtain credit and to participate in three types of fish trading: dry fish marketing at fairs, dry fish marketing within their community, and fresh fish trading at local markets. In general, small scale traders lack the ready cash to purchase fish at the lowest price from the auctioneer or fisherman. Additionally, traders lacking a permanent market location are subject to harassment by male officials, other vendors, and passers-by.

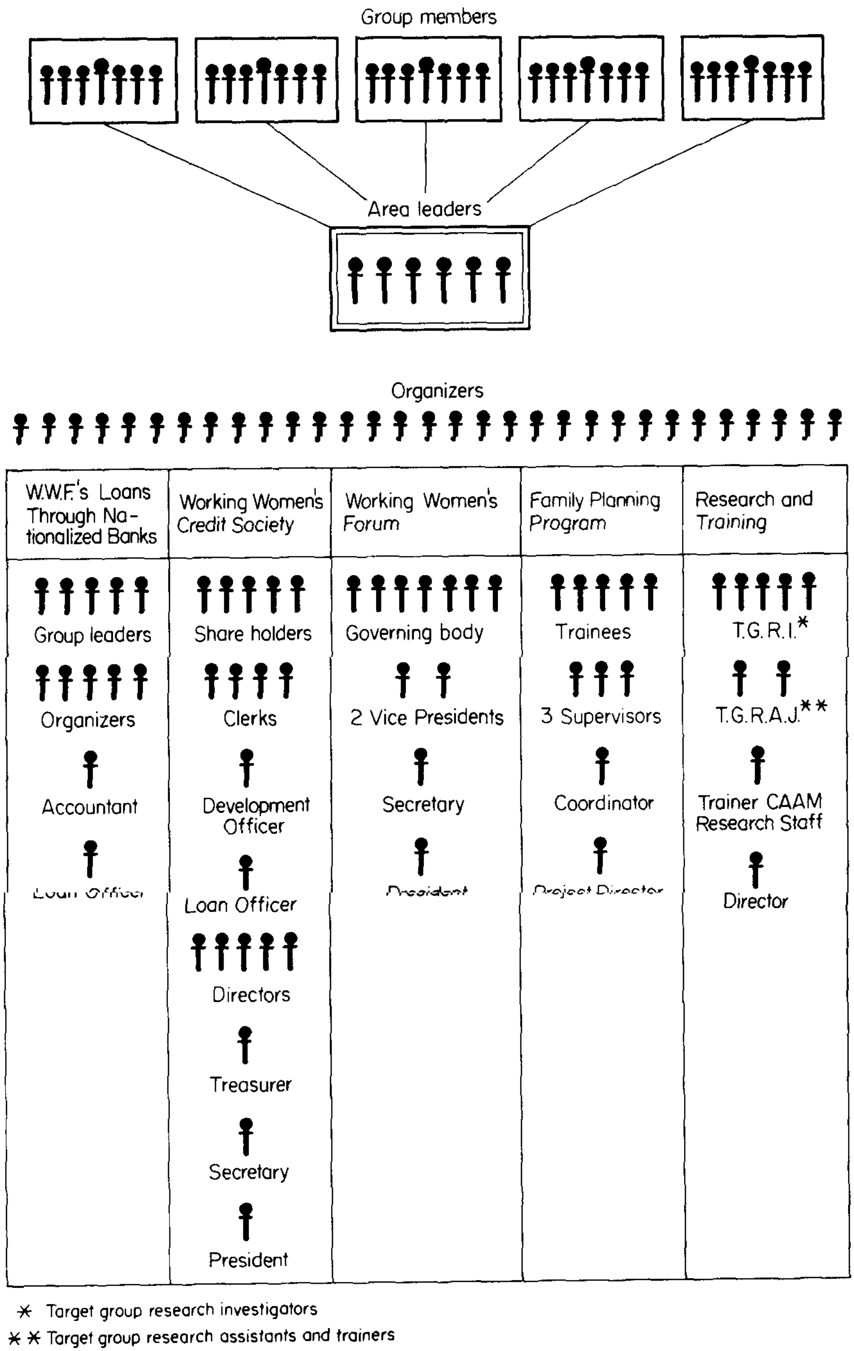

Figure 18.1 : Structure of the organization.

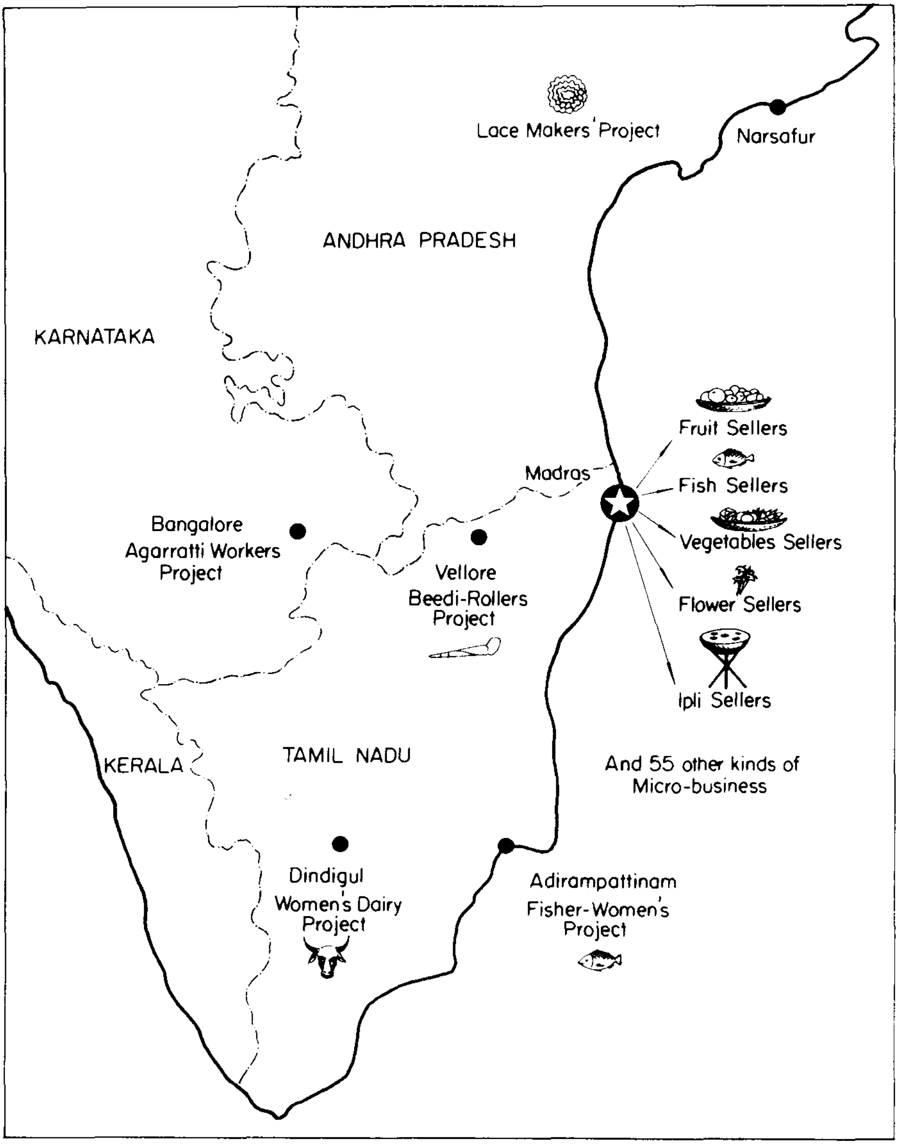

Figure 18.2: The branches of the Working Women's Forum (India).

Women respondents agreed that fish marketing in fairs is the most difficult trading enterprise. Of the respondents, 55 per cent visited the fairs 2-3 times a month, staying an average of 1-3 days. Market women buy large quantities of fish (i.e. 6 baskets of 1000-1800 fish) at the auction. Fish processing is carried out on non-market days, and then the fish must be transported to the railway station. In transporting fish to the fairs, these women often incur major costs with no guarantee of compensation. Women must pay coolie transport to the railway station (1 Rs/basket), railway pass (30 Rs/month), unloading by porter (1.50 Rs/basket), and a watchman's commission fee at the market (2 Rs).

At the market, the fish market women set up their wares in open areas and, exposed to the elements, market their fish for several days. Lacking permanent market locations, women are subjected to harassment by officials, both while marketing and at night when the women must find a spot to sleep. Also, thieves are plenty in fair areas, and women must guard against them.

In marketing dry fish within the local community, women buy dry fish in the village or from wholesalers by either kilos (2.50 – 3 Rs.) or bags (60-70 Rs). Women carry the fish to other communities by bus or on their heads, if transportation is not available. Carrying head-load baskets, these women may walk 25 miles from village to village marketing their fish. Payment is both in cash and in kind, and fisherwomen will often accept tamarind or rice as payment for dried fish. Returns vary according to climatic conditions. During the dry season, market women may expect a return of Rs. 10/day for an investment of Rs. 60-70.

In some coastal regions, fisherwomen may purchase fresh fish daily and sell it in local markets. After procuring fish from the boatmen, the women must transport an average of 50-100 pieces of fish through three miles of marsh and sand, in order to reach the market.

In all three types of fish marketing, women traders have lacked access to formal credit and have been subjected to the high interests charged by the informal money lender. The Bay of Bengal Program (BOBP) of FAO had been initially working in the village and invited the Working Women's Forum to organize a credit group among these fish market traders. Since that time, the group has organized more than 1200 fish marketing women and provided 1000 loans in 1.5 years. Repayment rates are as high as 90-93 per cent. In Adiramapattinam, fish marketing women assume complete responsibility for purchase and marketing of fish. They maintain independent control of finances and have already developed marketing and socio-political skills through daily haggling and bargaining. The Working Women's Forum provided credit and support services to reinforce the existing skills of the fisherwomen.

Narasapur

In Narasapur, traditional lace making provides the only steady income available to poor women. Agricultural wage labor, although more remunerative, provides employment for only two months out of the year. Out of the 30 respondents, 60 per cent did lace work for 10 months/year, and 40 per cent did lace work throughout the entire year. Lace work provides very low economic returns. Average monthly earnings ranged from Rs 40 (60 per cent of respondents) down to 20 Rs (20 per cent of respondents).

Initially, the Working Women's Forum offered credit assistance to female artisans engaged in sub-contract work. With the credit provided, the women were able to buy their own materials and sell the lace in a nearby town for a reasonable profit. Some women began to produce higher quality lace under contract for export. Other artisans, not initially affiliated with the forum, began to pressure their contractors for a general wage increase. As a result, the employers increased the piece rate from Rs 5/reel to Rs 7-8/reel of weaving lace. Now, through SIDA/ILO coordination, the Working Women's Forum has been able to establish a production unit to produce high-quality lace. These samples will be sent abroad in an attempt to identify alternative export markets. Cooperative control of export marketing by the women artisans should ensure greater profits.

In this situation, the Working Women's Forum is attempting to organize a cooperative group, comprised only of a small group of highest quality lace producers. The aim is to restrict production and thus increase the returns on production of high quality lace. The group is trying to persuade other lace makers to seek employment in rice farming or other village industries which would provide greater returns for their labor.

Dindigul

In Dindigul, agricultural wage labor provides women with only seasonal employment (3 months/year) at low wages (30-40 Rs/month). Additionally, in a drought-prone area, agriculture provides little steady employment for men also, and male income contribution to household expenditures is lower than females'. Furthermore, men spend half of their meagre earnings on beedis, betelnut, liquor and gambling. In contrast, women contribute a greater percentage of their income towards buying groceries, utensils or other necessary commodities for the household. Of the respondents, 60 per cent retained independent control over income gained in employment. Raising dairy productivity is crucial as this industry provides the only steady source of household income throughout the year.

The Working Women's Forum has concentrated its efforts in developing support services for the local dairy industry in order to guarantee a steady household income source. Income from the sale of milk provides from 90-300 Rs per month on a steady basis.

Poor women involved in cattle and dairy production face increasing problems in acquiring water and fodder for their cattle. Traditionally women have grazed their cattle on the land of nearby landlords, but the landlords may forbid grazing or confiscate the cattle as trespassing. It is also becoming more difficult for women to provide water and locally available fodder for their cattle.

The Working Women's Forum's organizers have assisted the women in settling accounts with the Milk Cooperative, which purchases the cow's milk. Members in the Forum's organization require the organizer's assistance in settling disputes over accounts. In almost all cases, women would not allow their husbands to tally the accounts because they said that the men had provided wrong information on the cash balance and had used the money on alcohol.

By organizing the women into groups, the Forum intends that group leaders assume responsibility for group monitoring of accounts. The village group leaders are responsible for collecting village membership fees, calling members to meetings, settling milk and credit loan accounts with the banks, monitoring credit repayment, and mobilizing new members.

Additionally, the forum also paid for a veterinarian to attend to the needs of members' livestock. In emergencies, it was still necessary to take the cattle to the veterinary clinic. The Forum has also trained women to supervise and record the daily milking by the Milk Cooperative's milk boys during the loan repayment period. In many earlier instances, women reported that the milkboys had cheated them. In the project's first year, the Working Women's Forum could not tally its accounts with the dairy farm. The organization paid Rs 900 to compensate for the members' unpaid accounts. Now, the members are instructed to supervise the milking and to argue with the dairy farm employees if the accounts do not tally.

Members said that livestock production and milk sales provided a steady cash income for their households. Even during drought periods, respondents continued to get income from their cattle. Women noted that they were able to feed their families, to make major purchases, and to have independent control over earnings. Of the respondents, 33 per cent no longer participated in agricultural wage labor and earned all income through dairy production. Specific improvements mentioned were house and construction, purchase of carts or tools, and investment in small business.

Conclusions

Based on the experience of these three projects, the Working Women's Forum has certain insights which may prove useful in similar efforts to develop alternative employment for rural women.

1 In general, people are slow to change their traditional attitudes, particularly rural women. By involving women totally in the following activities, the traditional attitudes can be changed. The Working Women's Forum has concentrated on raising women's consciousness about socio-economic oppression, providing a forum for women to learn political skills, and identifying potential leaders.

2 The organization develops professional group leaders through practical awareness about the banks, government, hospitals, and economic system.

3 In rural situations, social legislation has not benefited the rural labor force. The Working Women's Forum has created alternative employment options or strengthened existing skills through Credit and Training. Providing credit to very poor rural women helps them to play productive economic roles.

4 In areas such as Dindingul, exposure to the Working Women's Forum has provided strength to such women, increased their perceptions and their capacity to identify issues affecting women workers. It is difficult to undo the process of oppression inflicted on Harijan women. The issues here are not male-domination, but rather caste/class oppression.

5 Another valid observation is that women who work equally with men in field or earn increased incomes from the buffaloes are credited with an equal household status and decision making role.

6 In Adiramapattinam, most beneficiaries feel that the Working Women's Forum has enlivened their unexciting lives by bringing together fisherwomen, the lowest of social beings. Fisherwomen are active in group meetings, training programmes, research workshops or trips to the city of Madras visiting headquarters annually for mass meetings. They don't seek the permission of their male elders to participate. Furthermore, these women are oppressed by other fisherwomen from Adiramapattinam's richer streets who abuse the lower caste women. Working Women's

Forum has stressed the benefits of reaching all women and the general problems of male oppression. Women from all streets are compelled to meet, sit and work together to defy male-dominated Panchayat systems. Working Women's Forum has raised the women's consciousness of problems that affect them in general.

7 Elimination of male, élite control was another strategy which yielded quick results. Even for credit purposes, the target group's women leader guarantees the loans for her group members and guarantees that women workers are not obliged to any male family members or their employer. This to a large extent ensures the women retaining custody of their income.

8 Within a period of 5 years, Working Women's Forum has been able to demonstrate an alternative leadership pattern by encouraging women to learn to control their destinies.

The history of Working Women's Forum as narrated here now is the history of very poor women, who within a very short span of time have risen from destitution to leadership, by taking up full economic roles in challenging circumstances.

The challenges we face in our daily situations as voluntary action groups are many. Lack of resources and little recognition by the government are but two. I make an appeal here to other distinguished participants, to do their best to convey our concerns to those concerned in planning and policy making in the developing world.

19 Landless women agricultural laborers in India: some observations from Tamil Nadu, Kerala and West Bengal

Joan P. Mencher

Summary

This paper addresses two of the questions raised by the Conference: the impact of new technology on women's employment, especially the displacement of labor, and how technologies can help to diversify income-earning opportunities for women.

As background, it is pointed out that there has always been a significant use of landless labor in India's rice regions, and that this landless group is larger today — and more underemployed — than previously.

On the basis of data on actual days of employment for samples of landless agricultural laborer women in three states of India (Kerala, Tamil Nadu and West Bengal), it is shown that today there is considerable underemployment in all three (and that it is highest in the main rice-producing districts). Data on income and contributions to the household are then examined, and it is shown that the income of these landless women is crucial to family survival. It is also shown that to date, the impact of the new technologies has been primarily negative for this sector of the population.

Some specific suggestions are made for income-diversifying

technologies, which must be introduced with careful attention to local variations in ecology, agricultural practice, etc. It is strongly suggested that schemes for alternative employment for these women be introduced *before* labor-saving innovations are brought about in paddy cultivation.

Introduction

In the context of this conference, two important features of rice cultivation in South Asia need to be mentioned. The first has to do with the ways in which labor has been organized in wet rice cultivation. There is today, and has always been, a fairly close relationship between the organization of labor in wet rice areas and other aspects of the local political economy. Thus, even traditionally there was a sharp contrast between South Asia on the one hand and South East Asia on the other. Etienne has noted that an economy based on rice cultivation needs to have either a very efficient system of cooperative production or a high labor force of agricultural workers, since even those who own as little as one hectare cannot manage without outside help (1968:215). Traditionally in the South Asian context, even where tenancy was dominant, the heaviest and most onerous work in paddy cultivation was carried out by untouchables, members of low castes, or tribals who had no rights in the land they worked, and who often lived under conditions that were close to agrestic slavery.

The rice-growing areas of South Asia, which are coming more and more to be dominated by capitalist relations of production, can be usefully contrasted with socialist areas such as China and Vietnam, or even (for totally different reasons) with Taiwan. In the case of the latter countries, where in effect there is no longer such a phenomenon as landlessness, an innovation that decreases labor time need not impoverish anyone. In the case of Taiwan. even though it is a part of the world capitalist system, because the landlords were members of a different ethnic group from the leaders it was possible to institute a land reform that gave land to every single rural household, and so to end landlessness in the countryside.

The second set of comments concerns the relationship between social inequality and the new technology. In the context of India’s traditional rice regions, it is meaningless to talk about the new technology without recognizing that in each region (though the proportions may differ) there are three main groups of women who are involved in agriculture: landless agricultural laborer women, women with smallholdings who also work on the land (both their own and others’), and landowning women (small, medium and large) who do not physically work on the land themselves. The interests of those in the first and last categories are often diametrically opposed, in that they each represent different class interests; women in these groups may in fact share more with the males of their own class than with women of other classes. As for the women of the second group, their interests are often the same as those of the landless women in that they also depend in part on finding outside employment, but on the other hand they can also benefit from labor-saving innovations.

Another point to be noted has to do with the different ways in which operations involving women in India have been carried out, e.g. the contrast between situations where the female laborers are paid by time (e.g. Rs. 2.50 for a half day weeding)[1] and where they are paid by acreage (e.g. Rs. 100 for a group of women to transplant a field). In most of the areas where we have worked payment is by time, thus any kind of labor-saving device that might save time in transplanting, for example, would lead to a decrease in the amount of work available for laboring women. It might be argued that in areas where laborers are paid on an acreage basis, the introduction of labor-saving devices would not be as disastrous, but I suspect that it would soon lead to a greater differentiation among the landless agricultural laborers — between those who are organizers (and their close friends or relatives) and the rest. If a woman labor organizer can get a field transplanted with the help of 3 other women with the use of transplanting machines in the same amount of time it took formerly to do it with 15 women, she would have little incentive to continue dividing up the profit among 15. Furthermore, when landlords see that the work is done in less time, they are likely to decrease the payment per acre.[2]

One last contrast needs to be mentioned here, namely that between regions where paddy is the dominant (often the sole) crop, and areas with additional crops (such as tree crops, vegetables, lesser grains, roots, or legumes). As will be noted below, it is the areas where paddy dominates which have the greatest underemployment among female (as well as male) agricultural laborers. This may not have been true in the days when laborers worked as agrestic slaves, but as they organized and won better wages and better hours, the landowners cut back on hiring. This led to reductions in the number of days of work, leading to agitations for still higher wages, etc. (Panikar 1971). The net result, discussed below, has been fewer days of work and a lower total income in the main rice regions.

Background

Sources of information

This paper is based primarily on data being collected as part of a joint project being carried out with Dr. K. Saradamoni of the Indian Statistical Institute, New Delhi.[3] The study included 10 villages each in the states of Kerala and Tamil Nadu, and 8 villages in the state of West Bengal. The data I will be discussing are currently being analyzed. for some of the analysis we have been able to use 21 of the villages, for other parts of the analysis we have fewer data available. Furthermore, we have not yet carried out any detailed analysis of the correlations among variables. In spite of these serious limitations, some of these data are being presented here in the hope that they will help to shed light on the question of female employment in rice cultivation and the related one of female contributions to household maintenance. In addition, the paper draws on my previous detailed field work in Chingleput District of Tamil Nadu and in Palghat and Alleppey Districts of Kerala.

General description of the areas studied

All of the areas where we have been working have a high density of population per hectare of cultivable land, and an even higher density for each hectare of paddy land. In addition, the three states where our project is located all have high proportions of scheduled castes (Harijans) and scheduled tribes. This is not surprising, since in general in India the percentage of scheduled castes in the total population correlates fairly closely with the extent of irrigated wet land, as well as with paddy cultivation.[4]

Intensive paddy cultivation is capable of supporting much larger populations than any other grain. In most parts of India, this has led to highly-stratified societies in which the owners of the land (who normally belong to higher castes) either give the land to tenants or leave most of the labor-intensive tasks to hired laborers. Even among the so-called ‘agriculturalist castes’, apart from plowing and preparing the land for cultivation, the majority of owners had most of the manual work of cultivation done by laborers (male or female, depending on the task). This was true traditionally even of many small landowners.

It is striking that in rice regions, even when there is a relatively large surplus labor population of underemployed and unemployed males, women have continued to play a fairly large part in cultivation. In an earlier piece of research, I found that landowners in Palghat District (Kerala) on the average used women for 417 hours per acre of wetland per crop season, whereas they used males for only 106 hours per acre (Mencher 1980). Obviously this figure will vary from region to region, with undoubtedly a higher male/female ratio in Tamil Nadu and West Bengal than in Kerala. Nonetheless, women do play a very significant role in rice production. For example, in Chingleput District of Tamil Nadu (where I worked in 1963 and again in 1970-72), I found that while men may be involved in a more varied number of operations connected with paddy cultivation, there is a greater demand for women, since they work in some of the most labor-intensive aspects of paddy cultivation, namely transplanting and weeding. I do not have any data on the demand side from West Bengal from my own work (since the work I did in 1963 in West Bengal did not capture this dimension). However, the work of others such as Bardhan (1979) seems to indicate a large demand for women in paddy cultivation, especially for the traditionally female activities.

Initially we had intended only to cover a single crop season, but as the work progressed we realized that it made more sense to cover an entire calendar year. However, because of our initial decision (as well as a brief interruption when we were uncertain about funding), four of the villages – two in Chingleput District of Tamil Nadu and two in Birbhum District of West Bengal – were studied for a shorter period of time. This must be kept in mind in looking at the tables which follow.

The data were collected on a day-by-day basis for a full year from each of the female agricultural laborers. Space does not permit a full discussion of methodology, which appears in Mencher, Saradamoni and Panicker 1979 and Mencher and Saradamoni 1982.

Discussion of the data

The following discussion deals with gross data on female agricultural activities from 21 villages, and income and contributions to household maintenance from a sub-sample of the villages. (The first phase of the study only collected data on contributions to the household, not on total earnings. For that reason, those villages are left out of some of the tables. In addition, some of the materials have not yet been completely analyzed.)

Work days and activities

Table 19.1 presents data on the number of days of work our informants had during the study year. (The first figure indicates the average for all of our landless laborer informants in a given village; this is followed by the maximum and minimum figures for the village.) Note that the total number of days worked for wages is *not* identical to the total number of days on which an individual woman might have wage work, since in many instances a woman might get work for two half days instead of one whole day. We have considered three and a half hours or less as a half day, and four hours or more as a full day. This was necessary because of the great variation among villages, both in the working

Table 19.1 Number of days worked for wages.

State	District (Village no.)	Average	% of Year	Range Maximum	Range Minimum
Kerala (data for 52 weeks)	Alleppey (2) (Kuttanad)	63	17%	89	34
	Alleppey (1) (Kuttanad)	86	24%	185	36
	Trichur (2) (Kole region)	88	24%	169	53
	Palghat (1) (irrigated)	156	43%	227	56
	Palghat (2)	159	43%	225	61
	Trichur (1)	170	47%	282	72
	Cannanore (1)	192	53%	329	61
	Trivandrum (1)	195	54%	314	69
Tamil Nadu (52 weeks)	Thanjavur (1) (Eastern Delta)	77	21%	101	46
	South Arcot (1) (Eastern Delta)	97	27%	189	48
	South Arcot (2)	120	33%	230	46
	Kanya Kumari	120	33%	189	63
	Thanjavur (2) (Western region)	131	36%	239	36
(35 weeks)	Chingleput (1) (drier area)	73	29% of 252 days	143	32
	Chingleput (2)	83	34% of 245 days	148	35
West Bengal (52 weeks)	Burdwan (1)	119	33%	243	58
	Purulia (1)	159	44%	227	56
	24-Parganas (1)	187	51%	274	143
	24-Parganas (2)	256	70%	273	231
(26 weeks)	Birbhum (2)	104	57% of 182 days	165	44
	Birbhum (1)	131	72% of 182 days	182	88

pattern and in the tasks women do. In the Alleppey villages (in the famous Kuttanad area), we find that even the concept of half-day is misleading, since often a woman might only get work for one hour, or even a fraction of an hour. For the present purpose these short periods are treated as half days. (Often such a small amount of time might take a woman half a day or longer, counting time spent in travelling and waiting around.)

Another feature of this area is that most of the land lies below sea level and therefore must be de-watered collectively, which means that large areas are planted at the same time and are ready for harvest at the same time. This leads to an intense clustering of work days, resulting in a very unevenly spaced demand for labor in these localities. The five villages in our sample with this high degree of clustering are Alleppey 1 and 2, Trichur 2, Thanjavur 1, and South Arcot 1.

Looking at Table 19.1, it is clear that in all three states the villages with the fewest days of work are in the main paddy-growing regions (that is, villages located in paddy-exporting districts), except for one case: Palghat 1. This village happens to be fairly close to the forest, where at least some of the women have alternative sources of income, such as collecting fencing materials or firewood for sale. In addition, most of the land here has two (and occasionally three) paddy crops. Thanjavur 2, in the western part of the district, also has more second-crop paddy land, as well as more land given over to other (non-paddy) crops, than in the eastern deltaic region.

The table shows a wide range in the amount of work among villages in the same state, as well as among individuals in the same village. In the case of Kerala, the only two villages where our informants had work for more than 50 per cent of the year are in the extreme north (Cannanore District) and in the extreme south (Trivandrum District). Even in these two villages, most women had work for only about half the year, and many for only a third of the year. In the other Kerala villages, we found even more women suffering from underemployment. Though we have not as yet calculated the days of male employment, it is clear that the men also have few days of work — in some villages even fewer than the women. In Kerala, the main areas where the men earn higher wages or are able to get more work are those areas where non-agricultural daily wage work is available.

Apart from the village with the lowest amount of work, in all the others the range of variation within a village is between 3: 1 and 5:1. A number of factors seem to play a part in whether or not a woman gets more days of work, but from the preliminary analysis of data from some of the villages, it is clear that by far the major reason is unavailability of work, followed by illness.

Table 19.2 shows what we can call 'activity units', a concept introduced because of the variations in work patterns between different areas. These are not actual days or half-days of work, but the specific operations or tasks carried out in the course of a morning's or afternoon's work. In some villages an operation like transplanting or harvesting is carried out continuously for an entire half day, while in other areas a woman might do harvesting, carry the harvested sheaves, and thresh them, all in a single morning or afternoon.

Table 19.2 Distribution of work in agriculture among landless agricultural workers in activity units.[1]

Sub-region	District (Village no.)	Activities relating to paddy: Trans-planting	Weeding	Harves-ting	Post Harves-ting	Other paddy	Total paddy	Other work outdoors
KERALA								
1) Primarily paddy	a) Alleppey (1) (Kuttanad)	12	65	20	38	19	154	negligible
	b) Allepey (2) (Kuttanad)	24	105	32	44	31	235	negligible
	c) Trichur (2) (Kole area)	30	42	25	27	9	134	155[3]
	d) Palghat (1) (irrigated area)	55	25	47	88	39	254	74
	e) Palghat (2) (rainfed)	69	17	37	103	24	249	109
	f) Trichur (1) (rainfed)	51	15	41	95	33	234	109
2) Mid-land with many hills	g) Cannanore (1) (rainfed, a lot of cashew and aracenut)	17	72	20	5	57	170	216
	h) Trivandrum (1)	49	46	45	47	60	251	179
TAMIL NADU								
1) River irrigation	a) Thanjavur (1) (Eastern Delta)	68	39	30	neglible	0	144	12
	b) Thanjavur (2) (West Region)	55	41	42	65	16	218	82
	c) S. Arcot (1) (Eastern Delta)	69	35	31	130	neglible	266	136

2) Pump-sets and tanks	d) S. Arcot (2)	48	66	43	185	neglible	343	210
	e) Chingleput (2) (35 weeks' data only)	50	48	65	negligible[4]	negligible[4]	169	14[4]
3) Rain and tank	f) Chingleput (1) (36 weeks' data only)	29	90	49	negligib1e[4]	negligible[4]	182	neglible[4]
4) Rain only	g) Kanya Kumari (1) (two full monsoons)	97	158	18	negli-	10	283	neglible
WEST BENGAL								
1) Major irrigated (river) rice region	a) Burdwan (1)	59	37	57	52	negliible	212	245
2) Other parts of active Delta	b) 24-Parganas (1)	98	25	68	183	30	403	288
	c) 24-Parganas (2)	115	53	127	185	13	492	135
3) Other regions	d) Burbhum (1)[4] (26 weeks)	17[4]	9[4]	65	109	18	218[4]	137
	e) Birbhum (2)[4] (26 weeks)	14[4]	5[4]	59	115	negligible	195[4]	128
	f) Purulia (1)	59	25	47	81	36	248	77

1. Data are in terms of *activity units,* not half-days. The detailed breakdown of activities was recorded during each half-day it took place, so that if in a given morning a woman pulled seedlings, carried them, and then planted them, this would count as three units.
2. This includes work on other crops as well as collecting fuel, grass, and fencing materials.
3. This includes loading sand, coconuts, or bricks.
4. The data for Chingleput (1) were collected for 35 weeks and for Chingleput (2) for 36 weeks. The data for the two Birbhum villages were only collected for 26 weeks. In the case of the two Chingleput villages, this has led to very few post-harvest activities being recorded for the women. During the January harvest period the women have very little time to spend in post-harvest work, since they almost immediately have to start transplanting for the next crop. In May/June they also participate in post-harvest operations. We lack data for the period mid-March to mid-July. For the two Birbhum villages, we lack data for the early part of the planting season, as well as for the second crop season when potatoes and vegetables are grown.

Looking at the Kerala data in Table 19.2, it is immediately obvious that the two Alleppey (Kuttanad) villages have little work for women outside paddy cultivation, whereas in all of the other villages there is other work such as carrying (e.g. coconuts to market, sand and bricks for construction work), collecting (e.g. firewood or fencing materials), or other agricultural work (e.g. picking areca nuts or cashews).

Table 19.1 shows that in our sample Tamil Nadu villages, there is considerably less work for women than in most parts of Kerala: no area has work for women for more than one-third of the year. In part, this may be because we have not included any villages in the drier zones of Tamil Nadu, which have both less dense populations and a greater diversity of crops, and thus would probably have in many cases more work per individual as well as a more even distribution of work throughout the year (Sen 1982). This suggestion is supported by the statements of women in one of our sample villages (South Arcot l), reporting that women from nearby dry villages often come to work in their village during periods of peak labor demand — whereas these dry villages do not require outside workers because of the more even distribution of work. It is also possible that the proportion of women working as agricultural laborers (out of the total female population) is a factor here, since the figure for Tamil Nadu is almost twice that for Kerala. It may be that ecological factors (such as the distance between paddy field and forest) also play some part. Incidentally, the range in the number of days of work available is equally striking in both the southern states.

Apart from these rather speculative matters, a number of specific factors emerge from our data in relation to the differences between Tamil Nadu and Kerala in this regard. The following may be mentioned: in some districts in Tamil Nadu, caste Hindu laboring women traditionally do not perform certain operations (though in others there is no such restriction); as indicated in Table 19.2, Tamil Nadu women get much less work in other paddy-related activities than Kerala women, for two kinds of reasons: the relative lack of forest land in Tamil Nadu means very little use of leaves for green manure; and there are important differences in the sexual division of labor, e.g. irrigation in Tamil Nadu is primarily from pumpsets or river channels, and is done exclusively by males; preparation of the ground is also primarily a male prerogative; in Tamil Nadu men pull out the paddy seedlings before they are transplanted by the women, whereas in Kerala women generally do both parts of the operation: in Tamil Nadu both men and women do harvesting, while in Kerala it is done primarily (in some areas exclusively) by females; threshing is also largely a male occupation in Tamil Nadu, especially when done with the aid of bullocks, otherwise by mixed groups — again, it is mainly women's work in Kerala. In this connection, it may be noted that males in Tamil Nadu do not get nearly as much casual non-agricultural work as in Kerala.

In West Bengal, women on the whole get more work in the course of the year than in the south. In one of the villages in 24-Parganas women get wage work on the average about 70 per cent of the time, with little variation between the maximum and minimum. This is less true in Burdwan and Purulia Districts. Even though there are fewer days of work in Burdwan than in 24-Parganas, the number of days is far higher than in the villages near the bottom of the scale in Kerala and Tamil Nadu. The women get far more work in post-harvest activities in West Bengal than in the south, with the exception of South Arcot 2. This also needs further probing. One possible reason for the greater number of days of work in West Bengal is that the proportion of female agricultural laborer women to the total number of females is even lower than in Kerala. Thus, the number of women who form the agricultural laborer pool may be smaller.

Apart from rice mills, another way in which women have been replaced in agriculture has been the introduction of artificial fertilizers and the use of chemical pesticides and herbicides. In the areas where chemical fertilizers are used, men have come to replace women (who previously applied cow dung), or perhaps more accurately a single man has come to replace a number of women, since the new technology requires much less time and effort. Apart from one West Bengal village, we did not find women applying chemical fertilizers, pesticides or herbicides.

Income

Tables 19.3, 19.4, and 19.5 present information on income for some of the villages discussed above. Note that the average size of the households and the average number of adult working members vary from village to village, though if we leave out the two Alleppey (Kuttanad) villages, there does seem to be some sort of rough relation between the average number of working members and the average income per household. It is possible that in Kuttanad, because of the concentration of workdays discussed above, as well as problems in finding house-site land (since so much of the area is under water), adult members appear to be living together for a longer period before partitioning.

There is considerable difference in income between, as well as within, villages. As can be expected, a close parallel exists between the villages with the highest average total income per household and the villages with the largest number of days of work. This is not surprising, since landless laborers get very little income other than that which they get

Table 19.3 Average total income and size of household

State and Village	Average Income per Household (Rupees)[1]	Average Size of Household	Average Number of Working Members	N (Total Households)
Kerala				
Trivandrum (1)	3574	4.75	2.56	32
Palghat (2)	3448	5.52	2.48	27
Cannanore (1)	2780	5.53	2.37	30
Trichur (2)	2115	4.71	2.00	31
Alleppey (1)	1834	5.55	2.55	29
Alleppw (2)	1443	5.56	2.56	32
Tamil Nadu				
South Arcot (1)	2726	4.91	2.94	32
Thanjavur (2)	2609	4.66	2.91	32
South Arcot (2)	1768	5.13	2.33	30

1. 1 Rupee = $ .11

Table 19.4 Landless households: income information

Region and Village	(1) Average Total Income per Household (Rupees)[1]	(2) Average Wage Income per Household (Rupees)	(3) Ratio of Wage Income to Total Income	(4) Total Incomes per Household		(5) Average Income (Wife)	(6) Average Contrib. (Wife)
				Max	Min		
A. Kerala							
Trivandrum (1)	3574	3569	99.8%	7128	559	1423	1084
Palghat (2)	3448	3350	97%	7191	1094	1065	962
Cannanore (1)	2780	2780	100%	6862	596	1054	905
Trichur (2)	2115	2115	99.8%	41 34	353	735	646
Alleppey (1) (Kuttanad)	1834	1829	99.7%	4011	326	752	691
Alleppey (2) (Kuttanad)	1443	1443	100%	2848	458	525	418
B. Tamil Nadu							
South Arcot (1)	2726	2692	98.7%	5557	919	699	693
Thanjavar (2)	2609	2609	100%	5355	527	710	704
South Arcot (2)	1768	1684	95%	4225	456	587	566

1. 1 Rupee = approximately $ .11 during the study period.

Table 19.5 Average contributions to the household in four sample villages.[1]

State and District	Average contributions in month of lowest female earnings				Average contributions in month of highest female earnings			
	Wife		Husband		Wife		Husband	
	amount[2]	percent[3]	amount[2]	percent[3]	amount[2]	percent[3]	amount[2]	percent[3]
Kerala								
Alleppey (1)	4	80	10	66	123	83	82	73
Trivan-drum (1)	22	71	100	53	168	89	142	79
Tamil Nadu								
S. Arcot (1)	9	100	63	85	146	100	185	86
S. Arcot (2)	35	99	46	71	90	99	90	85

1. This is based on a sub-sample of households all with husband and wife working. The data for the remaining villages are still being compiled.
2. This is given in rupees. 1 Rupee = approximately $ .11 during the study period.
3. This refers to the percent of contribution divided by income during the given month.

(7) Range in Income		(8)	(9)	(10) Range in Income (Husband)		(11)	(12) Percent of Income Contributed		(13)	(14)
Max.	Min.	Average Income (Hus-band)	Average Contrib. (Hus-band)	Max.	Min.	Ratio of Wife's Contrib. Hus-band's	Wife	Husband	Average Income (other Women)	Average Income (other Men)
2595	365	2235	1141	4713	1040	.95	76%	51%	895	1195
1648	108	2039	1406	4139	163	.68	90%	69%	497	1705
2274	467	1965	1303	3910	62	.69	86%	66%	1181	1727
1501	349	1644	1213	3257	55	.53	88%	74%	675	947
2043	215	748	569	1967	100	1.21	92%	76%	481	719
808	267	772	562	1292	166	.74	80%	73%	429	797
919	258	1449	1226	1867	560	.55	99%	87%	467	1243
1509	80	1137	880	2384	313	.80	99%	77%	544	1115
1375	124	935	667	1360	31	.85	96%	71%	509	829

from selling their labor. And despite differences in wage levels, the single most important problem facing the workers is lack of work. Every time I visited a village personally perhaps the first words uttered to me, after being welcomed and going through the normal introductory formalities, consisted of a request for more work. Though women certainly wanted other things such as drinking water wells close to their dwelling places, all the women I met were most desperate for additional sources of income, no matter how much housework they might have. It is also interesting that in most cases, especially among the men, those with the highest earnings were not employed in agriculture, but worked as casual laborers in a variety of nonagricultural jobs.

The average total income per household, and the average income for our female informants, follow the same pattern e.g. in the case of Kerala, the village that has the highest total income also has the highest average income for our female informant, and vice versa. In each village, most of the better-off agricultural laborer households have more earning members. The households with the lowest incomes seem to have little or no male income, often with only one female being the main support of the household. This includes widows, divorcees, or abandoned women with only minor children, solitary elderly couples, and a few cases of elderly persons supported by a daughter.

As noted, among the landless agricultural laborers most income comes from wage labor. Only a few households manage to supplement their income with sales of milk, eggs, or poultry. Only one of the villages in our sample, Chingleput (2), has a scheme for providing the landless with loans for cows, but in that village we do not have wage income data. In one other village not reported in this paper, a number of women have been trying to get cattle loans, but none had been sanctioned as of the end of 1982. In South Arcot (2) a few households have been breeding ducks and manage to earn something from the sale of both duck eggs and ducks, but the risk is also great (as one of our sample households found out when they lost 5 dozen ducks to disease in 1980). Few households living on the margin of existence can afford such risks.

In most of the households where the wife has a substantial income, the income of the household as a whole is higher than where the woman's income is small, partly because most of the income of the wife is normally brought to the house. The main outside expenditure women have is for betel, and for food while on the job (since nowadays, especially in Kerala, many workers are not longer fed a noon meal).

No correlation exists between the wife's and the husband's earning. We found households where one earned substantially and the other very little and vice versa, and those where the earnings of both were high, and those where both were low. The only correlation that might be noted is that where both husband and wife are elderly, they tend to earn less.

In some villages there is a greater disparity in male and female wage rates than in others. Some of this differential is rooted in traditional patterns, but it is also reinforced by some of the recent legislation (see Mencher and Saradamoni 1982). On the whole the tasks performed by women also tend to be paid at a lower rate than those performed by men. In addition to the number of days of work a woman gets in the year these differential wage rates also affect the actual amount of income she gives to the household. In a few areas this differential has been reduced (e.g. Chingleput l), but this is not true even in some of the neighboring villages.

What is most significant in these figures is that in every case, the proportion of income contributed by wage-earning women to the household is far higher than that of their earning husbands. As noted above, where the female is not contributing all of her income to the household, it is mostly because she is obliged to buy food outside. This is most striking in the case of our Trivandrum village, where the ratio of the female contribution to earning is only 76 per cent.[5] But even here, where the female percentage contributed is low, that of the working husbands is even lower (51 per cent). Looking at Table 19.5, which is based on a sub-sample of households all with a working wife and a working husband, it is striking that in the month of lowest female income the males did not increase either the proportion or the absolute amount contributed to the household.

In absolute terms, the amount contributed by the female informants in the eight villages in Table 19.4 ranges between 1.21 times that of the average for the working husbands (in Alleppey 1) to 0.53 (in Trichur 2). It is interesting that in Trichur 2, most of the work reported for males involves non-agricultural work such as mason’s work, wood work, or loading. For Tamil Nadu, we note in this table a range between 0.85 in South Arcot 1 on the one hand and 0.55 in South Arcot 2. In the latter case the men are employed primarily in agriculture, but according to informants the female income (and thus their contribution) is very low for reasons mentioned previously: the caste Hindu laboring women here are unwilling or unable to perform certain operations, and women from nearby villages come to South Arcot 2 for transplanting and harvesting.

In some of our other Tamil Nadu villages, where we only have the data on the absolute amounts contributed to the household (and no data on the total amount earned) – i.e. Thanjavur (l), Chingleput (1) and Chingleput (2) – we get the following ratios for all male to all female contributions in each household, namely 1: 1.20, 1: 1.20, and 1:0.86. These are villages with little in-migration of labor at the time of transplanting or harvesting, and where almost all the female laborers do all kinds of work. In any case, we still need to probe further to find out the reasons for differences between villages.

Some have argued that it is a waste of time (and possibly even divisive) to look at female income and employment as such, and that what is important is to look at household income. According to this view, if one can increase employment or wage levels for males their households would be better off. This would certainly help the poor, but our data seem to indicate that the situation is much more complicated, and that in fact, if the primary concern is with child nutrition or the welfare of the next generation, it is essential to pay more attention to female income. The contribution of our female informants is crucial for family survival, even in households where there are working males.

Conclusions and recommendations

This paper has been restricted to an examination of one sector of women in rice-producing villages in India. While the main study has not been a longitudinal one, I have tried to bring to my analysis some observations that I have made in the field since I first started working in these villages in 1958. When I first went to villages in Kerala and Tamil Nadu, it was a common thing to hear daily the sound of the long poles going up and down while the women pounded the paddy by hand. In those days women spent a lot of their leisure time weaving palm leaves for roofing, both for their own use and to sell. Landowning households tended to have large numbers of poor women working for them, and though wages were extremely low, food was included. There were a wide variety of other activities in which landless women and men were engaged.

Much of this has now changed, not only because of changes in agricultural practice but also because of agricultural labor movements. The latter have brought to the laborers much more reasonable working hours and more decent rates of remuneration, but have led to landlords cutting back on the amount of work available (see Mencher 1980). Other changes have also affected the workers. Today paddy is mostly husked in mills, roofs tend to be tiled, or to be of tin or concrete (except for those of the poor), and many of the other traditional subsidiary occupations have been eliminated. In addition, even though the rate of population increase among the poor is lower than among the middle classes, the landless agricultural labor force has increased because of the impoverishment of former tenants (in Tamil Nadu especially), because of other people's losing land for a variety of reasons, and because of people with other occupations taking to agricultural labor (such as fisher folk who have lost out to mechanized fishing, coir workers, etc.). The result is more women for the same amount of work.

In many cases, we find that the interests of the landowning households and those of the laborers have been diametrically opposed. In designing any technology-transfer programs for the rice regions of India that I am familiar with, it seems absolutely essential that this be kept in mind, and that innovations that are introduced try to keep a balance, so that the landless do not end up with even greater impoverishment.

The conference prospectus raised the question, 'Do women in landless households have more or less opportunities for wage labor in rice cultivation as a result of the introduction of the new technologies?' This question cannot have a simple answer. In southern India, apart from the introduction of rice mills which has affected every region, the new technology – the use of high-yielding varieties and their accompanying inputs – has made the greatest inroads into women's work in the irrigated areas (Alleppey 1 & 2, Palghat 1, Thanjavur 1 & 2, Chingleput 1 & 2, and South Arcot 1 & 2 in our sample). In West Bengal they have had the greatest impact in Burdwan District (though the status of Birbhum District in this regard is still uncertain).

One generalization which can be made, however, is that the new technologies have not brought about any increase in the amount of wage labor, and in fact have in most cases led to its reduction. It is further clear that to date, women have not been able to replace the lost opportunities with other sources of income. The effect of this on family welfare has on the whole been negative, since there is less income per household member. Even in villages where males have been able to find alternative work, there is no help for the households without male earners. Thus I would like to state that as of now, the impact of the new technology on the poorest sector of the population, namely the landless laborers, has been entirely negative.

I have argued elsewhere that it is not the new technology *per se,* but the sheer absence of work, that has played some part in keeping the children of agricultural laborer households in school in Kerala (Mencher 1980). Certainly one can witness a massive increase in education among the children of this lowest stratum of rural society. But this education has not led to much in the way of alternative employment. Thus, we find in our Alleppey sample of agricultural laborer women girls with high school diplomas who simply cannot get any other kind of work. This leads to the phenomenon of hungry, educated, underemployed, landless laborers – not a happy condition in any society. Though major structural changes (as in China) would certainly improve the situation of women in landless agricultural laborer households, at the present time this is not on the horizon for India. Thus it becomes important to look for possible ways to make some improvement in their lives soon.

Under the present circumstances, what can be done to help these women?

I divide my tentative policy suggestions into two parts. The first part has to do with strictly agricultural or agronomic possibilities; the second is more far-reaching and includes suggestions that lie outside the field of agriculture *per se.*

Some suggestions for changes in agricultural practices

Ideally, one would like to identify types of innovations which both require greater labor input, and at the same time increase yields or profits enough to motivate landowners to pay for the extra labor time. This is not easy to develop agronomically, nor is it easy to convince the owners. One obvious suggestion has been to increase the number of paddy crops in a given year. But this is complicated. To begin with, I am told by entomologists that it is important to have a break in the paddy cycle, in order to reduce the pest population. Secondly, there are water management problems in many of these areas. Even in the irrigated part of Palghat District of Kerala (Palghat 1) we find that a third crop can only be grown in a good year. In addition, shortening the crop season often means that paddy is ready for harvesting when there are heavy rains, which create problems in drying. Perhaps more crucially, I have found that many landowners are not interested in increasing the number of paddy crops unless the price of paddy goes up substantially, which is less likely with higher production.

One alternative here would be to find some other, extremely labor-intensive crop which commands a good price in the market and can be grown in some sort of rotation with paddy, such as certain types of vegetables which require constant tending and are much in demand (e.g. certain 'western' vegetables which are in high demand in urban areas). I would not presume to suggest which specific crops would be most advisable, since what is best for one area might not be best for another. In fact, it is clear that whatever strategies are adopted must be regionally specific.

It might also be possible to look for crops (e.g. tree crops) which could be grown on the dykes between fields, or on any available government-owned land. In Kerala, even small household compounds could potentially be highly productive, but I have rarely seen a really productive household compound whose owners were landless agricultural laborers — primarily because they have neither the resources nor the know-how to develop what little land they may have (even 3 or 4 hundredths of an acre). Even in Tamil Nadu, many Harijan colonies have enough land around each house for a few productive trees, but such opportunities have never been exploited. Other possibilities for further development to provide employment in these areas include replanting forests that have been totally destroyed and left barren (again in Palghat 1 and Trichur 1, women formerly used to earn quite a lot by going to the forests for firewood or fencing materials to sell, and by collecting wild fruits etc. – while today one sees barren mountainsides), seriously encouraging dairying, even if it is only a supplementary source of income (this can only be a success if all of the infrastructure is available – credit loans, feed, a reliable market for milk – regardless of socio-economic status, caste, or religion) and introducing poultry schemes (a very tricky matter since it must be linked to egg distributors, chicken freezing plants, as well as accessible veterinarians).

Some suggestions for related income-producing activities

There are a number of other possible ways to provide work for these landless agricultural laborer women. One matter of great concern, however, is that labor-saving devices (such as transplanting machines, or herbicides to eliminate weeding, or harvesting machinery) are often introduced before alternative employment is found for the landless laborers. Thus I suggest that the introduction of alternative employment should really precede these labor-saving agricultural innovations. One possibility that has been mentioned for India is the use of women for agro-related small-scale production in rural areas. Though this notion has been much discussed, very little has been done in the areas where I have been working. In many of these areas there are already fairly good roads, and electricity is available. And though the electric supply is not totally reliable, many villages are in areas where local-level small-scale solar energy or biogas plants could be used to supplement electricity. If there are good roads, most of these villages would be no more than 2-3 hours from one or another rising small city. It is also possible to think of having some phases of production for urban factories 'farmed out' to the villages. However, all of this needs careful planning to avoid it turning into exploitation of the women for substandard remuneration.

In any case, these are merely meant as possible suggestions. The one clear and unequivocal conclusion that I would like to emphasize from my own work is that the landless agricultural laborer households (and I would include the marginal landowners) in the three areas 1 know best are living a very marginal existence and are most desperate for work. Any innovations brought in must take this fact into account.

Notes

1 One rupee equalled between \$0.10 and \$0.12 during the project period.

2 This is exactly what was done in parts of Chingleput District of Tamil Nadu with sharecroppers when pump-sets came in. Where there was no pump-set a sharecropper normally got 50 per cent of the yield, but where there was a pump-set it became 33 per cent or 1/3 of the yield (Mencher 1978).

In looking at our project data and in talking to people who have worked in different parts of India, I have found that payment by acreage only occurs in a few places in Tamil Nadu (Madurai and Tirunelveli Districts), in parts of Andhra Pradesh, and at the Rice Research Institute in Orissa's model farm. Discussion with staff of this Institute suggests that even if the amount of time were reduced, it might not lead to reduced income for the workers on their farm since as a government institution the Institute would be under pressure to maintain people's incomes. This is really a special case, however.

3 The data presented in this paper come from a project on women and rice cultivation that I have been carrying out since 1979 in collaboration with Dr. K. Saradamoni of the Indian Statistical Institute, New Delhi. The tables presented in this paper are for data collected between July 1979 and August 1982. This present project has been sponsored by the Smithsonian Institution in Washington and a grant from the Indian Council of Social Science Research in Delhi. In addition, some dollar funds have been provided by the Research Foundation of the City University of New York. Other data referred to come from a joint project carried out in two parts of Kerala (Kuttanad and Palghat) with Dr. P.G.K. Panikar of the Center for Development Studies in Trivandrum, under funding from the Indian Council of Social Science Research, and grants to the author from the Guggenheim and Wenner-Gren Foundations in New York. Earlier work in Tamil Nadu was supported by the National Science Foundation. The views expressed in this paper are solely the author's.

4 The main exceptions to this are (a) in the case of south Kerala, where we find many Christian laborers (often converts from scheduled castes), (b) in the north of Kerala, especially Malappuram District, where many of the laborers are Muslims (possibly converts from untouchable castes), and (c) in some parts of West Bengal and of course Bangladesh, where one finds many Muslim laborers.

5 This does, however, fit fairly well with the description of female workers in the area by Leela Gulati (1977).

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20 Declining employment for the labor-increasing involvement by land-owning women

K. Saradamoni

Introduction

Paddy is essentially a crop of the developing countries of the world. To be more specific it is Asia's cereal in term of area under cultivation and total production though rice is produced and consumed extensively in many parts of the globe. The figures in Table 20.1 from FAO make this clear.

Table 20.1

Area under paddy as percentage to total cereals – 1981	
World	19.58
Africa	6.69
North America	2.03
South America	19.41
Asia	42.02
Europe	0.52
Developed Countries	1.54
Developing Countries	33.25

Tables 20.2 and 20.3 which give some detailed statistics on both production as well as area under cultivation make clear the importance of Asian countries in world paddy production. However, while dis-

Table 20.2 World paddy production (millions of tons).

	1982 (Estimated)	1983 (Point Forecast)
Asia	381.8	390.0
Africa	8.6	8.8
Central America	2.1	2.3
South America	14.5	13.0
North America	7.0	4.9
Europe and USSR	4.4	4.5
Oceania	0.9	0.5
World	419.3	425.0
Developing Countries	394.2	402.0
Developed Countries	25.1	23.0

Source: *Food Outlook,* No. 7, FAO, Rome, July 26,1983.

Table 20.3 Major paddy producing centers in descending order 1981.

	Area (1000 hectares)		Production (1000 MT)
India	40,000	China	1,46,087
China	34,480	India	82,000
Bangladesh	10,100	Indonesia	33,000
Thailand	9,140	Bangladesh	20,000
Indonesia	9,005	Thailand	19,000
Brazil	6,066	Burma	14,636
Vietnam	5,615	Japan	12,824
Burma	5,500	Vietnam	12,570
Philippines	3,500	USA	8,408
Japan	2,278	Brazil	8,261
Pakistan	1,989	Philippines	7,720
USA	1,539	Korea (Rep)	7,032
Nepal	1,270	Pakistan	5,093
Korea (Rep)	1,224	Korea (DPR)	4,900
Kampuchea	1,200	Nepal	2,407

Source: FAO Production Year Book, 1981.

cussing the main theme of this conference, it has to be kept in mind that most of these countries are characterized by the involvement of a large proportion of the population in agriculture, and low income. It has also to be remembered that many of these countries are also importers of rice. In common parlance technology brings to mind machines and tools which can adversely affect human involvement. But in the case of rice growing areas, the technology we have to consider deals not only with agronomical and ecological issues but also with raising production of paddy and increasing the purchasing power of the producer. Again, if the introduction of technology is to be really beneficial we have to be clear as to who the producer is. This question is examined below taking the Indian case. (See Tables 20.4 and 20.5.)

The involvement of land-owning women in paddy production

The decennial census of India gives a break-down of the population into workers and non-workers. A further division of workers gives the broad categories of cultivators, agricultural laborers, and workers in household industries and others. Though changes in concepts and definitions create problems in comparison over periods, the division into the categories of cultivators and agricultural labor has remained unchanged. Yet a clear understanding about these two categories of

Table 20.4 Area, production and average yield per hectare – all India.

		1950-51	1960-61	1970-71	1980-81
Rice	A	30,810	34,128	37,592	39,773
	P	20,576	34,574	42,225	53,231
	Y	668	1,013	1,123	1,338
Total Cereals	A	78,230	92,018	101,782	103,157
	P	42,414	69,314	96,604	118,702
	Y	542	753	949	1,151
Total Food-grains	A	97,321	115,581	124,316	125,791
	P	50,825	82,018	108,422	129,867
	Y	522	710	872	1,032

A - Area in thousand hectares
P - Production in thousand tonnes
Y - Yield per hectare in kgs.

Source: Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.

Table 20.5 Area, production and average yield per hectare of major paddy growing states.

State	Area (1000 acres)	Production (1000 tonnes)	Yield (kgs per hectare)
Bihar	5490.5	5476.0	997
U.P.	5180.6	5175.7	1050
West Bengal	5175.7	7465.6	1442
M.P.	4797.5	4001.9	834
Orissa	4199.0	4331.0	1031
A.P.	3607.3	7134.2	1978
Assam	2275.0	2522.8	1109
T.N.	2112.0	3975.0	1882
Maharashtra	1503.8	2360.6	1570
Punjab	1178.0	3223.0	2736
Karnataka	1084.7	2210.0	2037
Kerala	785.0	1291.8	1646
Haryana	472.0	1228.0	2606

Source: Directorate of Economics and Statistics, Ministry of Agriculture, Government of India.

workers is essential for our discussions. For example, the 1981 census gives 28.85 per cent men and 6.08 per cent women as cultivators (India-Rural). The figures are percentages to total workers. The corresponding figures for agricultural laborers are 12.67 and 8.17. In the same census, under 'distribution of main workers by broad categories', 55.26 per cent of males and 36.86 per cent of females are cultivators and 24.26 per cent of males and 49.57 per cent of females are agricultural laborers for all India (rural). It has to be noted that in almost all the main rice growing States there is a predominant agricultural labor population. In the hilly States of Himachal Pradesh and Nagaland, and in the non-rice growing State of Rajasthan, there is a smaller proportion of agricultural laborers. In the former two States, small peasant households which engage in cultivation of their own land prevail. However it has to be noted that in rural Himachal Pradesh 91.82 per cent of women workers as against 67.79 per cent of men workers are recorded as cultivators. The corresponding figures for the Nagaland area are 90.87 and 56.09 showing thereby the greater involvement of women in cultivation. Table 20.6 shows the preponderance of women agricultural laborers in almost all the rice growing States in India. Though it is not necessary for the purpose of this conference to go into the reasons for this, we have to keep clearly in mind these two categories of women – cultivators and laborers – whose numbers are

Table 20.6 Distribution of main workers (rural) by broad occupational categories (1981).

		(% of main workers)			
	Male/ Female	Cultivators	Agricultural Laborers	Household Industry	Other Industry
Bihar	M	52.15	33.66	2.55	11.64
	F	26.87	64.75	3.03	5.35
U.P.	M	69.92	16.15	2.98	10.95
	F	50.95	36.96	4.24	7.85
West Bengal	M	32.39	23.32	3.67	40.62
	F	14.82	38.29	8.19	38.70
M.P.	M	54.00	17.72	3.68	24.60
	F	47.31	40.35	4.13	8.21
Orissa	M	51.38	22.59	2.97	23.06
	F	24.68	53.42	6.02	15.88
Andhra Pradesh	M	44.84	31.53	4.96	18.67
	F	26.16	60.42	5.21	8.21
Tamil Nadu	M	44.11	30.81	3.78	21.30
	F	26.60	58.78	4.76	9.86
Maharashtra	M	50.40	26.90	2.91	19.79
	F	42.62	49.71	2.33	5.34
Punjab	M	49.81	28.97	2.78	18.44
	F	15.32	41.94	5.89	36.85
Karnataka	M	55.54	23.50	3.10	17.86
	F	28.75	54.37	5.84	11.04
Kerala	M	18.80	27.16	2.79	51.25
	F	5.66	47.79	8.54	38.01
Haryana	M	67.79	3.50	3.24	25.47
	F	91.82	2.05	0.81	5.32

Source: Census of India, 1981, Provisional Population Totals Workers and Non-Workers.

quite significant in the rice growing areas. Yet, unfortunately there has not been any serious study or recorded material which can tell us in detail about their life and work.[1] In all the major official surveys on rural or agricultural labor, it has been the practice to treat men, women and children in a kind of accepted descending order of priority.[2] The accepted official view about women cultivators is that women in the upper class and upper caste households 'do not engage' in manual work. There has not been a serious attempt to explore beyond this.

The project on ‘Women and Rice Cultivation’ from which Joan Mencher and myself present the findings in this volume focused directly, while collecting data, on women, both in the land-owning as well as landless labor households. The data collected from nearly ten villages each in the States of West Bengal, Tamil Nadu and Kerala give extensive information about women’s involvement in rice production. Joan Mencher speaks in detail about the landless labor women in our study area. In brief, the major findings are:

1. Wage labor in paddy fields provides the major share of these women’s income. They are mainly engaged in the traditional occupations of weeding, transplanting and harvesting. Harvesting in different areas means different contributions of work. For example, in some Tamil Nadu villages women cut and men carry, while in at least one Kerala village harvesting includes cutting, bundling, carrying and threshing.
2. The number of households where women’s income is substantial or where women hold the primary responsibility in household maintenance is significant. It is not always caused by widowhood or desertion. Declining availability of work for men is also a reason for women seeking extra work and income.[3]
3. Differences in the availability of work are very high between regions. More significant are the interhousehold differences at the village level.[4]
4. Agricultural labor households are characterized by lack of assets, irregular work and insufficient income as well as exploitative labor relations.

Our findings about the agricultural labor households have been corroborated — with the difference that our major emphasis has been on women — by other studies. As far as the land-owning households are concerned, we are of the view that most of the currently available information on landowning women’s involvement in agriculture is based on insufficient knowledge about the nature of agricultural practices and the types of work that each crop generates, as well as about women’s life and work in general. We also hold the view that the concept of work itself needs a fresh look and redefinition if women’s involvement is to be captured fully.[5] Before proceeding further, we have to touch upon a widely held assumption that transition from food to cashcrops lead to a decrease in female involvement in agriculture. These kinds of broad statements have helped to hide the work landowning women do. First of all we have to remember that even paddy cultivation beyond the amount required for consumption becomes a cash crop. Introduction of cash crops which use less female labor need not necessarily reduce the involvement of the landowning women. In fact in our study area, (especially in Kerala), we found women taking the initiative in introducing such crops as cocoa, cinnamon etc. which are distributed by the agricultural departments, in their household compounds which have become smaller in recent times.

The data on the involvement of women in the landowning households consist of diaries written by the women themselves, diaries where a list of 21 activities was printed (see Table 20.7) and women made a daily mark against those activities in which they participated that day, detailed interviews of these women by the senior investigator towards

Table 20.7 List of items in daily diaries.

1. Talking with others in the house about seeds, fertilizers, pesticides, laborers, etc.
2. Buying needed items (seeds, fertilizers, pesticides, or other articles needed for agriculture).
3. Distributing the purchased items (seeds, fertilizers, etc.) to the laborers.
4. Supervising field work.
5. Supervising work in the house compound.
6. Supervising work in the garden.
7. Doing agriculture-related work in the house or house compound such as stacking straw, threshing grain, winnowing paddy.
8. Getting laborers for work.
9. Making and serving food for the laborers.
10. Taking meals to those working in the fields.
11. Giving the laborers their daily wages.
12. Supervising the harvesting and distributing their share of the grain or paying them in kind.
13. Boiling and measuring the paddy, supervision of laborers.
14. Participating in boiling the paddy, setting it to dry, etc.
15. Taking or sending the paddy to the mill for husking.
16. Looking after the livestock (grazing the cattle, giving fodder, milking, etc.).
17. Other tasks connected with animals (looking after chickens or pigs), or catching and drying fish.
18. Talking with agriculture officials, reading something connected with agriculture, or listening to agricultural programs on the radio.
19. Talking with other women (land-owners or laborers) about agriculture.
20. Writing accounts of agricultural expenses.
21. Doing nothing connected with agriculture (Note: this item was included as a check.)

the end of the data collection period, and informal questioning and observations by the project directors. Data from the landowning households were collected at the same time that detailed information about employment, income and contribution to households was being collected from landless and marginal agricultural labor women on a day-to-day basis. In both cases, data were collected for one year.[6]

Our data from the land-owning women's diaries and other information have not undergone a final processing. What we are presenting here is preliminary and tentative. Broadly our findings are as follows.

Landownership is in a dynamic process of change in India today. As a result of land reforms, social and economic mobility and migration, changing family size and composition etc., major changes are taking place in the size of holdings, crops grown, and also interest in cultivation. We find women in one of the Tamil Nadu villages leasing in 30 or 35 cents (1 acre = 100 cents) of temple land to cultivate paddy. We also find women in one of the Kerala villages operating 45 to 60 acres of land owned by their children, or by other members of their own or their husbands' family who are living in different parts of the globe. We have areas where paddy alone is cultivated, as well as areas where other crops like legumes, maize and groundnut are also cultivated in the paddy field. We have another set of villages where in addition to paddy fields we find gardens with coconut and/or cashew trees, plantations, several kinds of yams, and vegetables. Some households also own rubber estates of one acre or more. Hence we cannot restrict ourselves only to paddy even while discussing women and rice farming.

Custom, caste practices and class decide whether women would do work like weeding, transplanting and harvesting. But there are many other paddy-related as well as agricultural tasks in which landowning women are involved. Even supervision of laborers or crops in the paddy field by these women depends upon many factors, including the distance between field and residence. In Tamil Nadu, especially in villages where the fields surround the residential area, women frequently respond that they 'took a round' of their fields. They themselves may not think of this as an important activity. Actually, the function of this 'round' is to see whether the previous day's work was neatly done, whether weeds have grown, whether there has been attack by pests, or any other damage to the crops. In fact these regular visits help them keep an eye on the growth of the plants.

Even those women who make statements like 'our fields are not near. I will not go to supervise fields even if my husband is ill,' are not ignorant of what goes on in their field. They have regular discussions with the other members of the households, with the manager if they have one, and even with laborers regarding day-to-day work.

On the whole women in the land owning households in our study area showed remarkable interest and knowledge about paddy and other crops. Most of them could, without hesitation, answer our questions regarding different varieties of seeds, pest control, and labor requirements. Many of our respondents are aware of the radio programmes for farmers and listen to them. But they added that they would follow the suggestions only if they felt that they were beneficial to them.

These women's participation is manifested in several ways, which cannot always be classified under known categories like 'manual work' or 'supervision'. Many of our respondents said that they do more work than they did some years back and also more than their mothers did.

More than one respondent, especially in Kerala, said that paddy cultivation is a losing proposition. They complained about increasing labor cost. Official estimates also support this.

While discussing women and paddy technology there is yet another category of women whom we cannot ignore – the consumers. Though the land-owning women and laborers are also consumers, there are other women who may not be producers. The things they are concerned about are price, availability and quality (taste). Women are known to have rejected a particular variety for the bad smell it produced while cooking and because the volume of cooked rice at a specific measure was small. The laborer women have also specific ideas about the height of the plant, length of stalk etc. which they would accept or complain about in terms of their convenience to cut or bundle as well as use as fodder.

Broad conclusions

Women have a great stake in paddy production and any innovation in paddy technology has to take this into consideration. However it has to be remembered that women involved in the production and processing of paddy are not a homogeneous group. There is growing interest and involvement of women from the land-owning households in the agricultural operations and processing of rice. At the same time the laborer women who have been traditionally involved in the actual cultivation are facing increasing unemployment and under-employment. This is coupled with an increasing urgency on their part to shoulder the responsibility of household maintenance for various reasons including increasing male unemployment. The women in the small peasant households where women do take part in family labor as well as management need special consideration.

All the women we have dealt with above do attend to operations around rice production in addition to their domestic chores which are not touched upon in this paper. At the same time relief from drudgery should not be the sole consideration behind new technology. Technology should be viewed in a wider sense and changes in technology should not lead to displacement of labor, but in the creation of more, varied and rewarding activities.

In countries like India narrowing the disparities in employment opportunities and income as well as upgrading skills and reducing drudgery should go hand in hand.

There is no neutral technology. Any innovation has to take into account the regional class and gender interests which may work against the objectives with which the new technology is introduced.

We have to learn from the experience of the developed countries where a sharp decline in the proportion of the population engaged in agriculture has taken place, and which now faces problems of unemployment, worklessness and leisure and consequent socio-economic problems.

Notes

1 This aspect was dealt in detail in my paper *Women's Work: Need for an In-Depth Look* read at the I.S.I. Golden Jubilee Symposium on Women Work and Society, September 1982.
2 See the Reports of the Agricultural Labor Enquiry and the Rural Labor Enquiry.
3 Many women laborers say 'Our men have less work. We have to work to feed our children.' For details, see 'Changing Land Relations and Women: A Case Study of Palghat' by K. Saradamoni in *Women and Rural Transformation,* Concept, New Delhi, 1983.
4 These inter household differences in the availability of work and income can keep the workers apart and can have grave implications as far as workers' solidarity and unionization are concerned.
5 This is necessary even to capture a fuller social reality while collecting statistics. Right now many women themselves are not aware of their contributions and do not think that they are doing something worthwhile because the current notion of work involves a payment.
6 A detailed picture of the methodology of data collection is given in the paper *The Invisible Hand Behind Agriculture: Landowning Women in Supervision and Management* by K. Saradamoni and Joan P. Mencher submitted at the XI ICAES, Vancouver, August 1983.

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21 Paddy production, processing and women workers in India - the south versus the northeast

*Gita Sen**

The general belief that paddy cultivation is associated with the presence of women workers in agriculture and, in particular, of women wage laborers, is largely based on the experience of east and south-east Asia. In India too there is a common perception that the regional concentration of women agricultural laborers is based on the extent of paddy cultivation relative to other foodgrains. In fact, however, systematic analysis across states and districts elicits no such simple association between the two.[1] In earlier work, I had found, if anything, that paid women agricultural laborers predominate, inter alia, in areas where the fine grains (rice and wheat) are *not* grown. This led me into a closer analysis of the rice-growing areas of the country, and of the practices employed in paddy cultivation and processing.

Rice has traditionally been grown in India in the southern states (Andra Pradesh, Tamil Nadu, Kerala and parts of Karnataka), in some of the coastal and interior districts of an otherwise dry grain state like Maharashtra, and in the eastern and north-eastern states (Orissa, West

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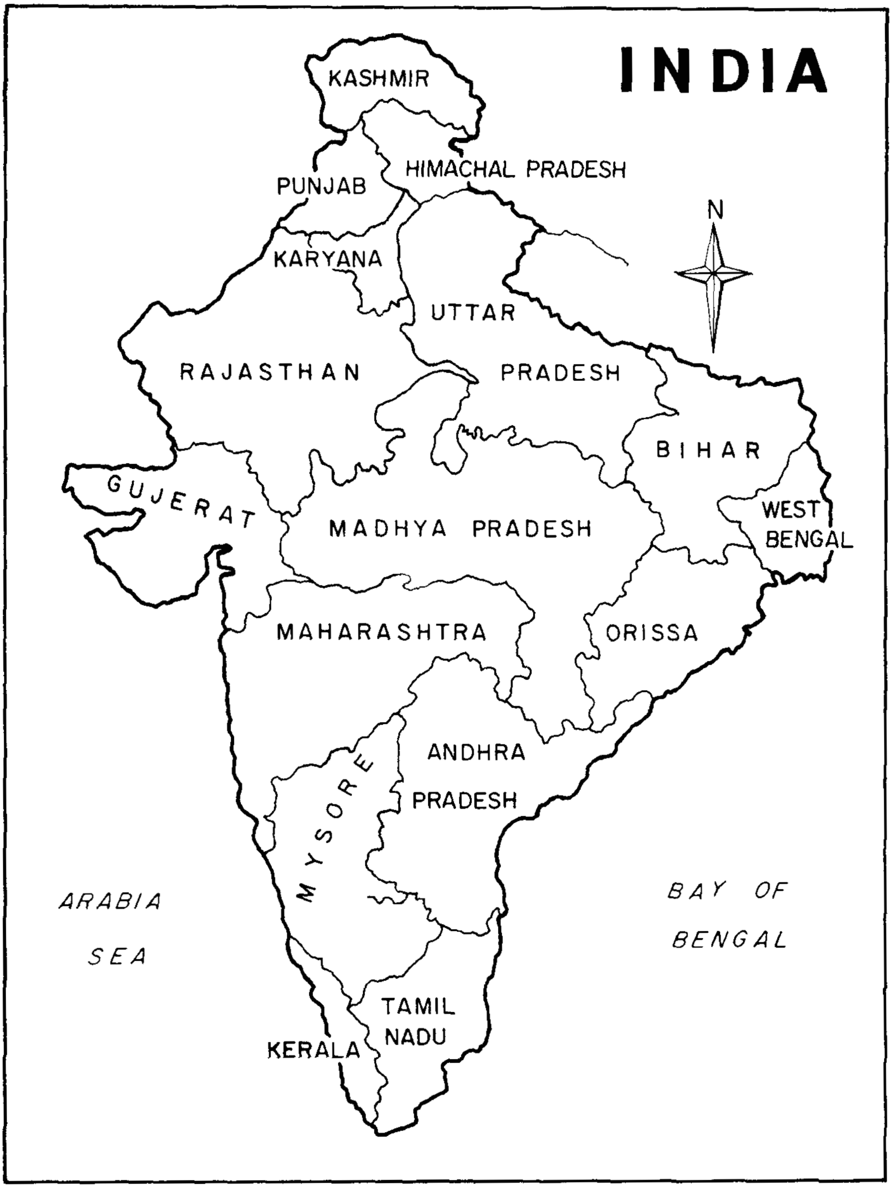

Figure 21.1 : Map of India.

Bengal, Assam and large parts of Bihar, east Uttar Pradesh and east Madhya Pradesh).[2] (See Fig. 21.1.) However, as a broad generalization, women agricultural laborers as a proportion of the female population are to be found chiefly in the southern states, and only to a much lesser extent in the eastern and north-eastern states. We shall, in this paper, compare paddy production practices in the two broad regions in order to obtain some clues to this puzzle. These two regions are by no means homogeneous in agro-climatic terms, and we shall use this broad division only as a starting point.

Paddy production across regions

A striking feature of the regional comparison of paddy acreage, production and yield is that the eastern and north-eastern states have the largest acreage under paddy, but the lowest yields. The four southern states had the highest yields in both the early 1960s and the mid 1970s (i.e. pre- and post-HYV), followed by Maharashtra, West Bengal and Assam, while Orissa, Bihar, Uttar Pradesh and Madhya Pradesh have the lowest yields (see Table 21.1). This pattern appears to be broadly true during the pre-independence period as well, with the highest yields being found in Madras presidency (see Table 21.2). The pre- and post-independence data cannot be compared more systematically because of the wide-ranging reorganization of states after independence. It is apparent, however, that the regional patterns of area and yield are not a new phenomenon, but have existed historically.

What accounts for this pattern appears to be a systematic difference in the extent of irrigation. As far back as 1918-19, fully 70 per cent of the rice acreage in Madras Presidency, i.e., in the south was irrigated.[3] In the period 1927-28 to 1936-37, on average 72 per cent of the rice area in Madras was irrigated, while only 10 per cent was irrigated in the United Provinces in the north, with the other principal rice regions falling between (see Table 21.3). Again, this pattern continues to hold in the more recent period, as can be seen in the table. Over 90 per cent of the rice area in Tamil Nadu and Andhra Pradesh is now irrigated, while the irrigated proportion is considerably lower in the eastern and north-eastern states. The proportion of area irrigated is, admittedly, only a first approximation to an explanation of yield differences. The quality of irrigation (wells, tanks, canals or pumpsets) affects the actual control by the farmer over the amount and timing of water use, which are also critical to the yield obtained. Likewise, the type of water source together with the social and institutional structure affect the distribution of irrigation water, its timely availability to various classes of farmers, and hence the average yield.

Table 21.1 Area, production and yield of rice, post 1947, and percentage of women agricultural laborers to the rural female population, 1971

		Area in hectares, production in tonnes, yield in Kg. per ha.	
		1960-61 to 1962-63	1970-71 to 1972-73
Andhra Pradesh	Area	3,276,352	3,046,600
	Production	4,139,708	4,382,400
	Yield	1,263	1,441
	% women agricultural laborers		18%
Assam	Area	1,879,785	2,001,600
	Production	1,706,783	2,021,900
	Yield	908	1,009
	%		0.3%
Bihar	Area	5,176,930	5,133,800
	Production	4,410,491	4,630,666
	Yield	852	903
	%	1,352	7%
Karnataka	Area	1,057,171	1,096,800
	Production	1,430,764	1,932,900
	Yield	1,352	1,762
	%		9%
Kerala	Area	778,086	874,100
	Production	1,054,953	1,329,800
	Yield	1,356	1,521
	%		7%
Madhya Pradesh	Area	4,188,705	4,464,400
	Production	3,097,939	3,581,567
	Yield	740	802
	%		11%
Maharashtra	Area	1,319,816	1,324,066
	Production	1,381,930	1,259,066
	Yield	1,048	945
	%		14%
Orissa	Area	4,098,296	4,537,400
	Production	3,714,268	3,979,700
	Yield	910	878
	%		4%
Tamil Nadu	Area	2,573,775	2,672,733
	Production	3,830,229	5,329,800
	Yield	1,488	1,994
	%		11%
Uttar Pradesh	Area	2,573,775	4,565,900
	Production	3,210,365	3,575,200
	Yield	763	782
	%		3%
West Bengal	Area	4,490,396	5,007,633
	Production	4,887,711	6,130,233
	Yield	1,087	1,225
	%		3%

Source: *Estimates of Area and Production of Principal Crops in India,* 1954-55 to 1964-55, and 1972-73.
Census of India, 1971, Part II A (ii), Union Primary Census Abstract.

Table 21.2 Area, production and yield of rice — pre 1947[1].

British territories		Area in million acres, Production in million tons, Yield in Kg. per ha.[2] 1928-29 to 1930-31	1934-35 to 1936-37
Assam	Area	4.62	5.20
	Production	1.47	1.66
	Yield	799	801
Bengal[3]	Area	20.73	21.27
	Production	9.03	8.43
	Yield	1,093	995
Bihar	Area	10.79	9.94
	Production	4.36	3.10
	Yield	1,014	783
Orissa[4]	Area	3.38	5.08
	Production	1.38	1.45
	Yield	1,025	716
Central Provinces and Berar	Area	5.49	5.63
	Production	1.55	1.67
	Yield	709	744
Madras	Area	11.32	10.25
	Production	5.28	4.84
	Yield	1,171	1,185
United Provinces	Area	6.92	6.69
	Production	1.46	1.97
	Yield	529	739

Source: *Report on the Marketing of Rice in India and Burma,* Simla, Government of India Press, 1941, Appendices III and VI.

Notes:
1 The data are averages for the two triennia
2 1 ton = 1016 Kg. 1 ha. = 2.47 acres.
3 Includes both East and West Bengal.
4 Data for the first triennium exclude Ganjam and Koraput districts. Data for the second triennium are averaged over only 1935-36 and 1936-37.

Irrigation and female labor

Granting these caveats about the quality and distribution of irrigation water, the proportion of irrigated area would affect labor use in paddy cultivation directly by making it more possible to transplant rice, rather than sowing it broadcast. Transplanting becomes possible for a rice variety of a given duration if water is available for seed bed preparation prior to the actual cultivation season. Thus, transplanting is also possible in areas with a long and reliable monsoon, as is usually the case in much of India’s western coast line, covering the coastal districts of Kerala, Karnataka and Maharashtra, as well as in the north-east states of Assam and West Bengal. Many of these districts have low

Table 21.3 Irrigated rice area as a percentage of gross cropped area under rice.

Average of 1927-28 to 1936-37		1969-70	
		Andhra Pradesh	0.946
Assam	0.125	Assam	0.107
Bihar	0.291	Bihar	0.346
		Karnataka	0.649
		Kerala	0.545
Central Provinces and Berar	0.164	Madhya Pradesh	0.156
Bombay	0.100	Maharashtra	0.237
Orissa	0.167	Orissa[2]	0.228
Madras	0.721	Tamil Nadu	0.922
United Provinces	0.090	Uttar Pradesh	0.166
Bengal[1]	0.071	West Bengal	0.269

Sources: *Rice Marketing Committee Report,* 1941, op.cit., Appendix IV. *Indian Agricultural Statistics,* 1967-68 to 1969-70, Vol. II.

Notes:
1 Includes both East and West Bengal.
2 Data refer to 1967-68.

irrigation ratios, but transplanting is still possible within rainfed agriculture. Irrigation is then, by and large, a sufficient but not a necessary condition for transplanting rice. Allowing for this, the demand for transplanting labor is likely to be much higher in irrigated regions.

Irrigation also indirectly affects the demand for labor, by raising yields, and hence increasing the demand for harvesting labor. Since female labor is usually quite important in both transplanting and harvesting paddy, we would expect a strong association cross-sectionally between the proportion of area irrigated and the demand for female agricultural labor.[4] This effect would be strengthened if irrigation also led to an increase in cropping intensity, *ceteris paribus.* All this is, of course, predicated on the fact that techniques for replacing human labor by machine power in either transplanting or harvesting paddy have not made much headway in India.

Testing this hypothesis about the relationship between irrigation, transplanting and the demand for female agricultural labor requires data on all three variables, and these are not entirely satisfactory. Data on the proportion of irrigated to total rice area are fairly reliable, and have been obtained from the *Indian Agricultural Statistics,* which provides both *net* area irrigated (by irrigation source) and *gross* area irrigated (by crop). We have used the proportion of gross area irrigated under rice to the gross cropped area under rice.

Table 21.4 Transplanted area as a percentage of total rice area.

	1934-35 to 1936-37	1946-47 to 1948-49
Assam	0.825	0.80
Bihar		
Bihar proper	0.623	0.55
Chhota Nagpur and Santal Parganas	0.407	
Central Provinces and Berar	0.187	0.20
Orissa	0.460	0.35
Madras	0.718	0.86
United Provinces	0.393	0.40
Bengal	0.496	0.80[1]

Sources: *Rice Marketing Committee Report,* 1941, *op.cit.* Appendix XXXIV.
Rice Economy of India, Government of India, Ministry of Food and Agriculture, 1961, p. 41 (taken from the *Report on the Marketing of Rice in India,* 1954).

Notes: 1 Only West Bengal.

Unfortunately, we do not have available to us any recent data on the exact proportion of rice area that is transplanted. Our data go back to the pre-independence period, and are available for two triennia, 1934/35 to 1936/37, and 1946/47 to 1948/49 (see Table 21.4). Two features of the data merit particular attention. Firstly, the sharp increase in the proportion transplanted in Bengal in the later triennium is probably because of the exclusion of East Bengal, which had become a part of Pakistan. It is likely that the proportion of broadcast rice was much higher in East Bengal since rice was grown there in low lying tracts subject to flooding. Secondly, while the transplanted proportion in Madras is certainly higher than in Bihar, Orissa, the Central Provinces and the United Provinces, it is also high in both West Bengal and Assam, despite their lower irrigation ratios. It is evident therefore that our classification of the districts into two broad regions is inadequate. We need at least a four-fold classification as follows:

(a) the main rice growing districts of Andhra Pradesh, Tamil Nadu, Kerala and Karnataka – high irrigation ratios, high transplanting proportions;

(b) the coastal districts of Maharashtra and, to some extent, Karnataka and Kerala – rainfed transplanting;

(c) the rice-growing districts of eastern Madhya Pradesh, eastern Uttar Pradesh, interior Orissa, and the Chhota Nagpur and

North Bihar districts of Bihar — mainly rainfed with high broadcast proportions;

(d) West Bengal, Assam, coastal Orissa and the irrigated districts of Central Bihar — both rainfed and irrigated transplanting.

Ceteris paribus, we would expect the demand for female agricultural labor to be lowest in (c) above. Since our data on transplanting proportions are so meagre, we cannot directly test their impact on the demand for female labor. We shall therefore focus on irrigation alone.

Data on the third variable, women agricultural laborers, were obtained from the 1971 population census. The underestimation problems with the 1971 census data for women workers have been discussed elsewhere at length.[5] Suffice it to say that we do not believe these problems to be insuperable for the study of women agricultural laborers. However, the question still remains as to what is the appropriate variable to measure the incidence of women agricultural laborers. The ratio of women agricultural laborers to total women agricultural workers (i.e. laborers plus cultivators) is rendered suspect by the unreliability of the data on women cultivators, especially in the 1971 census.[6] We have used instead the ratio of women agricultural laborers to the female rural population as our variable to measure incidence. This avoids the problem with the earlier index, but is likely to be affected by variations in the population density across districts.[7] We have attempted partially to control for this by using population density as an independent variable in the regression.

We estimated an equation for the incidence of women agricultural laborers in the rural female population using cross-sectional data for 96 districts of the country where the proportion of rice in the gross cropped area under foodgrains was over 25 per cent in 1969-70.[8] This was the year nearest to the 1971 census for which we could get data. Two versions of the equation were tried. In the first version, the proportion of gross cropped to net sown area (i.e. the multiple cropping index), the proportion of rice to gross cropped area under foodgrains, and the proportion of irrigated to gross cropped area were entered as right hand variables, in addition to population per hectare of gross cropped area (an index of population density), the Gina coefficient of owned land, and the proportion of irrigated rice area to gross rice area.[9] Since the first three variables proved to be insignificant, possibly due to multicollinearity, a second version was run with the Gini coefficient of owned land, population density and the proportion of irrigated to total rice area as independent variables. The regression results for both versions and the correlation matrix are presented in Tables 21.5 and 21.6. The strong association between the irrigation ratio and the incidence of women agricultural laborers appears to conform to our

Table 21.5a Regression results.
(Dependent variable — ratio of women agricultural laborers to the female rural population, 1971)

Independent variable	Coefficient	Std. error	t-value
Intercept	–0.1276	0.0527	2.4194*
Gini coefficient of owned land	0.3392	0.0713	4.7600***
Population density	–0.0036	0.0014	2.6962**
$\frac{\text{Rice area}}{\text{GCA under foodgrains}}$	0.0267	0.0195	1.3721
$\frac{\text{Gross Cropped area}}{\text{Net sown area}}$	–0.0044	0.0223	0.1961
$\frac{\text{Irrigated area}}{\text{GCA}}$	–0.0343	0.0316	1.0864
$\frac{\text{Irrigated rice area}}{\text{GCA under rice}}$	0.0910	0.0157	5.8122***

n = 96, R^{-2} = 0.472

* – 5% significance level
** – 1% significance level
*** – 0.1% significance level

Table 21.5b Regression results.
(Dependent variable — ratio of women agricultural laborers to the female rural population, 1971)

Independent variable	Coefficient	Std. error	t-value
Intercept	–0.1209	0.0413	2.9246**
Gini coefficient of owned land	0.3304	0.0690	4.7889***
Population density	–0.0031	0.0013	2.4099*
$\frac{\text{Irrigated rice area}}{\text{GCA under rice}}$	0.0777	0.0106	7.3609***

n = 96. R^{-2} = 0.470

* – 5% significance level
** – 1% Significance level
*** – 0.1% significance level

starting hypothesis. The proportion of women agricultural laborers in the female population appears to vary systematically, *inter alia,* with the extent of irrigation, indicating possibly that it is not paddy cultivation *per se* but irrigated paddy cultivation that increases the incidence of female laborers.[10]

Table 21.6 Correlation matrix

Women agricultural laborers / Female rural population	1.0			
Gini coefficient of owned land	0.3 94	1.0		
Population density	– 0.190	– 0.122	1.0	
Irrigated rice area / GCA under rice	0.548	0.01 7	0.067	1.0

Rice processing techniques and labor absorption

Although the negative impact of a decline in hand-pounding techniques on female employment in paddy processing has been noted in other countries, notably Java, few systematic studies have been undertaken for India.[11] That there has been a very sharp decline over the last fifty to sixty years or so, and that the decline was particularly marked during and immediately following the Second World War, has been noted in some major official documents.[12] Here we shall attempt to provide some idea of the regional dimensions of this decline, and suggest some hypotheses by way of possible explanation.

The regional distribution of workers engaged in dehusking rice is presented in Tables 21.7 and 21.8 for two census years, 1931 and 1961. Data for the two years are not strictly comparable owing to changes in occupational definitions and in the territorial divisions. It is clear though that in 1931, dehusking was already a less labor intensive process in Madras when compared to Bengal, United Provinces, Bihar

Table 21.7 Regional distribution of workers in dehusking, 1961.

	Total Workers		Household industry workers		Household industry workers as a % of total workers
	Females	Males	Females	Males	
India	286,255	349,121	178,641	115,630	0.463
Andhra Pradesh	7,634	29,947	877	1,168	0.054
Assam	5,130	5,234	4,043	257	0.415
Bihar	40,497	17,287	35,003	7,449	0.735
Karnataka	7,843	13,674	2,185	3,404	0.260
Madhya Pradesh	24,329	24,140	20,128	10,700	0.636
Maharashtra	5,624	29,060	3,495	6,675	0.293
Orissa	19,560	3,994	15,470	1,830	0.734
Tamil Nadu	12,154	33,296	2,343	845	0.070
Uttar Pradesh	5 1,608	82,850	48,388	54,101	0.762
West Bengal	56,619	31,792	30,415	3,019	0.378

Source: *Census of India,* 1961, Vol. I Part II-B(i), General Economic Tables.
The data refer to workers in minor occupational group 200 – ‘production of rice, atta, flour etc. by milling, dehusking and processing of crops and foodgrains’.

Tablse 21.8 Regional distribution of workers dehusking, 1931

	Number of rice pounders, huskers and flour grinders Females	Males	Number employed per million tons of rice produced
India (British territory plus states and agencies)	482,187	117,933	
Assam	6,773	561	4,594
Bihar and Orissa	82,699	9,605	16,081
Central Provinces and Berar	5,910	3,381	5,249
Bombay	4,254	2,229	NA
Madras	41,449	13,899	
United Provinces	126,493	9,673	67,077
Bengal	138,390	10,964	15,738

Sources: *Census of India,* 1931, Vol. I, Part II – Imperial Tables, Table X, p. 280.
The data refer to occupational group 71, and include 'principal earners', 'working dependents' and those for whom this is a 'subsidiary occupation'; the first two categories include the bulk of the workers.

and Orissa. A rough index for this is the smaller number of workers engaged in dehusking per million tons of rice produced in Madras. Thus, the small power-driven hullers had already made greater inroads into the handpounding industry in Madras by 1931. The phenomenon was by no means peculiar to Madras. Indeed Census Superintendent L. J. Sedgwick speaks of the decline in handpounding employment in Bombay even earlier, between 1911 and 1921, consequent on the growth of mills.[13] Indeed, for India as a whole, the total number of female workers engaged in dehusking declined from 981,342 in 1911 to 626,362 in 1921 and 482,187 in 1931; the number of male workers fell from 134,844 to 121,172 to 117,933 during the same period.[14]

A second notable feature of the period prior to the Second World War is that the number of women workers far outnumbered male workers, being in the ratio of 4:1 in 1931. The 1931 distribution shows that this was true in all the provinces. However, the decline between 1911 and 1931 was far more precipitous for women. There was a 51 per cent decline for women compared to a 13 per cent decline for men, indicating possibly that men were at least partially being reabsorbed by the milling sector.

By 1961 women constituted only 45 per cent of all workers in rice milling (inclusive of both the handpounding and power driven sectors), although they still predominated in the household industry sector.

Our chief concern here is with the regional pattern which appears to indicate a greater relative importance of power-driven milling in the southern states, especially Andhra Pradesh and Tamil Nadu, compared to most of the eastern and north-eastern states, both before and after independence. The data we have examined so far have been based on

Table 21.9 Number of rice mills

	End of 1960	End of 1965	1970-71	Jan. 1, 1975
India	34,527	47,175	71,023	91,333
Andhra Pradesh	4,667	7,135	9,605	15,366
Assam	338	441	441	2,295
Bihar	745	1,808	1,828	4,678
Karnataka	2,996	4,284	7,171	8,013
Kerala	2,832	3,643	4,619	8,368
Madhya Pradesh	1,904	2,567	5,198	5,428
Maharashtra	2,208	2,608	4,852	5,626
Orissa	1,386	1,850	1,921	3,243
Tamil Nadu	7,411	8,903	12,455	11,722
Uttar Pradesh	1,444	1,699	5,524	6,380
West Bengal	5,211	6,957	6,829	6,507

Source: *Bulletin of Food Statistics,* various issues.
The data include hullers, shellers and modern rice mills. Each year's data represent the latest available figure for a particular state.

employment in milling. The distribution of the number of mills also indicates a similar pattern (see Table 2 1.9).

Data on the number of mills must however be treated with caution since they include mills of very different capacities, from small hullers to modern large rice mills. We have not been able to obtain capacity data for the mill sector. The *Bulletin on Food Statistics* provides data on number of mills by different categories – hullers, sheller-cum-hullers and modern rice mills, without providing average capacity ratings. However, in the early 1960s there were very few large mills, and the majority of the mills in all states were hullers. Of course, even within hullers, there may be wide capacity variations [15] and this must be borne in mind.

We do, however, have some data that indicate that the ranking of milling capacity and number of mills do not diverge, at least in the first decade after independence. The Rice Milling Committee of 1954/55 estimated the proportion of handpounded to total rice production for the various states for 1953/54 (see Table 21.10). Applying these proportions to the total rice produced in 1959/60 (a normal production year), we can obtain estimates for the total amount of rice hand-pounded or milled in each state. These estimates are given in the table. There is a very strong positive association between the estimated amount of milled rice and the number of rice mills in each state in 1960. [16] We may therefore reasonably conclude that the data on number of mills, total amount milled, and employment in the non-household sector, all point towards a greater absolute and relative importance of power driven milling in Andhra Pradesh and Tamil Nadu as compared to Uttar Pradesh, Bihar, Orissa, Assam or Madhya Pradesh in the early 1960s. Among the eastern and north-eastern states, only

Table 21.10 Estimated amount of rice milled, 1959-60.

	Milled rice as % of total production, 1953-54	Rice production 1959-60 (1000 tons)	Estimate of rice milled 1959-60 (1000 tons)
Andhra Pradesh	49.9	3614	1803
Assam	34.0	1629	554
Bihar	2.6	3886	101
Karnataka	95.7	1289	1234
Kerala	30.5	1025	313
Madhya Pradesh	20.9	3116	651
Maharashtra	61.5	1586[1]	975[1]
Orissa	12.8	2137	274
Tamil Nadu	91.8	3406	3127
Uttar Pradesh	34.0	2370	806
West Bengal	29.8	4172	1243

Source: *Rice Economy of India,* 1961, *op.cit.,* pp. 33, 117-118.

Notes: 1 Includes Gujarat.

West Bengal had a large number of mills or amount of milled rice in that period.

At least a part of the regional differences in milling can be attributed to the varying degrees of vigour with which the government's rice procurement policies were channeled through mills during the Second World War.[17] This policy appears to have been particularly strongly implemented in Madras provinces.[18] But, as we have already noted, the greater importance of milling in Madras predates the war. The policies pursued during the war tended only to accentuate the regional pattern that was already in existence.

A clue to the possible reason behind this is available in some of the government reports on the subject.

> Hand-pounded rice is produced mostly by the growers and agricultural laborers for their domestic consumption. In several areas, however, the hand-pounding industry has been producing rice on a commercial scale and even for export to other states in the country. . . . . . While the bulk of the milled rice is put on the market, only about one-fourth of the hand-pounded rice is marketed. Thus the total marketed surplus of rice consists more of milled rice than of hand-pounded rice. (*Rice Economy of India,* 1961, p.33.)

A possible hypothesis that is indicated is that the higher the share of marketed surplus of rice in a region, the higher the proportion of production that is milled. The Rice Marketing Committee of 1941 had estimated the average marketable surplus by province for the triennium 1934/35 to 1936/37, as also the proportion milled. These data are given in Table 21.11. There appears to be a positive association between the two,[19] although it is clear that, on the one hand, not all of the marketable surplus was being milled in some provinces, while even some of the non-marketed production was being milled in others.

Table 21.11 Marketable surplus[1] and milled proportion, 1934/35 and 1936/37.

	Marketable surplus as % of production less seed	Milled rice as % of production less seed
Assam	6	3
Bihar & Orissa	33	10
Central Provinces & Berar	38	30
United Provinces	38	7
Madras	67	62
Bengal[2]	48	16

Source: *Rice Marketing Committee Report,* 1941, *op.cit.,* Appendices XXIV and XXV.

Notes:

1 Marketable surplus is defined as total production minus the amount retained for domestic consumption, barter, payments-in-kind and seed.

2 Includes East Bengal.

The relative cost of handpounding versus milling may have been one reason why more of the marketed rice tended to be milled.[20] Hand-pounding being generally more costly than milling, the price of hand-pounded rice would have had to be proportionately higher *ceteris paribus* in order to afford the seller an equal profit on both. It is doubtful whether this was the case. According to the Rice Marketing Committee of 1941, in many provinces there tended to be a price differential of one to four annas per maund of favour of handpounded rice of the fine or medium varieties. On the other hand, for the coarser varieties, milled rice was often higher priced than the handpounded.[21] Since even the price differential in fine varieties was unlikely to have been large enough to cover the extra cost of handpounding, the logic of the market seemed to be firmly against hand-bounding. This would particularly affect the cost calculus of an intermediary trader who purchased paddy, processed it and sold it in the form of rice. It may be a less critical factor if paddy were retained for domestic consumption, and handpounded by family labor. While the imputed cost may be high in this case, the actual money cost of handpounding might be lower than paying for milling. There might therefore be a greater tendency for the marketed paddy to be milled, than that which was retained for own consumption by the cultivating household. Variations in the relative cost and price ratios as between handpounded and milled rice in the different provinces may have been an important reason for the varying extents to which the marketed surplus tended to be milled. This, however, needs further investigation.

In the light of the above discussion it would appear that government procurement policies during the war gave an extra fillip to the already favourable economics of power-driven milling. Although some post-war attempts were made to control the growth and spread of mills through Rice Mills Control Orders in some states, these ceased to operate when rice was decontrolled in 1954. In any event, although the First Five Year Plan attempted to introduce various measures, viz., the ‘Common Production Programmes’ to allow coexistence of handpounding along with the mills, it became impossible to check the rapid (often unlicensed) growth of small hullers. Far more active and earlier (prior to the war) intervention would have been necessary to improve the technology of handpounding and thereby strengthen its competitive position.

Conclusion

This paper has examined some of the regional dimensions of two aspects of paddy cultivation and processing which have traditionally been highly intensive of female labor. Although the empirical evidence linking the practice of transplanting rice *inter alia* with the incidence of women agricultural laborers is not sufficiently up to date, the data do indicate a strong relationship between irrigation and inequality of land holding on the one hand and the presence of women laborers on the other. To the extent that transplanting is predicated on irrigation (and this is not true everywhere), we may infer that transplanting is linked to the presence of women laborers in the current period as well.

The data on paddy processing indicate that milling paddy made greater inroads into female employment in handpounding in the main southern rice producing provinces even prior to the war. While government policies during the war undoubtedly speeded up the overall growth of mills and accentuated the regional differences, handpounding had already been doomed by economic considerations.

What is particularly interesting about the regional dimensions is that the regions where there is a high incidence of women laborers in paddy cultivation are also the regions where women's role in paddy processing has declined earliest. A much deeper analysis is required to study the possible inter-connections between the two. For example, one might hypothesize that the early presence of transplanting in the southern parts of the country and the consequent high demand for female labor reduced the supply of labor available for handpounding, thereby tilting the relative costs in favour of milling, once the technology became available. On the other hand, the increase in milling would probably have increased the supply of female labor for cultivation and depressed the wage there. We require a better knowledge of the historical evolution of both the technology and the relative prices and wages in order to test these hypotheses.

Notes

1 See G. Sen, *Women agricultural laborers – regional variations in incidence and employment,* Centre for Development Studies, Working Paper No. 168, April 1983.

2 We have excluded Punjab from our analysis; although rice production has made rapid gains there in the last 5-10 years, it is not *traditionally* a very important rice area.

3 See C.R. Srinivasan, *Report of the rice production and trade in the Madras Presidency* Madras, Government Press, 1934, Appendix 2, pp.83–84. Unfortunately we do not know whether this refers to gross or net area irrigated.

4 Transplanting is not inevitably women's work, though it is largely so. See F. Bray, *Recent changes in padi farming in Kelantan, Malaysia,* Report for the Royal Academy, the British Society and The East Asia History of Science Trust, September 1977, for an example of male labor in transplanting.

5 We have focused on women agricultural laborers rather than women cultivators (including family labor). There is, if anything, a negative correlation between the presence of women cultivators in the female rural population and the proportion of gross cropped foodgrain area under paddy.

6 Ibid., pp. 17–21.

7 I am grateful to N. Krishnaji for pointing this out. He suggested an alternative index, viz., the number of women agricultural laborers per hectare of gross cropped area, which will be tried in further analysis.

8 Kerala, Orissa and Assam were excluded from the regression since I did not have access to district-wise irrigation data.

9 The rationale behind this equation is that the incidence of women agricultural laborers is positively associated with both the extent of irrigation and with inequality in land holding. The latter was measured by the Gini coefficient, while two alternative measures of irrigation intensity were tried in the first version. In addition we tried to see if the multiple cropping index had an effect over and beyond that of irrigation. The proportion of cropped area under rice was also included to see if paddy acreage *per se* had any effect.

10 The low incidence of women agricultural laborers despite widespread transplanting in Assam and West Bengal remains somewhat puzzling. The residuals of the estimated from the actuals show that the regression tends to overestimate the proportion of women agricultural laborers by an average of 1 percentage point in almost all districts of West Bengal. This indicates some additional factors at work in West Bengal, depressing the proportion of women agricultural laborers. One such may be the tendency to use seasonal migrant laborers for peak seasons in at least some districts.

11 An exception is the work of Mukul Mukhopadhyay. See 'Impact of modernisation on women's occupations: a case study of the rice husking industry of Bengal', *Indian Economic and Social History Review,* Vol. XX, No. 1, January-March 1983, pp. 27–46.

12 See *Report on the Marketing of Rice in India and Burma,* 1941, *Rice Economy of India,* 1961. Three other reports to which I have not had direct access are *Report on the Marketing of Rice in India,* 1954, *Report of the Rice Milling Committee,* 1955 and *Rice Economy of India,* 1973.

13 According to him, while part of the decline was due to a change in occupational categories, '. . . there seem to be reasons to believe that the very laborious occupation of husking rice in pits with enormous pestles, and the almost equally laborious occupation of grinding flour by hand (otherwise than for purely domestic needs) have given place to mechanical methods, which render necessary a very much smaller number of persons. . .' (*Census of India,* 1921, Vol. VIII, Bombay Presidency, Part I, General Report, p. 229).

14 These numbers are obtained from the *Census of India,* Imperial Tables on occupations for 1911, 1921 and 1931. The data cover British territories, states and agencies for the occupation 'rice pounders, huskers and flour grinders' which was occupational group number 56 in 1911, 65 in 1921 and 71 in 1931. They include 'actual workers' plus 'partially agriculturists' in 1911 and

1921, and ‘principal earners’, ‘working dependants’ and ‘subsidiary occupations’ in 1931. Between 1911 and 1921, total workers plus their dependents in this occupational group declined from 1,575,122 to 1,139,345.

15 While small builders had an annual output rating of 12,000 maunds, large hullers can process 48,000 maunds. (1 maund = 373.22 Kg). See A.S. Bhalla, ‘Choosing techniques. handpounding versus machine – milling of rice – an Indian case’, *Oxford Economic Papers,* Vol. 17, No. l., March 1965, pp. 147–157.

16 The rank correlation coefficient for the eleven states is 0.845, significant at almost the 0.1% level. The rank correlation coefficient between the estimated amount milled and the proportion of workers employed in the non-household sector of rice processing in 1961 is 0.641, significant at the 5% level.

17 The procurement of rice through the mills gave a strong incentive to milling.

18 See Mukhopadhyay, op.cit., p. 39–40, using the *Report of the Rice Milling Committee,* 1955 as the source.

19 The rank correlation coefficient for the nine provinces for which data are provided is 0.767, significant at the 5% level.

20 In 1953-54, the unit cost of processing paddy in a rice mill was between half and three-fourths of the cost of handpounding in six of the main rice producing states. (Mukhopadhyay, op.cit., p. 41; the *Report of the Rice Milling Committee,* 1955 is the source.)

21 *Report of the Rice Marketing Committee,* 1941, op.cit., p. 163.

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22 Harnessing technology for eliminating the drudgery of rural women engaged in rice production, processing and utilization

*J. C. Srivastava**

Introduction

Rice is a staple food for the majority of the world's population. Statistics reveal its importance among the cereals grown in the world. India is the second largest producer, contributing about one-fifth of total world rice production. Rice encompasses nearly 25 per cent of cropped area and accounts for 40 per cent of food production and nearly 20 per cent of GNP. In India, rice production and processing also provide employment opportunities for the majority of the rural poor.

One country's efforts to raise agricultural productivity may not be appropriate in another situation. The advanced countries have mechanized their farming, but India and many Asian countries need employment-creating rather than labor-saving technologies. Research and development should focus on labor-using technology.

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Directing scientific and technological development at rural women is a challenging task because they represent an unorganized, weak and vulnerable group in rural society. This paper details the extensive productive role of women in rice processing. Further discussion provides examples of appropriate technologies which can both raise overall productivity and improve the economic conditions of the rural poor.

Developing appropriate technologies will build up indigenous competence and receptivity, generating new assets and resources and creating gainful activities and a sense of pride among women about their significant contribution in development. It aims at complementing and supplementing the on-going efforts towards strengthening their economic condition.

Developing appropriate technologies requires greater attention to local needs and constraints. The technology should meet conditions of relevance to local needs, availability of local skills, meeting some of the basic needs, using local raw materials, consuming minimal energy, eliminating drudgery, and be easily adopted for local reproduction.

Rural women in India

Out of the total population of 684 million (1981 census), 524 million people live in rural areas. Out of this sector, women constitute 249 million, i.e. around 47.5 per cent. More than 75 per cent of rural women belong to the families of small and marginal farmers. The majority of landless women also belong to scheduled castes and scheduled tribes. Approximately two-thirds to one-half of the farm manual labor is done by women. Two-thirds of rural women are illiterate. The Sixth Five Year Plan of India (1980-85) indicated the distribution of rural female workers as 60.4 per cent self-employed and 35.6 per cent casual labor, mainly in agriculture. The rest were distributed in other activities. The employment rate for agriculture labor households was as high as 15.8 per cent, against only 2.7 per cent for self-employed households with agricultural occupations.

All women, irrespective of the household's tenure, provide 14-18 hours of productive physical labor in a wide variety of activities directly connected with domestic chores, agriculture and traditional professions. Men often consider women's tasks unproductive, since they often do not contribute directly to the family's economic well-being. Thus the pattern of female labor utilization has not been as productive as it should be. Furthermore, the energy inputs in performing more tasks than are physically feasible, for a below subsistence standard of living, draw our attention to the plight and drudgery of rural women.

Women's role in rice processing

Rural women in India participate extensively in all stages of rice production, from seed selection to post-harvest activities. This paper focuses on their role in rice processing: parboiling, pounding and dehusking, and preparing rice products for home consumption and sale.

The parboiling process reduces grain shattering during pounding or milling. Generally, the paddy is put in boiling water and steamed in a special type of oven. The traditional practice employed, however, renders a product of low acceptability, requires high energy utility and produces an undesirable odor. The Central Food Technological Research Institute (CFTRI), Mysore has done excellent work on parboiling techniques which have been extensively adopted. The Central Rice Research Institute, Cuttack (Orissa) has also developed a small scale domestic parboiling unit in which both soaking and steaming is done in the same unit. The capacity of this unit is 75 kg/batch. Milling tests revealed a head rice yield of 2 per cent more than in traditional parboiling. Parboiling by the improved unit costs about Rs. 70/ton in contrast to Rs 98/ton by the traditional method.

Handpounding or footpounding (Dhenki) for dehusking gives a better product nutritionally, but the grain shattering rate is higher than in machine pounding. Additionally, rice by-products, such as husk, bran and broken rice, are mixed together with the grain and of little value. After dehusking, winnowing is done to remove the unhusked rice grain. Winnowing is a skilled job which mothers teach to their female children. After dehusking, sieving cleans the rice further. This is done by sifting through hand sieves or by standing and pouring the grain over a riddle. All of these tasks are slow, laborious, and inefficient operations. Productivity rarely exceeds the processing rate of 5 kg/worker/hr. See Table 22.1.

Improvements are needed to obtain both optimum output and a higher yield of head rice, and to meet the growing consumer preference for polished rice. A number of machines (hullers) run by hand and power have been developed in India. However, men tend to operate and manage these machines. While the machines work much faster than traditional methods and turn out a better quality of rice at a substantially lower price, the machines have reduced the employment opportunities of large numbers of poor rural women workers. A study (1980) estimated that Indian women have lost 125 million women days of work/year, representing an income of about $55 million. This loss equals more than 4 months full-time of 8.3 months half-time for one million women. The decrease in female employment is offset by an estimated annual gain in male wages of about $5 million (7).

Also, women traditionally make several of the processed products

Table 22.1 Comparative efficiency of various rice milling techniques/technologies practised in India.

Rice Milling technique/ technology	Average yield of rice (%)	Capacity of milling kg./hour	Losses due to broken rice	Quality of by-product	Employment potential per unit	Remarks
Handpounding	–	4-5	High	Bran mixed with husk	1-2	Involves drudgery and low level of productivity. Here the concept of loss should not be compared with mechanical technologies.
Mechanical milling (electricity/oil run motor)						
a. Huller	60	200-400	High	Bran mixed with husk	1-2	Low efficiency with impure bran
b. Centrifugal sheller	68	200-1000	Low	Pure bran	2	Good for high moisture paddy
c. Disc sheller & Cone polisher						
i) Parboiled rice ii) Raw-rice	70 68	500-400	Low Medium	Pure bran	5-7	Good for parboiled and fair for raw rice
d. Rubber roller sheller and cone polisher	70	500-500	Low	Pure bran	5-7	Good for both parboiled and raw rice
CFTRI Composite mini rice mill	68-70	300-500	Low	Pure bran	4-7	Very good at rural level as tiny unit.

and convenience foods from rice. These products are beaten rice, parched rice and puffed rice. In addition, a number of deep-fried products are prepared from rice, such as curls and papads. Certain fermented products for breakfast and snacks, such as *idli, dosai,* and *uthapam,* are also made. In all these areas, technological development has helped to improve the quality and efficiency of rice processing (for details refer to CFTRI, Mysore, India). The Central Rice Research Institute, Cuttack has standardized the technique for making puffed rice. In addition, hand-operated equipment for puffed rice has been developed by the Indian Institute of Technology (Post-Harvest Technology Division), Kharagour, India. This equipment has a capacity of 50-60 kg. and costs about Rs. 500/unit.

Since rice mills are now located in the towns and cities, rural villages are losing valuable by-products, such as bran and husk, resulting in a loss of local assets. The little handpounding/dehusking done by the village women is mainly for home consumption. The resultant by-products are also consumed locally, such as bran in cattle-feed and husk for burning. A number of new technologies have, however, been developed to process by-products and produce a number of value-added products. Application of these methods would be possibly only if decentralized small efficient units of rice milling and by-product processing are established in the rural areas. This strategy will not only generate assets, but also compensate for women's employment losses due to mechanization of these activities. Many of the technologies are simple and efficient and could easily employ women.

Development of appropriate technologies

Farmers generally sell their paddy to rice mills, and the processed rice is then returned to the rural areas for purchase at a higher price. Valuable by-products are also diverted to urban areas. Introduction of high-yielding varieties increased paddy yields and also the potential for pofitable use of the by-products of rice processing.

On an average, 100 kgs. of paddy (rough rice) yields the following materials: head rice (65 kg.), broken rice (2 kg.), bean (5 kg.), husk (25 kg.), and impurities (3 kg.).

Handpounding involves laborious and tedious labor. The rice hullers are inefficient and produce low quality by-products which cannot be used for commercial purposes. Development of new milling techniques needed to meet two criteria. Firstly, milling must produce a high percentage of whole head rice, to satisfy consumer preference. Secondly, the milling process should produce by-products in their pure form for more effective use. This problem draws scientists' attention to designing milling machinery which would reduce head rice losses and produce optimum yields of processed rice and its by-products. Additionally, scientists recognized the need to develop technologies which could use these by-products effectively, efficiently, and productively.

The following section discusses the development of three types of small scale efficient machines which address the problems mentioned above: the mini rice mill, the paddy husk combustor, and the fuel briquetting machine. These machines represent components of decentralized agro-based industries. Scientists' goals should be to develop better machines which reduce milling losses, utilize rice by-products better, and will be located near the paddy farming areas. Locating the machines in the village provides access to by-products and to employment opportunities.

Mini rice mill

A development of recent origin is the composite rice mill. Developed by the Central Food Technological Research Institute (CFTRI), Mysore (India), the mini rice mill is capable of processing small paddy quantities with the same efficiency, quality, and standard of large mills. The mill (see Figure 22.1) is composite in the sense that it carries out all cleaning, shelling, polishing and separation operations. A centrifugal type of sheller, suitable for mixed varieties of paddy including that with a high moisture content, polishes by an adjustable vertical cone or a horizontal type rotary polisher. A well designed aspirator system separates the husk and bran by-products. Table 22.2 shows the technical and economic data of the mini rice mill.

Paddy husk combustor

The Central Fuel Research Institute (CFRI), Dhanbad, in association with the Central Mechanical Engineering Research Institute (CMERI), Durgapur, has developed a paddy husk combustor cum heat exchanger with a drying capacity of 1-2 tons of parboiled paddy by burning about 100 kg. of husk/hour. This drying technology completely eliminates any chance of sulphur contamination of rice, which normally occurs in furnace oil operated drying systems. The husk received as a by-product during milling is also utilized without adding to the cost of drying. The Indian Grain Storage Institute, Hapur also has developed technology using coal as fuel.

Bran and husk are the two important by-products of paddy processing. It is commonly observed that they are poorly utilized or wasted. Substantial scope, however, exists to increase the utilization

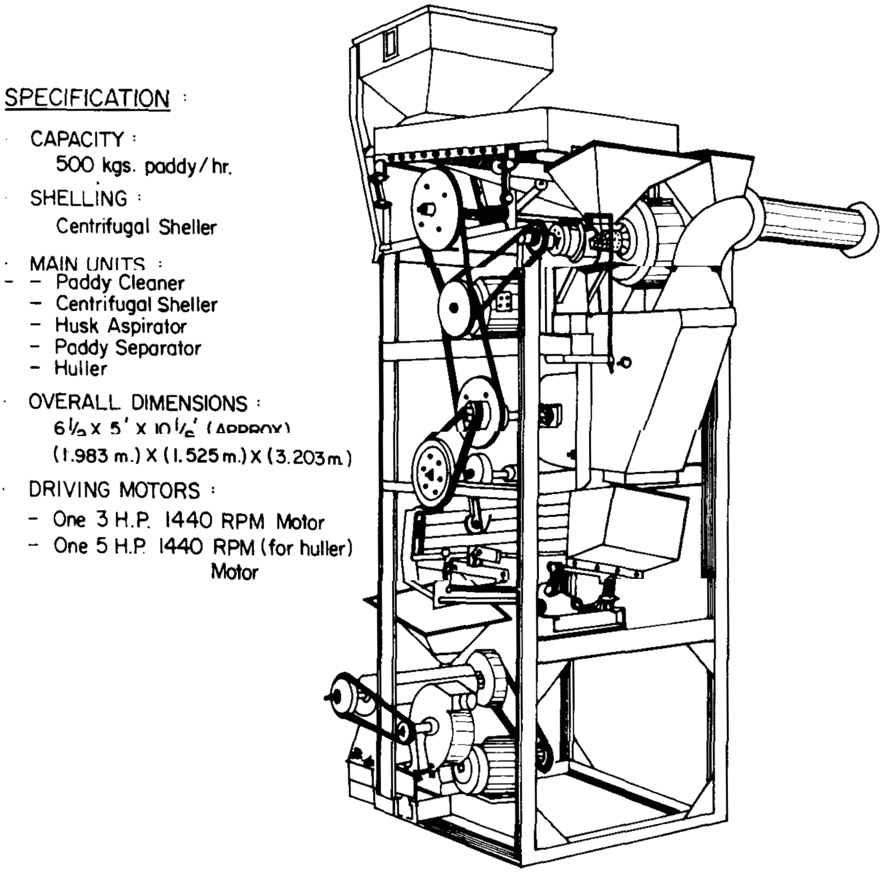

Figure 22.1 : The mini rice mill.

Table 22.2 Technical and economic capacity of the mini rice mill.

Technical	
Operating capacity	500 kg. (0.5 tonnes) of paddy/ hour
Power requirement	10 KWH
Size of main milling machine	2 x 1.5 x 4 metres (6' x 4.5' x 12')
Average yield of head rice	68-70 per cent
Price of the mill proper	Rs. 4,000 or U.S. $4,000
Economic	
Return on investment	30 per cent
Debt equity ratio	1:0.86
Break even point (even if the mill works for 90 days in a year, it can break even)	33 per cent
Employment potential	1 – self employed entrepreneur 1 – skilled labor 1 – helper 4 – unskilled labor

level of these by-products through modern technologies (see Figure 22.2).

Bran, which constitutes 5-6 per cent by weight of paddy, is the most valuable by-product and is normally used as cattle feed in the rural areas. It contains 15-20 per cent oil which could be extracted by solvent extraction. Since the bran turns rancid and deteriorates rapidly owing to the presence of lipase, bran needs to be stabilized before being transported for extraction of oil. A few technologies have been developed in India to stabilize the rice bran both at cottage and small scale. Table 22.3 summarizes the efficiency of a few such stabilizing technologies.

Husk forms 25 per cent of the weight of paddy and this is the most abundant of the agricultural residues. The introduction of high yielding varieties of paddy results in the larger quantities of husk now available. This increase warrants planning for utilization of the husk by-product as one of the research priorities.

Rice husk has been used as fuel, soil conditioner, bedding material in poultry farms, and packaging of fragile items, among other uses. Recent technological innovations have opened up new avenues for better and more sophisticated utilization of this material. Prominent among these are the rice husk board (Indian Plywood Research Institute, Bangalore and Regional Research Laboratory, Jorhat), rice husk fuel pellets (ITT, Delhi) for domestic fuel needs. Even when the husk is

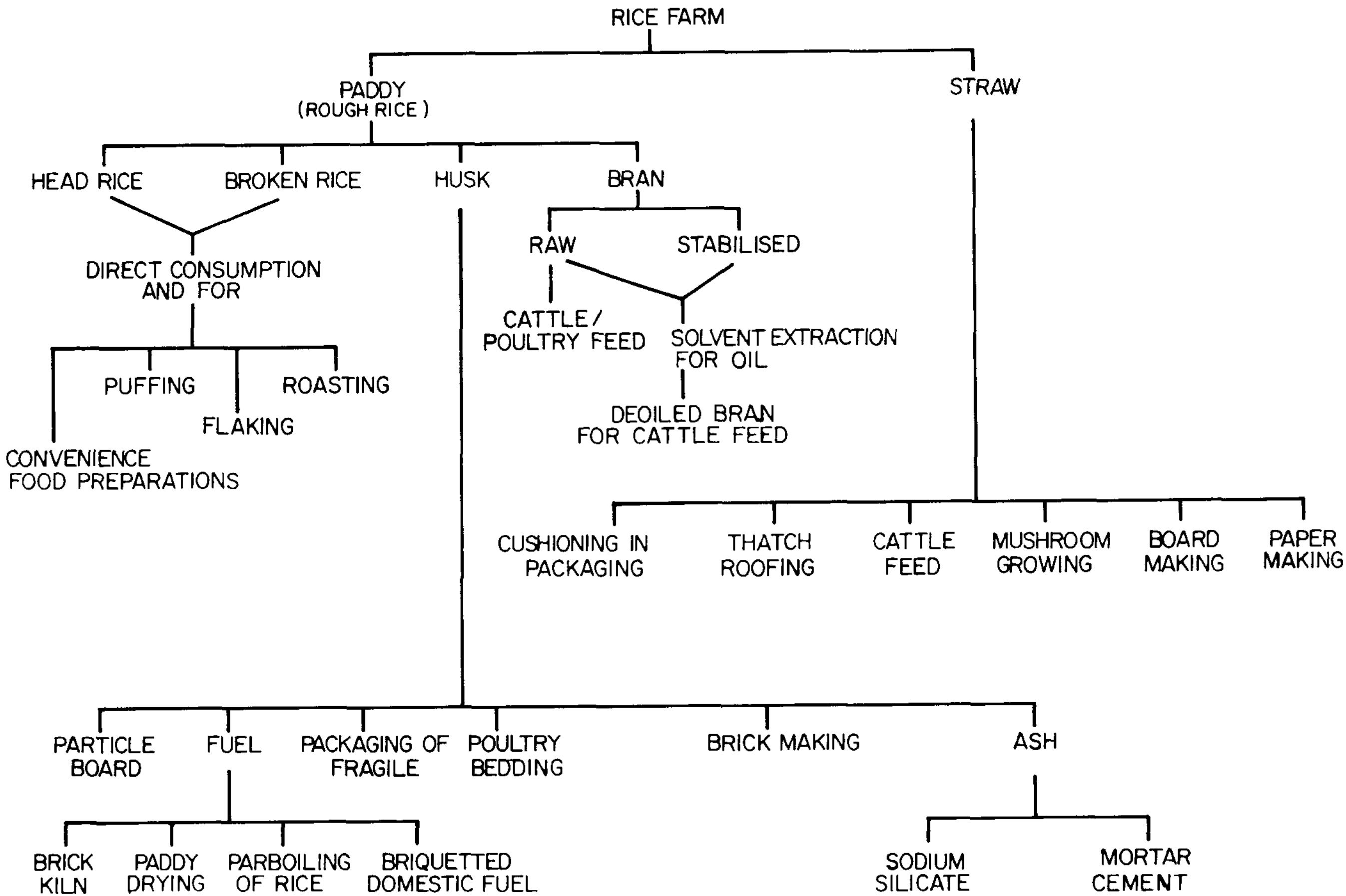

Figure 22.2: Technological perspective for the utilization of rice and its by-products.

Table 22.3 Technologies for stabilization of rice bran.

Organization	Capacity of stabiliser	Cost (approximate)	Type of energy used	Remarks
Oil Technological Research Institute, Anantpur	70 kg. per batch	Rs. 5000	Hot air	Portable unit of small capacity (8-16/hr) is also possible
Post Harvest Technology Centre IIT, Kharagpur	25 kg./hr.	Rs. 10,000 (1981) Exclusive of boiler)	Steam	Manually operated
Central Food Technological Research Institute Mysore.	i) 30-50 kg. per batch of 30 min.	Rs. 15,000	Electricity	Already in use
	ii) 200-250 kg. per batch of 30 min.	Rs. 14,000	Steam	
	iii) 1000 kg./hr. (Continuous)	Rs. 15,000	Steam	
Jadavpur University Calcutta	Pilot Plant (Close circuit fluidised bed heat transfer system)			Already in use
Paddy processing Research Centre, Tiruvarur	100-150 kg. per batch	Rs. 3,500	Hot air fuel gas	Low cost and appropriate for rural application Mechanical/Mechanical operation possible

used as a fuel either directly or in the form of pellets, it produces an ash rich in silica. This ash can also be used in a variety of ways. Important technologies available to utilize this ash include mortar cement (ITT, Kanpur, RRL, Jorhat, Cement Research Institute, New Delhi), rice husk bricks (Central Building Research Institute, Roorkee), silica bricks and detergent powder (RRL, Jorhat), sodium silicate (Central Glass and Ceramic Research Institute, Calcutta, Modern Rice Processing Center, and Annamalai University, Tamil Nadu). Rice husk also can be used as an insulating material.

Fuel briquetting machine

The fuel briquetting machine has been developed by the Prototype Development Training Center of the NSIC Ltd., New Delhi. It produces briquettes of 48 mm. diameter and 12-30 mm. in length. Relying on electricity as a power source, the machine's capacity is 300 kg./hour. Overall, the machine stands 1400 meters in height, 900 meters wide, and 16 meters in length. It costs 200-300 Rs. to construct the machine.

The technology has been developed by the Indian Institute of Technology (IIT), New Delhi. The P-1 model of 4 t/day (5-6 tons/day of rice husk) plant costs about Rs. 112,000 (U.S. $12,000). While the energy source is electricity (31 BHP equal to 24 KW), the water requirement is 10,000 1/d. The wet briquettes are dried in the open sun. Briquette production costs are about Rs. 500/ton (U.S. $50) and the employment potential is 18-20 persons. Figure 22.3 gives the flow diagram of this plant.

IIT has also developed a 15-25 kg./day plant which uses empty oil drums (costing about Rs. 200 each). Human labor supplies the energy source. This unit of IIT is of 2 ton/batch, costing about Rs. 27,000 (U.S. $2700). In addition, the manually operated extruder costs another Rs. 1500 (U.S. $150). The unit provides employment to 5-8 persons.

Additionally, the School of Applied Research, Sangli has developed three types of machines using clay as binder: manually operated, bullock operated, and electric. The manual machine has a 50 kg./day capacity and produces briquettes of 10-30 mm. diameter, at an initial cost of Rs. 6000 (U.S. $600). The capacity of the bullock operated machine is 150-200 kg./day, and the machine produces briquettes ranging from 50-60 mm. diameter. It costs Rs. 2200 (U.S. $2200). The 600 kg./day machine is run by electricity (3 HP.1440 rpm single phase, A.C. motor). The cost of the machine is Rs. 45000 (U.S. $4500).

Meeting fuel needs especially for domestic cooking and heating in rural areas has become a serious drudgery to women and children. While it could be tackled from several fronts, the rice husk briquetting

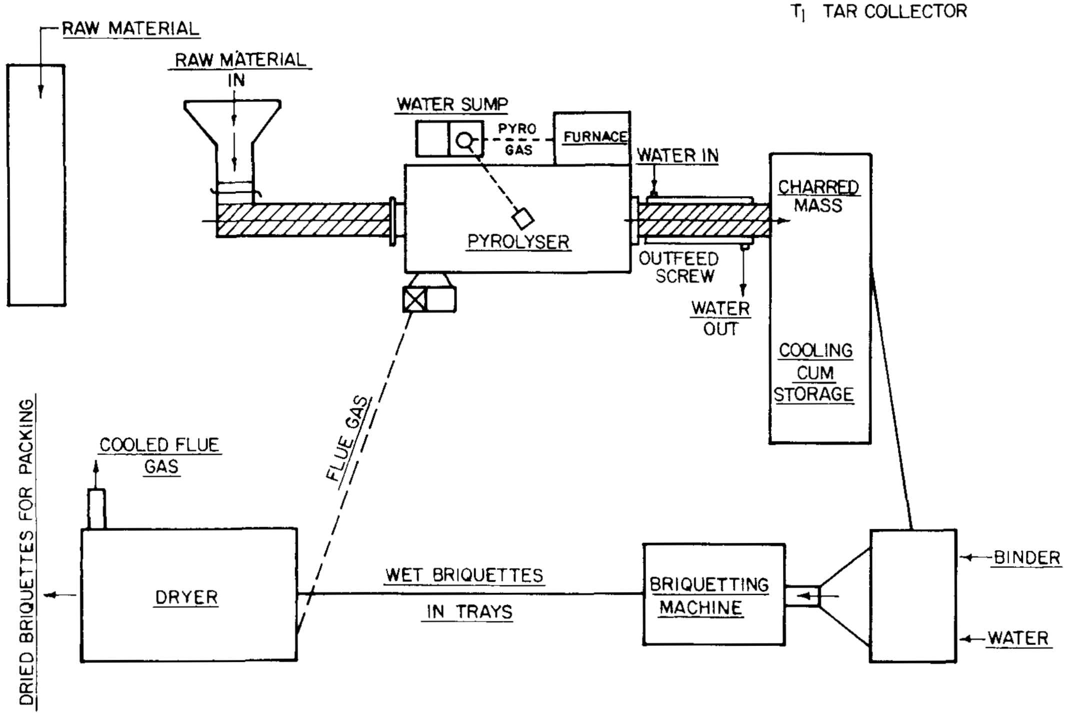

Figure 22.3: Schematic flow diagram of 4TPD ‘PARU’ briquetted fuel pump.

has given some ray of hope to meet the needs and imagination of women. Here, the technology does not displace women from work, produces no waste, creates no environmental problems and simultaneously generates new gainful employment opportunities.

Conclusions

Figure 22.2 projects the prospects of processing rice and its by-products. There could be some more uses. Since all these are location specific, an exercise must be undertaken to study the prerequisites to arrive at an optimum model of product combinations.

In the planning stage itself the local people, prospective entrepreneurs, and educated unemployed may be taken informed and the spirit of the project explained to them. They should be made aware of the technicalities of starting and managing the project themselves in the future. It is imperative that linkages with suitable agencies for marketing the end products in the semi-urban areas be organized and established for the ultimate success of the project.

The following guidelines could be followed in implementing the complex:

(a) identification of a voluntary agency to implement the project;
(b) patronage by the government to support and monitor the project;
(e) committed credit assistance by financial institutions; and
(d) linkages with other centers for marketing.

Technological research in India has clearly indicated a vast potential for improving the entire post-harvest activities to derive optimum output, value adding, quality improvement of end product and by-products, low cost of production and environment protection. Whereever provided, appropriate technology produces a better response to development. Agro-based industries need to make an integrated and concentrated effort to upgrade the linked technologies compatible with available agro-materials. The social cost-benefit accrues with the use of by-products and wastes at the source of their availability. Such an approach may also help to check the diminishing village industries.

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23 Women in African rice farming systems

*Jennie Dey**

Introduction

This paper is the first part of a larger study which includes 11 case studies based on field visits in 1983 to development projects in the following countries: The Gambia (inland fresh water and mangrove swamps and irrigation schemes), Ivory Coast (rainfed and irrigation systems), Upper Volta (inland swamps and settlement irrigation schemes), Senegal (mangrove swamps and irrigation schemes), Mauritania (irrigation development), Zanzibar (irrigation project) and Madagascar (rainfed, swamp terraced-systems and modern irrigation schemes).

Women have customarily played a major role in rice farming systems, particularly in Asia and Africa where prevailing cultivation practices demand a heavy manual labor input. However, research programmes

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and development projects have repeatedly failed to take these roles into account, with consequences that are often detrimental not only to the economic security and social status of the women themselves and their families but also the success of these programmes and projects in meeting national or regional development objectives. This paper therefore sets out to examine the different aspects of women's roles in rice production, post-harvest work and marketing, and the implications for expanding production and raising productivity and incomes under different cultivation conditions.

Rice farming systems

Rice farming systems generally form one or more sub-systems within a larger farming system which includes the full set of crops and livestock produced in a particular ecological region by a particular socio-economic group. Farming systems gradually evolve over time as a result of natural or human-induced changes in the various factors affecting the systems. Two of the most fundamental factors are the physical environment (soil, water, temperature, solar radiation) and the biological characteristics of the plants or animals. These may be modified, for example, by improving water control through irrigation or drainage, the use of improved seeds, fertilizers, chemical pest and disease control.

However, farming systems and their evolution are also affected by social norms and actual practices (which may be different) which determine the way in which production and consumption are organized at a household or village level. These norms and practices affect the sexual division of labor between crops or different farming operations; access to and renumeration of household and non-household labor; access to and control of land, capital resources, the crops and livestock, and the income derived from their sale or any by-products; and managerial and technical skills. The ways in which these factors of production are distributed and used may vary according to class, caste, economic status, religion, ethnic groups or gender of the household head, both within regions and also among households with different population sizes and developmental cycles.

Different rice farming systems have evolved in response to specific cultivation conditions (upland, inland fresh water swamps, mangrove swamps, hydromorphic and irrigated conditions). A single farmer may manage two sub-systems, for example, swamp and upland or swamp and irrigated rice, where not only the physical conditions but also the land ownership, labor organization, use of capital and production inputs, and the final control and destination of the crop may be quite distinct. While the rice crops may or may not compete with other crops for physical resources such as land and water, they invariably do compete for labor and capital, forcing farmers to make trade-offs between their different crops. These are affected by prices and marketing structures, overall labor requirements, labor bottlenecks and conflicts. labor costs, the developmental cycle of the household and the ratio of male to female labor required by and available for rice and alternative crops, comparative risks posed by different crops, food preferences and ceremonial needs for certain foods.

The farmers' choices may change over time with repercussions on the organization of the farming system as a result of the following:

(a) national policies affecting the agricultural sector such as the allocation of development investment finance and recurrent expenditure; priorities accorded to particular food or cash crops, pricing and marketing; exports, imports or import substitution; education and training;
(b) community structures and their integration into national political organizations which largely determine the effectiveness of rural pressure groups in influencing national policies and in gaining access to development projects;
(c) specific political or development interventions which increase access to new technologies and knowledge (for example, tractors and threshers; new varieties of seeds and fertilizers; improved agronomic practices such as live mulching) or which lead to changes in the organization and remuneration of labor (brought about, for example, by the abolition of domestic slavery in many African countries at the end of the nineteenth century or the growth of large estates requiring (migrant) wage labor this century);
(d) alternative and more attractive economic opportunities and higher living standards in towns and the richer industrialized and Third World countries (such as Saudi Arabia, the Gulf states, Ivory Coast, Gabon), leading especially to male migration with serious repercussions for the sexual division of labor in agriculture, women's work-loads and responsibilities.

Although the rice farming systems which have evolved in different countries for similar cultivation conditions do share many common features, at the same time each country or even region within a country has some specific peculiarities because of its unique mixture of physical, biological, socio-economic and political factors.

The main issues

At present there are no comprehensive global or regional analyses of the major issues arising from women's roles in rice farming systems, although there are a growing number of scattered country case studies (some of which have been summarized by Agarwal, 1981) examining women's traditional roles and the impact of the introduction of specific technologies on women, their families and the national economy. The term 'technology' is generally used in its widest sense to include hand tools, mechanization, improved production inputs and agronomic practices, water and land management.

This paper focuses on the following issues resulting from the introduction of new rice technologies for women:

1 To what extent are rice technologies appropriate to women's needs being developed and introduced?
2 What are the implications for women rice farmers of increasing the value of rice land by improving water control and land management? Do women lose their traditional rights to land? Are these appropriated by men who see themselves in competition with women for the control of resources? What is and should be the role of government in protecting women's rights to land? If women lose access to rice land, are they still able to fulfil their traditional obligations towards their families and if not, what is the extent and type of suffering experienced by their children and the wider family?
3 What are the implications of the sexual division of labor and differential male and female control of rice crops for the choice of new technologies? If technologies such as tractor ploughs are introduced to reduce labor required for male tasks, is demand for female labor (for example, for transplanting and weeding) increased to unreasonable levels? When men control the rice crop, are they prepared to pay for labor-saving technologies for women? If men purchase technologies such as rice mills, are women displaced from wage labor on which they and their families depend for their livelihood?
4 What are the implications of the introduction of new technologies for poor or landless female wage laborers? Under what conditions are they displaced from traditional tasks? Are new or expanded employment opportunities being created for women?
5 Why do extension agents channel inputs and advice through male farmers even when women are responsible for the work, and what are the implications of these indirect information networks? Are marketing and credit facilities reaching women?
6 What are the implications of the intra-household distribution of resources and control of the crops for women's social and economic status and the welfare of their children?

Although the issues to be discussed in this paper are of global significance and should provoke a re-examination of these and similar problems in other parts of the world, they are analyzed here in detail with reference to sub-Saharan Africa for two reasons. First, Asia not only has a longer[1] and more intensive tradition of rice cultivation than most African countries but modern research has been more sharply concentrated on Asia. However, attempts to transfer to Africa labor-saving equipment, new seeds and agronomic practices developed in Asia have often met with disappointing results because they were inappropriate for African conditions. A fairly obvious example, with which scientists are well familiar, is the breakdown of Asian seed varieties to blast *(Pyricularia oryzae)* which is a common disease in Africa. Researchers are now working on this particular problem by breeding more horizontal resistance into the vertically-resistant Asian varieties.

A more fundamental and serious problem, however, arises from the transfer of technologies that are simply inappropriate to the socio-economic organization of production and consumption in African countries. This has particularly occurred when complete new irrigation systems have been grafted on to traditional farming systems, resulting in considerable disruption of labor relations, increasing socio-economic differentiation, the erosion of women's traditional independent farming roles, and projects which have been less successful than they might have been in reaching national objectives of raising rice production (Dey, 1982). The basic problem is that many scientists and planners have assumed that the European or Asian-style 'family farm' with a single household purse also exists in Africa. However, with the notable exception of Madagascar whose population has strong historical immigration and commercial links with Indonesia, the Philippines and Malaysia, in much of sub-Saharan Africa households contain several separate granaries and 'purses'. These may be controlled by men or women depending on their different but complementary responsibilities to the household. Generally women have an obligation to produce subsistence food crops for household consumption, either by contributing labor to the communal household fields or by organizing the cultivation of a separate plot. In many societies both men and women also have the right to cultivate a personal field on their own account from which they meet certain obligations to the household and their personal expenses. However, men's cash crop fields are usually substantially larger.

The second reason for the focus on sub-Saharan Africa is the growing food crisis in the sub-continent. For a variety of reasons which include natural disasters, declining rainfall and land fertility, civil strife, rural-urban migration, and production, marketing and pricing policies that favour export cash crops, *per capita* food production has actually fallen in the last decade. This has led to rapidly rising imports of basic staples to feed the growing urban populations and to supplement inadequate food production in some rural areas. Rice and wheat are generally the main grains imported, owing to changing food preferences. However, the growing balance of payments problems faced in recent years by both oil importers and exporters, compounded by falling prices for other major African exports such as cocoa, coffee, groundnuts and copper, has led many countries to adopt food self-sufficiency programmes.

As a major strategy for expanding food production governments increasingly turned to capital-intensive, and often large-scale, irrigated rice development schemes in the 1960s and 1970s. While such developments were undoubtedly important, particularly in drought-prone areas, they have often encountered serious managerial and social problems which have undermined their economic viability. During this period traditional upland and swamp rice received rather less attention.

Since the 1970s many governments have attached considerably greater importance to developing upland and swamp rice. However, the various complex studies started in the 1960s onwards for the integrated development of hydro-electric power and hundreds of thousands of hectares of irrigable land in Africa's river valleys will be moving into their operational phases in the next ten to twenty years.

It is therefore critical at this stage not only to evaluate the impact of existing rice development projects and policies in Africa on the farming system and the consequences for both national development needs and different socio-economic groups in both rural and urban areas, but also to take a fresh look, without preconceptions, at the organization and advantages of, and constraints in, traditional rice farming systems. This should lead to the formulation of more cost-effective improvements in traditional swamp and upland rice cultivation as well as the introduction of new irrigated rice systems, all of which should not only promote national economic development but also reinforce rather than disrupt those aspects of the traditional farming systems which the farmers themselves value.

It is within this wider context that this paper examines the role of women in rice farming systems in Africa and shows the importance of taking these roles into account in developing rice projects for the benefit of the women themselves and the national economies.

Rice cultivation conditions in Africa

In 1974-76 an estimated 3.8 million hectares of rice were harvested a year, with an average production of 5.4 million tons of paddy. These figures are projected to rise to 8.6 million hectares with a gross output of 18.8 million tons by the year 2000. (FAO/International Rice Commission (IRC), 1981, item 3).

Precise figures on areas under rice and production levels are not available except for the fifteen member countries of the West African Rice Development Association (WARDA)[2]. In 1979 these accounted for roughly half of the area and a third of rice production in Africa. Other rice producing countries include Angola, Cameroon, Mozambique, Tanzania, Zaire, Zambia and Madagascar (IRC, 1981. item 4).

The International Rice Commission (1981, item 4) gives the following classification of rice cultivation conditions in Africa, with the percentage distribution of the area under cultivation for the WARDA countries only: dryland (or upland) rice (62.5 per cent), inland swamp (22 per cent), mangrove swamp (8 per cent), irrigated (5 per cent) and hydromorphic (2.5 per cent).

This paper examines the socio-economic organization of production for the first four conditions (hydromorphic conditions can be considered a sub-category of inland swamps) and the implications of the role of women in these production systems for development initiatives.

THE IMPACT OF RICE DEVELOPMENT PROJECTS ON WOMEN: ISSUES, FACTS, ACHIEVEMENTS AND PROBLEMS

Traditional rice farming systems in sub–Saharan Africa

The most striking difference between African and Asian farming systems in the general absence in mainland sub-Saharan Africa of a concept of a European or Asian-style joint family farm where land. capital resources and labor are pooled and controlled by the (male) household head who then distributes the income equally or at least fairly between his dependents.

The sexual division of labor

It is generally recognized that a clear sexual division of labor exists between crops or between farming operations in most sub-Saharan countries. This may differ for a single crop according to whether it is grown as a household or a personal crop. The division of labor for the same crop grown under similar cultivation conditions varies considerably not only between countries but also between ethnic groups living in close proximity. These are summarized for rice in Figure 23.1.

Figure 23.1 : Division of labor and control of land and crops in traditional and improved rice farming systems.

			Traditional Rice Farming Systems					Improved Rice Farming Systems				
Cultivation Conditions	Country	Ethnic Group	Main Cultivator	Control of Household Crop	Control of Personal Crop	Rice Land Use rights/ Owership	Rice Land Inheritance	Main Cultivator	Control of Household Crop	Control of Personal Crop	Rice Land Use Rights/ Ownership	Rice Land Inheritance
Upland	Ivory Coast	Bete	F	M+F	F	Compound	Compound	F	Not known	F	Compound	Compound
		Gouro	F	M	F	Compound	Compound	F	M	F	Compound	Compound
		Senoufo	M	M	M	Compound	Compound	M+F	M	M	Compound	Compound
Inland Fresh Water Swamp	Ivory Coast	Senoufo	F	F	F	Compound	Compound	No planned developments for this type of rice which will probably be eliminated by current development projects to expand acreages and mechanize production.				
	Madagascar	All	M+F	M	n.a.	Mainly M	Sons	No significant development projects to date.				
	Gambia	Mandinka	F	F	F	Compound F	Compound Daughters	Development project starting 1983 – changes not yet known.				
	Upper Volta	Goin Turka Karaboro	F	F	F	F	Daughters	F	M	Reduced F	M	Sons
Mangrove Swamp	Gambia & Senegal	Mandinka	AS ABOVE					Only some technical developments so far – no changes in socioeconomic organization recorded.				
	(Casamance)	Diola	M+F F	M/M+F F	M+F F	M/Compound F	Sons Daughters					
Irrigated Rice	Senegal & Mauritania	Toucouleur Soninke	Swamp Rice F	F	F	Mainly M/ Compound	Sons/ Compound	M+F	M	n.a.	M/ Compound	Sons/ Compound
	Zanzibar	Shirazi	Rainfed Rice – F	M	n.a.	M+F	Sons/ Daughters	F	M	n.a.	State/ M	State/ M
	Gambia	Mandinka	Fresh + Mangrove Swamp – F	AS ABOVE				M+F	M	Mainly M	M	Sons
	Upper Volta	Mossi	Swamp Rice F	F	F	Compound	Compound	M+F	M	n.a.	State/ M	State/ M

As can be seen, in some cases there is a rigid sexual division of labor between crops. In Zanzibar women are responsible for the field crops (the most important of which are rainfed rice and cassava) while men take care of the tree crops and the marketing of their own and the women's crops. In the riverain areas of The Gambia women produce swamp rice as both household and personal crops and men cultivate millet, sorghum and maize as food crops and groundnuts or cotton for sale.

In other cases men and women have complementary labor roles for the same crop. Among the Bété of the Ivory Coast men cut and burn the forest and make the fences round the rainfed rice plots while women carry out all the other operations. The women in turn help the men on their cocoa and coffee plantations, often in return for some payment. In the Banfora region of Upper Volta women help men on the upland crops of millet, sorghum, maize, groundnuts and cotton which the men control and use to meet both household consumption needs and their own and the household cash requirements. Women, however, have a right to cultivate swamp rice on their own account to meet their personal cash needs.

When irrigated rice systems have been introduced into Africa a new sexual division of labor has generally developed between farming operations. In the case studies of The Gambia, Senegal, Mauritania and Upper Volta women specialized in certain operations such as transplanting, weeding and winnowing and help with harvesting and threshing, while men were largely responsible for the other operations. However, if women cultivate irrigated rice as a personal crop (as sometimes happens in The Gambia) or as a household crop in the case of widows in the Senegal River area of both Mauritania and Senegal, then the women generally carry out all the farming operations themselves.

Many studies of agricultural labor and project appraisal documents are concerned only with an analysis of the sexual division of labor between crops or farming operations. However, even detailed data on actual hours or the proportion of work performed by men, women and children are of limited value in planning research and development projects unless these data are used in combination with a clear understanding of who owns or controls the factors of production, the crops and the income derived from crop sales since this person (or persons) takes the essential production and marketing decisions.

Access to and control of land

In countries or among ethnic groups which have a long-standing sexual division of labor between crops, men and women generally have the right to own, inherit or use land suitable for their specific crop(s). Thus in The Gambia, for example, a woman may establish individual rights to rice land by clearing and bringing a virgin area under cultivation. These rights may then be inherited by her daughters. Although compound rice land is in theory controlled by the compound head, in practice a woman cultivates the same plots until she is too old or sick when she hands them over to a co-wife or a daughter-in-law. In the Banfora region of Upper Volta where swamp rice is a purely female crop, women do not have such individualized rights to land. However, they do have secure access to rice land in their own as opposed to their husband's name through the *chef de terre* (lord of the land). The husbands sometimes assist in the negotiations with the *chef de terre* but the women are responsible for providing the chicken and money accompanying the negotiations to ensure the necessary sacrifices and for the gifts of some paddy to the *chef de terre* every three years. A woman has the right to use this land until her death or until she is too old to farm when her daughter has the first right to request this land from the *chef de terre.* In both countries marriage is virilocal which means that rice land circulates between compounds.

In most of the other countries studied land rights traditionally belong primarily to the compound unit and are controlled by the compound head. However, women always have access to land for both their household and personal crops. While women largely depend on compound land, among some ethnic groups, for example, the Toucouleur and Soninke of the Senegal River area, they may inherit small plots of *dieri* (upland). Malgache women sometimes purchase land on their own account and on divorce have the right to one third of the land bought jointly by the couple or by the husband during the marriage.

In most sub-Saharan countries men and women who are short of land can generally borrow plots from friends or kin. In Madagascar, where there is considerable land pressure, the ancient system of terracing has increased the economic value of rice land. Such land is not therefore lent free but under share-cropping arrangements which are onerous for the tenants. Since women are less likely than men to inherit land, widows are not infrequently forced into such share-cropping arrangements in order to bring up their children.

Labor

In all the countries studied women have an obligation to work on a household or an individual food crop field, the produce of which is allocated for household consumption. In a number of countries a woman will assist her husband on his cash crops for which she is paid in cash or kind. In both Ivory Coast and Madagascar women are paid money for their work on their husband's coffee and cocoa crops. Diola women in the Casamance region of Senegal are paid for harvesting the men's millet in villages subject to Mandinka influence. Serahuli[3] and Mandinka women in The Gambia are given cash or cloth for picking their husbands' cotton, unless he reciprocates by lifting their groundnuts.

Women are entirely responsible for organizing the labor for their own personal plots. Generally they do most of the work themselves, helped by their daughters and daughters-in-law to whom they would give money or a gift at harvest time. However, in Africa women very commonly have recourse to reciprocal work groups and large communal (often age-grade) societies. The crop owners have to cook a good meal for these groups, the ingredients for which the women provide from their own resources. The women generally also have to pay for any hired labor and mechanical services such as tractor plowing for their personal fields, as well as for all the production inputs.

Capital

In none of the countries visited for these case studies did any woman have any productive capital assets for rice farming apart from a few locally made hand tools. Since steel is rarely available, the blades are usually made of easily broken iron.

Skills

One of the most striking points to emerge from all these case studies and from other published work on women rice farmers (for example, Jones, 1982, for the Cameroons; Linares, 1981, for the Casamance region of Senegal; Carter, 1982 and Tonkin, 1977, for Liberia; Karimu and Richards, 1980, for Sierra Leone) is the enormous range of skills and knowledge that women have about rice cultivation conditions and practices which have essentially been passed on from mother to daughter. This includes very detailed knowledge of different soil types, toxicities and salinity conditions; water sources and fluctuating levels at different seasons and the problems posed by water control; an appreciation of the different characteristics of seeds and their suitability for different cultivation and labor requirements; agronomic practices, for example, to minimize weed growth and erosion and to maintain soil fertility; labor organization to reduce bottlenecks and to carry out operations at the optimum time to maximize returns.

The Soninke in Mauritania provide a good example of the intricate and efficient way in which women organize labor. Before the start of the rains they plant short-duration rice seeds in holes in the lighter upland soils where weed infestation is not a serious problem. The rice germinates with the rains and gets established before weeding is necessary. The heavier clay soils in the depressions which flood during the rainy season are too hard to be touched until they have been softened by the first rains. Since weed growth is also rapid and strong with the rains, the women hoe in the first weeds and then broadcast their medium to long duration rice seeds which are harvested after the flood in the depressions has receded. In between these labor operations required by their rice, the women insert the work needed on their own or the household upland fields. Similar complex labor organization for rice has also been noted for The Gambia (Dey, 1980).

Control of the rice crop

If rice is cultivated by women as a household food crop, it belongs to the household unit and may be controlled and stored in the men's granaries (as among the Gouro of Ivory Coast and some groups of Diola in the Casamance region of Senegal) or it may be controlled and stored in women's granaries (for example, the Mandinka in The Gambia and the Casamance or the Goin, Turka and Karaboro in the Banfora region of Upper Volta). In theory household rice supplies are not supposed to be sold although it is not uncommon in most of the countries covered in the case studies for women or men to sell or exchange small quantities to buy other cooking ingredients. In The Gambia, for example, one onion was valued at two small cups of clean rice between 1977-81.

However, when women grow rice as a personal crop they may dispose of it as they wish. Some is usually put on one side to feed guests or labor groups recruited to work on their rice fields the following season; some is also reserved for ceremonial obligations. Women sell the rest of their rice, either immediately after the harvest (when they generally get low prices) or they 'bank' it and sell small quantities bit by bit throughout the year as and when they need money to solve a problem.

Women's need for an independent income

Women in most sub-Saharan countries in Africa rely on their income from their rice and other crops to meet a variety of household and personal expenses. Both men and women invariably have a distinct set of obligations to the household as well as certain rights. Men's obligations generally involve providing housing, some clothing, supplementing self-produced food supplies when necessary, meeting the marriage payments of dependent men, entertaining guests, providing the necessary food and money for their own religious and ceremonial obligations, paying for production inputs and hired labor for household and their own crops, and meeting a variety of other expenses such as taxes and school fees. However, women also have obligations to provide a variety of other goods and services for the household which include meat, fish, vegetables and condiments for the sauces eaten with the staples, clothes and medicines for themselves and their children, school fees and books, cooking utensils and some simple furnishings. They are responsible for their own ceremonial obligations which cover dowries for their daughters, gifts and other expenses at marriages, naming ceremonies, funeral and circumcision, sacrifices, religious charities, and, for Muslims, the *zakat.* Women also have to pay for the production inputs, hired labor or the food provided for reciprocal labor groups working on their personal fields or on the household crops under their charge. If they wish to take advantage of labor-saving technologies such as tractor plowing or grain mills they generally have to provide the money themselves.

The fulfillment of these obligations is contingent not only on women's access to resources, particularly land, labor and water, but also their control over and right to dispose of some or all of the crops they cultivate. However, competition between men and women for these same resources often leads to tension and conflict within the households and villages. Unfortunately women generally have less social and political power to protect their interests and rights than men.

It therefore seems imperative that where possible governments and development projects should protect women's traditional rights, for the loss of these would probably lead to a failure to carry out their traditional obligations. This would be both shameful and distressing to the women themselves and could well impoverish the family.

Impact of rice development projects on women

Although there are numerous examples of successful introduction of new technologies for rice cultivation, nonetheless many development programmes and projects have disappointing or negative results that stem from a failure by scientists and planners to appreciate the complexity of the farming systems. They also underline the need to take into account a whole range of inter-related socio-economic, physical, biological and even political factors if programmes and projects are to be planned which not only use resources more efficiently to reach national targets of economic growth and increased rice production but which also coincide with the urgent development needs of rice farmers and reinforce their own development initiatives.

A farming systems approach requires sensitivity to the two following points:

1 Planners and scientists inevitably have different educational backgrounds from the farmers and different perspectives of the purpose of development and the role of household-level agricultural development within the context of overall national development objectives. To bridge this gap, planners, scientists and people implementing projects need to consult and work closely with both men and women farmers who have enormous skills in their own spheres and who are generally very articulate about expressing their needs if given the chance. The case studies show that farmers are rarely consulted. In only one example, that of a project constructing causeways in a mangrove rice swamp in The Gambia, did the project engineers and management work with women farmers in building some sluice gates and canals, and this was entirely due to the women's initiative in requesting a meeting with the project staff and asking for help. Despite the fact that the project staff publicly stated how impressed they were with the women's knowledge and awareness of the technical problems of water control, they did not continue to work with the women but built causeways which the women did not use because they were inappropriate. This example underlines the fact that farmers are generally very receptive to planning and implementing projects with the 'experts' and it is the latter who usually need to take more initiative in meeting the farmers half-way.
2 Planners and scientists also need continually to bear in mind the fact that men and women often have conflicting interests over control of resources and incomes within the household and that women generally have less economic power and socio-political support to protect their interests. Thus those planning and implementing projects may at times need to intervene to protect women farmers. The remainder of this section highlights the common issues that emerge from the development projects studied which require greater attention by scientists and planners.

Introduction of technologies inappropriate for existing conditions

The countries studied provide numerous examples of the introduction of technologies that are inappropriate to the women farmers' needs and which could have been avoided with prior consultation. Some of the irrigated perimeters in The Gambia were constructed on land near the river which is flooded in the rains (a fact the women are fully conversant with since they transplant indigenous rice varieties in these areas). The projects did not provide any drainage facilities with the result that these fields cannot be cultivated under irrigated conditions in the rains. In the mangrove swamp area impressive-looking but expensive causeways were constructed in swamps that were much farther from the villages than the women's existing fields. This would not only mean much longer distances for them to walk but also, and more seriously, to carry their seedlings and young children. Since the swamps have deep water levels, the seedlings cannot be transplanted until they are tall and heavy. Moreover, men and women do not share capital resources and the women therefore have no right to use their husbands' donkey carts (obtained on credit under another project) without payment in cash or kind. While they can afford to hire carts at harvest time when they can pay in bundles of rice, few have any money (or rice) to do so at the time of transplanting. Finally, in a largely subsistence economy, women cannot afford to risk abandoning their well-known fields to concentrate on a new area where soils and water conditions might require different seed varieties, cultivation techniques and labor organization.

In Upper Volta the women rice farmers complained that the irrigation and drainage canals designed by the project and constructed by village men who had no experience of rice cultivation led to over-drainage. Some of the fields, which formerly had suitable water levels for the preferred rice varieties, are now too dry and the plants suffer severe water stress. A few areas have even been rendered unsuitable for cultivation.

The first type of irrigation scheme, dependent on a single large pump, which has been introduced in the Senegal River area of Senegal and Mauritania, has also led to a number of problems. First, the farmers (men or women) cannot operate such pumps which require trained technicians. Second, because of the size of the schemes, management has to be centralized and technocratic. The farmers are given very little flexibility in organizing cultivation which could prove a problem if they are ill or short of sufficient male or female labor that may be required for specific operations. Third, all the farmers on a single scheme are forced to grow the same crop, selected by the management, since the different potential crops would have varying water requirements. While this system is designed to meet government production targets, it could be disadvantageous to farmers if producer prices are low and relative returns to labor unattractive (as at present) or if marketing is unreliable (as has been the case in the last few years with the dry season tomato crop). Male household heads and widows who are own account farmers bringing up their children suffer equally from the problems posed by these technical innovations. The governments' experiments with village-level schemes and now with new hybrid medium-size developments where irrigation perimeters are to be sub-divided into smaller areas with separate pumps, attest to the gravity of these problems. It is yet to be seen to what extent women will be involved in the organization and management of these new schemes.

In the Casamance region of Senegal hundreds of hectares of cultivated mangrove swamp rice land were destroyed by a development project in the early 1960s. Setting out to improve the traditional water control system, the project drained land subject to acid sulphate toxicity, rendering it completely infertile. Current technologies for reversing this condition would not be economic in such an extreme case. Since local farmers are familiar with acid sulphate toxicity, this tragedy could surely have been avoided if the project staff had consulted the women farmers. Another more recent example in Casamance was the capital-intensive development of mangrove swamp for double-cropped rice. By the end of the 1970s the whole scheme had been abandoned because of the encroaching saline intrusion, an occurrence which the farmers had been monitoring carefully for some years.

The final examples of inappropriate technologies to emerge from the case studies concern agronomic practices. In the Ivory Coast women complained that the stalks of the new seed varieties were too short. Since their upland fields contain many tree stumps hidden by the rice they cannot harvest by sickle but only with a small knife. However, this is a very slow process and cutting the short rice varieties involves painfully long periods of back-bending work.

The extension services' efforts to introduce line-transplanting in Madagascar and the Casamance have so far met with resistance from the women since it only increases weed growth and therefore labor needed for weeding. The services have not yet offered any feasible solutions to this labor problem. Neither appear to have considered the use of herbicides while the rotary hoes introduced in Madagascar are too heavy for women, and men are hardly interested in taking over the women's traditonal task of weeding. Finally, the extension services are trying to encourage Diola women in the Casamance to make their seedbeds in the rice fields where cattle roam uncontrolled. The women prefer their current practice of preparing them in the rich soils of the forest where there is no need for manure or fertilizer, and where they are protected from cattle and the fierce sun. Moreover, the forest seedbeds are generally nearer the villages. The women have, however, requested help in obtaining mechanical equipment to clear forest areas for these seedbeds, a point which the extension services have not yet addressed.

Lack of extension of suitable technologies for women

Ironically a range of technologies does exist which would greatly reduce labor time and energy used for women's work, increase their productivity and minimize drudgery, thus improving their own and their babies' health and the general welfare of their families. However, strikingly few have actually been introduced to women because of the bias towards men which most development projects have.

The most obvious agricultural technologies are the use of tractors for land preparation in the swamps and irrigated schemes (existing machines are not suitable for the fragile upland rice soils) and for haulage of crops, seeds, fertilizers, manure, wood fuel and household water supplies. Women (for example, in the mangrove swamp case studies of The Gambia and Senegal) were adamant that they would find the money to pay for these services, either from their own crop sales or by forming cooperatives to buy equipment on credit. Sickles and threshing machines have been introduced into some countries (for example, The Gambia) for the men's irrigated rice but have not been made available to the women despite the fact that rice is a traditional woman's crop. To be used effectively in some of the more deeply flooded swamp rice plots new seed varieties which are tolerant of flash floods and are resistant to lodging and shattering may well be necessary.

Virtually all the women visited for these case studies drew attention to a very pressing need for grain mills. Pounding grain by hand is a most tiring and time-consuming task, often carried out in the early hours of the morning when the men and children are still asleep or after dark when the women have returned exhausted from a long day in the fields and then have to pound the grain and prepare the evening meal. Even men quite commonly mention this problem but they are not prepared to spend their money on buying this labor-saving equipment for the women. Clearly this is an area in which development projects could well set up organizations for women to purchase the mills on credit and run them on a cooperative basis.

Loss of access to rice land

In all five case studies of irrigated rice schemes (Senegal, Mauritania, Zanzibar, The Gambia and the Kou Valley in Upper Volta) and the example of the project in the Banfora region of Upper Volta which improved water control in the inland rice swamps, the development projects deliberately handed over the improved land to the male household heads even though in all these countries women had hitherto been exclusively responsible for rice cultivation and had often had independent rights to rice land. The projects did so on the assumption that the household forms a homogeneous unit and that women would automatically benefit from this land too. However, in no case did women benefit as much as the men and in the two Upper Volta schemes women actually lost some of their traditional land rights, with distressing consequences.

The basic problem (noted also by Cloud, 1982) is that as land is improved and its value increases there is a move from traditional communal use rights to a more individualized system of land ownership. Men, by virtue of their position as household head, tend to extend personal control over the land, squeezing out women. Inheritance practices, whereby land passes from father to son, reinforce male control of land, often depriving even widows with young children of rights of access to adequate land.

In the case of Senegal and Mauritania widows are assured the loan of their husband's irrigated rice land which is eventually inherited by their sons. However, in Madagascar women lost ownership rights to swamp land taken over and developed for irrigation at Lake Alaotra and then redistributed to the men. In the Banfora region of Upper Volta women have lost their independent access to rice land through the *chefs de terre.* The improved land was reallocated to male household heads on the assumption that they would sub-divide their plots between their wives since the latter are responsible for all the work. However, it is clear that men have every intention of maintaining close control over this land which has now increased greatly in value and which has been gratuitously given to them. The 'liberated' women[4] are, of necessity, lent plots but these are smaller than their former fields. Men are now attempting to reserve most of the remaining land for household rice crops, to be cultivated by the younger married women. In theory these women are supposed to be lent areas to grow their own rice but these appear to be very small and could not be easily delineated in the fields. Thus, the younger women who customarily worked three days out of five on the household upland crops and one day on their personal rice fields now often find that they are working four days out of five on crops controlled by the household head. They have no way of insisting on their right to their own day since they have little or no land on which to spend it.

Increase in women's labor

New rice technologies may save labor for some tasks, permitting an expansion of the area under cultivation which in turn increases the demand for labor for other farming operations. Irrigation introduces the possibility of double-cropping into a dry season that most African societies have customarily reserved for compound maintenance, non-farming income-earning activities, migrant labor and social obligations and ceremonies. The prevailing sexual division of agricultural labor means that these technologies are in effect sex-specific and that indiscriminate introduction of these technologies may distort the existing relative balance in labor demand for male and female tasks. The case studies indicate that to date more rice technologies have been introduced for men with negative consequences for women. In Madagascar mechanized plowing has reduced men's labor input in this task and permitted an expansion in the area under cultivation which has in turn increased demand for female labor in transplanting and weeding. The swamp rice development project in the Banfora region of Upper Volta imposes substantially more intensive cultivation practices (line transplanting, fertilizers, careful weeding, water control). Since rice production is entirely the women's responsibility, this has considerably increased their workload. At the same time they still have to give the same labor input on the upland crops with the result that they are now working harder and spending longer hours in the fields than before.

Double-cropping may well overburden women and they may derive little personal, material benefit from their increased work. This happens in all the case studies where the new dry-season crops are controlled by the men. Thus, in The Gambia women's unpaid work on a dry season household rice crop controlled by their husbands enables the men to save some of their groundnut cash income which they used to spend on supplementing household grain supplies or reduce the area under the male food crops of millet and sorghum to cultivate a larger groundnut field. The additional income belongs to them entirely and they may spend it as they wish.

Fofana (1982) reported considerably increased demand for female labor in the Geba irrigated rice project in Guinea Bissau. Men do little beyond visiting the rice fields from time to time while women now have to work as unpaid family labor for eleven out of twelve months on the rice crops, and are forced to forego their traditional dry season activities (pottery, vegetable cultivation, marketing, production of soap, palm oil and cotton thread) which assured them a personal income.

Certain programmes and projects (for example, in Zanzibar, the savannah region of the Ivory Coast, the settlements schemes in Mwea, Kenya and the Kou Valley, Upper Volta) are deliberately setting out to create a 'family farm' where the male household head will control female labor as well as all the capital resources and the crops produced. As we have seen, this is an entirely alien concept in most sub-Saharan countries and if such attempts are successful the consequences for women will be distressing. So far women are resisting these programmes in Ivory Coast and Zanzibar. However, in the settlement schemes they have little social or political support since they are cut off from their natal villages and with no access to land of their own in these schemes they have no practical way of asserting some independence. In Mwea this has resulted in increasing incidences of divorce and female migration from the settlement area (Hanger and Moris, 1973). In the Kou Valley, where there is considerable social pressure against divorce among the Mossi, women complain frequently to the female extension staff of their unhappiness and problems, but feel incapable of getting out of an oppressive situation.

In other countries, for example Ivory Coast, The Gambia, Senegal and Mauritania, the allocation of irrigated land to the men in effect requires the operation of a cooperative household unit to manage the more complex and intensive cultivation practices. However, where women have independent access to their own land for rainy-season crops (and to a lesser extent for the dry season) they are able to keep control of their own labor and devote it to their own crops. Thus, men with rights to irrigated land may not be able to cultivate this land at all in some seasons, or farming operations may be delayed beyond the optimum time because female labor is not available. Men's dependence on female labor is emphasized by the fact that they may have to pay even their own wives in order to get them to work for them. Thus, in The Gambia men frequently have to employ their wives and other village women for transplanting and weeding the irrigated rice crops. In Mauritania and Senegal household women are paid in cash or kind for harvesting, threshing and winnowing rice and for picking tomatoes.

The introduction of new rice technologies, particularly irrigation, which have led to an expansion of the area under cultivation and the possibility of double-cropping have generally led to an increase in demand for female wage labor. Although in Africa, in contrast to Asia, few households are landless, women sometimes have no or inadequate access to land on which to grow a personal crop to which they have a right. Such women are therefore eager to do wage laboring work to supplement their personal incomes. In the dry season this may be their only source of income since the irrigated land is usually male-controlled. In Madagascar poor women (especially widows) do laboring work on the irrigation schemes at Lake Alaotra. Gambian women earn extra money transplanting and weeding the men's rice fields, often working for the richer trader-farmers to repay cooking ingredients such as sugar and oil which they have borrowed on credit. In the Senegal River area of Senegal and Mauritania the Peulh and Wolof who have been severely hit by the continuing drought are able to eke out a precarious livelihood with wages earned on the irrigation schemes farmed mainly by the Toucouleur and Soninke. In Zanzibar where women are resisting cultivating irrigated land on their husband's behalf, wage laboring on the seed multiplication farm is popular, for the women control this income themselves. It should, however, be noted that in The Gambia, Senegal and Mauritania, for which data are available, women are paid less than men and the absolute wage rates are low. This raises a fundamental question about women's inability to protect their interests and resist exploitation.

In none of the case studies where men control the rice crop have they been prepared to pay for labor-saving equipment for women. This is particularly noticeable in the case of rice mills which even men observe would considerably lighten women's work in a most onerous task. Occasionally a businessman operates a mill and the women have to pay commercial rates for the service. In some cases, for example in The Gambia, women have no automatic rights to use men's equipment, such as donkey carts and seeders, without payment. Indeed, the rice seed plates for the commonly used seeder are not widely available in the country while those for the men's groundnut, millet and maize crops are easily obtainable.

In societies in which men are responsible for marketing the rice and controlling the income, women have no incentive to increase the area under cultivation or to intensify production since this would only increase their already substantial work load with no material benefit. Thus, the Zanzibar case study shows that women are not interested in joining an on-going rice project where all the benefits from their increased labor would accrue to their husbands. Development programmes now starting on rainfed rice in the forest area of Ivory Coast and among the Diola in the Casamance region of Senegal may well encounter a similar problem since women do most of the rice work but the crop is often controlled by the men (though with some variations between villages and according to ethnic differences).

Limited input supplies, marketing and services for women

All these case studies have indicated that inputs, marketing and services have generally been channelled through the men, even where women are the main users. This often means that women either do not know of the existence of possible improved inputs or, as in the case of the rice fertilizers given to men in Ivory Coast, the women rice farmers were not shown how and why to use them and simply threw them away or the men put the rice fertilizer on their cocoa crops.

The basic problem is that the majority of the extension services have no female staff and the male extension workers either know little about female crops (often upland or swamp rice) or prefer to meet male farmers. However, in most African countries, men and women have quite separate spheres of work and decision-making. Moreover, they rarely spend time in discussions together in the house or in public and, where there is a sexual division of labor between crops or farming operations, it is uncommon for them to be together in the fields. Thus, extension programmes aiming at improving the rice cultivation practices for which women are responsible need to work directly with the women farmers. Women themselves have extensive and efficient networks for disseminating information and giving each other samples of new seeds with which to experiment. It is not only a common sight to see this going on in villages at the start of the cultivation season, but it is clear that this information goes far beyond a single village. Since women often marry into other villages but return to their natal villages for various religious and social ceremonies. seeds, seed dressings, fertilizer and ideas are easily transferred. It was striking to note that in the Casamance women used Gambian seed varieties (one, for example, was called 'Banjul' and was also popular in the fresh water swamp area of The Gambia). In the Banfora region of Upper Volta the preferred rice variety is called 'Gambiaka', a name which attests to its origin.

Marketing proved to be a common problem in most of the case studies. All too often the buying officials turn up irregularly and while men have more leisure to wait around for a few days if necessary, women's domestic duties preclude them from doing so. The present alternative is for women to sell their rice locally (as among the Mandinka in the Casamance) but they then get a lower price because they are 'selling to relatives in need'. Why should men benefit from official market prices and the women sell at 'charity' prices?

Finally, credit is almost invariably channelled to men who are generally not prepared to take on the responsibility of guaranteeing loans to their wives since the men have no control over the women's crops. Credit institutions therefore need to be developed to reach women rice farmers who, indeed, have good records of repayment.

Rice projects, women's status and family welfare

Rice development programmes and projects which lead to a loss of women's traditional rights to rice land and to control a personal crop will have serious negative consequences for the women and their families. First, they would be unable to fulfil their customary obligations to their families, the core of which consists in the provision of vegetables, meat and fish as well as other cooking ingredients and condiments. Men have no obligation to make good their wives' inability to provide these things, as the extreme examples of the settlement schemes in Kenya and Upper Volta demonstrate. The inevitable result would be an impoverished diet, reinforcing malnutrition already so common in many countries.

Second, women would become economically dependent on their husbands for a whole range of things which they now provide themselves, such as clothes, cooking utensils, bedding, religious and ceremonial expenses, soap and personal items. Since men have no tradition of meeting these expenses, some may resist giving their wives adequate money.

Third, women derive considerable social and personal esteem from being good rice farmers; to deprive them of their independent role as rice farmers would lower their self-respect and undermine their social status. The inevitable consequences are already apparent in some countries. There is growing out-migration of dissatisfied women in the forest region of Ivory Coast, the Mwea Irrigation Scheme in Kenya and from among the Diola in the Casamance region of Senegal.

General recommendations

Recommendations for government policy

Governments need to:

1 Consider women's role in rice farming within the context of their multiple roles and obligations which include other cash and food crop production, additional income-generating activities, domestic work (pounding grain, fetching water and fuel, collecting wild leaves and fruits, washing, cleaning) and their reproductive and child-caring roles.

2 Strengthen and expand research on rice farming systems and women's roles within these, integrating macro and micro-level information.

3 Consult women rice farmers on their roles, constraints, needs and priorities in improving rice farming, post-harvest technologies, storage, marketing, input delivery and pricing.

4 Ensure that where women do all or most of the rice cultivation work but men market and control the crop, women are either given the right to control some of the rice land and crop or are least helped to develop other income-earning activities to compensate for their lack of benefit from the rice crop. Women will have little incentive to increase rice production and a marketable surplus if all the benefits accrue to the men and government's rice import-substitution policies will have little chance of meeting their objectives.

5 Give greater attention in implementation to the possible negative aspects of development at the village or household level. Otherwise, for issues such as land distribution, government in fact leaves the arena open to the stronger social groups – the socially or economically influential members – and women are unable to protect their own rights and interests. Indeed, any direct

action by women to fight to retain their traditional rights to land and other factors of production could be highly disruptive of family structures.

Recommendations for research

Research needs to concentrate on:

1. Breeding varieties that are resistant to shattering, lodging, pests and diseases, as well as climatic (drought, flash flood and submergence) and soil stress. Greater attention is also needed to other qualities such as duration, length of the stalks and palatability. These factors will only become apparent if research programmes are integrated much more tightly than at present within a farming systems approach that embraces socio-economic as well as technical aspects.
2. Increasing field-testing of new varieties, new cultivation techniques, etc. not only under farmers' conditions but by farmers themselves, discussing and experimenting together, taking full advantage of each other's experiences, skills and priorities. Particular attention need to be given to the views of women farmers who have been so long overlooked.
3. Greater coordination between research programmes and national development ministries and organizations at all levels so that more relevant and applicable research programmes are devised. Field-testing can also be carried out in collaboration with extension staff.

Recommendations for project design, delivery, monitoring and evaluation

Programmes and projects introducing new technologies for rice which include mechanization, new agronomic practices and inputs, water control and physical access to fields and markets, should take into account the following recommendations throughout the design, delivery, monitoring and evaluation phases:

1. Protect women's traditional rights to rice land and give them equal access with men to improved or irrigated land.
2. Ensure that new rice technologies which permit an expansion in area under cultivation or double-cropping do not increase women's workload to intolerable levels.
3. Develop appropriate labor-saving technologies for women for both agricultural and domestic work and ensure that these are made available to women through the extension services, on

credit if necessary, possibly disbursed through revolving funds, cooperative loans, etc.

4 Recruit female extension staff and train both these and male extension staff to work with women farmers.

5 Decentralize rice marketing structures so women can dispose of their own surplus produce at a convenient distance from home.

6 Recruit women as members of farmers' cooperatives or other organizations which are responsible for allocating improved rice land, negotiating loans for machinery and production inputs, marketing, etc. so that they can protect the women farmers' interests.

7 Establish monitoring and evaluation units in development projects which have the flexibility and power to modify or if necessary to change completely projects while they are being implemented. These should collect and take into account base-line data on both the division of labor by gender and the control of returns to labor. All too often projects are evaluated (confidentially) after completion, when the damage is irreparable.

Notes

1 Rice is indigenous to The Gambia/Guinea region of West Africa where *Oryza glaberrima* varieties were domesticated long before Asian varieties, *O. sativa* were introduced in the sixteenth century.

2 Benin, The Gambia, Guinea, Guinea Bissau, Ivory Coast, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo, Upper Volta.

3 The ethnic group called the 'Serahuli' in The Gambia are known as the 'Soninke' in Senegal and Mauritania.

4 This is said to be a literal translation of the term used in the indigenous language for older women who still live in their husbands' compounds but are entirely responsible for cultivating their own crops, feeding and clothing themselves, paying their own taxes in exchange for 'liberation' from their obligations to work on the household food and cash crops controlled by the male household heads and 'liberation' also from the marriage bed. The husband decides the timing of the 'liberation'.

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24 The mobilization of women's labor for cash crop production: a game theoretic approach

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In the last decade or so, economists have modeled phenomena such as household labor supply, fertility behavior, and child survival rates using the household as the unit of analysis. This paper presents data that call into question the assumption that the household is a joint decision-making unit which maximizes a neoclassical household utility function. The data come from a study of the mobilization of women's labor by their husbands for irrigated rice production in North Cameroon. The first section of this paper describes briefly the Massa rice and sorghum farming system and then considers the relationship between the amount of compensation women receive from their husbands for their labor on rice production and the amount of labor they allocate to rice production. The findings suggest that a bargaining model may describe the intrahousehold relations of production and distribution better than the neoclassical model. The second section specifies a Nash bargaining model and contrasts it with the neoclassical model of the household. Using the bargaining framework, the third section explores in more detail possible explanations of the allocative inefficiency which seems to characterize many of the rice-cultivating households.

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The mobilization of women's labor for irrigated rice production

Massa farmers cultivate irrigated rice under the direction of a World Bank financed project authority, SEMRY. Title to the irrigated rice land is vested in SEMRY; each year farmers sign up for fields, pay a fixed charge for inputs and are required to sell all but 10 per cent of their paddy to SEMRY at a fixed producer price. Farmers have the possibility of obtaining additional rice fields since a significant percentage of the irrigable paddy fields remain uncultivated each year.

Sorghum is the major food crop in the project area although rice is also consumed. Additional sorghum land is generally available and at present there is no rental market in sorghum land. Thus, there is a surplus of rice and sorghum land relative to the available labor supply in the project area. Even though the returns to labor from rice production are greater than those from sorghum in the period when the two crops compete for labor, all farmers continue to grow sorghum owing to their unwillingness to rely on the market for sorghum to meet their cereal needs.

Men and women have individual sorghum fields which they cultivate separately. Most of the sorghum from both men's and women's fields is home-consumed. Unlike sorghum fields, rice fields are almost invariably cultivated jointly by husband and wife. Even in the rare event that a woman registers for a rice field in her own name and cultivates it independently of her husband, she is still expected to turn over all the income from the sale of paddy to her husband who decides how it will be distributed. Men's ability to profit from their wives' labor depends, therefore, on denying women control over the disposition of the product of their labor.

Massa women consider the cash and paddy they receive from their husbands following the rice harvest to be compensation for their work on their husbands' fields. If a woman is given what she considers to be an insultingly small sum of money or no money at all, she will likely refuse to work on her husband's field the following year. Thus, both husband and wife recognize that her labor input is contingent upon the remuneration she expects to receive. The following regression is estimated to establish that there is a significant relationship between the amount of compensation women receive from their husbands and the number of days they worked on their husbands' rice fields:[1]

$$\begin{array}{llll} (1) & \text{COMPENSATION} = -1796 + 344(\text{DAYS}) & & R^2 = .67 \\ & \quad\text{(t-ratios)} \qquad\qquad\quad (.61) \qquad (7.26) & & F = 52.73 \end{array}$$

However, the estimated rate of compensation, 344 CFA/day, is rather low. Had women been paid for the labor they contributed at the hired labor wage rate for rice production,[2] they would have earned about

600 CFA/day. The average returns to rice labor are also in the 600 CFA/day range.

The amount of compensation that women receive is nevertheless somewhat greater than what they could have earned from their other income-generating activities throughout the rice cultivating season. To estimate the rates at which women were compensated for their transplanting, weeding and harvesting labor, the amount of compensation was regressed on the numbers of days they worked on each activity:

$$\text{(2)}\quad \text{COMPENSATION} = \underset{(0.4)}{142} + \underset{(3.12)}{450}\,(\text{TRANS}) + \underset{(2.32)}{335}\,(\text{WEED}) + \underset{(1.07)}{185}\,(\text{HARV})$$

(t-ratios)

$R^2 = .68$

$F = 17.21$

Rice and sorghum compete for labor during the period of rice transplanting and sorghum planting and weeding. Average returns to sorghum labor are in the 450-550 CFA/day range, which are similar to the wage rates paid for sorghum planting and first weeding labor[3] (compared to the 800 CFA/day paid for rice transplanting). Thus, the average rate of compensation for transplanting, 450 CFA/day. is probably equal to the opportunity cost of their sorghum planting and first weeding labor.

However, the rates at which women were compensated for their weeding and harvesting labor are greater than the opportunity cost of their labor. If women did not weed or harvest their husbands' rice fields, they would otherwise be earning income from beer brewing, fabrication of clay pots, petty commerce, etc., since rice weeding and harvesting do not compete with sorghum for labor. A survey of women's earnings in various periods throughout the year indicates that women rarely earn more than the equivalent of about 100 CFA/day even in relatively slack agricultural periods. This is less than the estimated weeding and harvesting intrahousehold compensation rates, 335 and 185 CFA/day. Thus, even though women have not captured a large share of the returns for their labor, in total their labor is not mobilized by their husbands at less than its opportunity cost.

It would seem, then, that once household subsistence sorghum needs are met, women would have sufficient incentive to allocate their labor to their husbands' rice production. However, the following data on women's labor allocation suggest otherwise. A comparison of the labor allocation pattern of widowed women,[4] who control the disposition of the product of their labor, with that of married women, whose husbands control the disposition, shows that the former spent 40 per cent more time transplanting, with a corresponding increase in area transplanted (per active household worker), than the latter. The additional transplanting that widowed women did was at the expense of the second weeding of their sorghum crops. Both groups spent the same amount of time planting and doing the first weeding of their sorghum fields. The small amount of sorghum production that married women would have sacrificed by not doing the second weeding of the sorghum fields could have easily been made up by retaining a slightly greater amount of paddy.[5] Thus, the underallocation of married women's time to transplanting (relative to widows') cost their households a significant amount of income, even considering the income they earned from the somewhat greater amount of sorghum they produced and from the nonagricultural income-generating activities they pursued instead of weeding and harvesting an additional rice field.

Thus, married women's households are allocatively inefficiently compared to widows' households. The above comparison suggests the hypothesis that if married women were compensated at a higher rate, they would allocate more labor to rice production. To explore this hypothesis the married women were divided into two groups on the basis of whether their households cultivated as much rice land per active household worker as the group of widowed women's households. As the following regression shows, the 15 per cent of the married women whose households cultivated as much rice land as the group of widows (and spent the same amount of time cultivating rice) were compensated at a higher rate than the rest of the married women whose households cultivated half as much rice land:

$$\text{(3)} \quad \underset{\text{(t-ratios)}}{\text{COMPENSATION}} = \underset{(.45)}{-175} + \underset{(6.04)}{299\,(\text{DAYS})} + \underset{(2.09)}{66\,(\text{DUMMY})} \qquad \underset{F=32.45}{R^2 = .74}$$

(where DUMMY is a dummy variable for the number of days worked by women whose households cultivated as much rice land as the widowed group). Apparently some rate of compensation greater than the opportunity cost of and less than the returns to married women's labor is sufficient for allocative efficiency to obtain.

In such situations, the intrahousehold distribution of income can be modeled as a mixed-interest cooperative game. In many areas of Africa women do not have independent access to the resources necessary for cash crop production. Although they have independent access to other income-generating resources, the returns for their labor are often lower than the returns for labor from cash cropping. Both husbands and wives can benefit, therefore, if women cooperate with their husbands on cash crop production as long as the share of the profits women receive is greater than the opportunity cost of their labor and less than the returns for their labor from cash crop production. In short, under such circumstances the agricultural household can be conceptualized as a bilateral monopoly in which the indeterminancy problem associated with the division of the gains is resolved by bargaining.

A game theoretic approach to the household utility function

This section develops a Nash bargaining model to illustrate the difference between the neoclassical and Nash household utility function. The following specification of the bargaining model reflects the farming system described above. As a result of a prior bargaining decision, it is assumed that husband and wife (h and w) allocate a fixed amount of time to household maintenance activities and also to producing some minimum quantity of sorghum. The remaining time, T_h and T_w, is available for income generating activities, which are restricted to rice and sorghum production, and leisure.

Bargaining models assume joint rationality.[6] Thus, if w decides to cooperate with h, she will allocate her labor to rice production since the returns for labor from rice production are greater than the returns for labor from sorghum production. The household earns $W_r (T_h + T_w — x_w — x_h)$ units of income, therefore, where w_r is the returns for labor from rice production (assumed to be constant because of the land surplus) and x_h and x_w are the amounts of leisure consumed by h and w.

It is assumed that income is allocated between h and w according to their responsibilities for specific categories of household expenditures (e.g., women purchase food, men buy cattle for bridewealth and pay taxes). However, men and women have different preferences regarding the optimal allocation of income among different categories of expenditure. Thus, each has a utility function of the form $U^i = U^i (Y_w, Y_h, x_i)$ for $i = w, h$, where Y_w and Y_h are the vectors of goods purchased by w and h at prices p_w and p_h. Although alternative specifications of the utility functions are possible this one best approximates the household expenditure pattern.

In the event of noncooperation, it is assumed that no transfer of income takes place between husband and wife, although each continues to be responsible for their particular household maintenance expenditures. The utility level f attains, therefore, is a function of the optimal quantity of goods and leisure she would purchase given the returns to her labor on sorghum production, w_s (assumed constant because of the land surplus) and prices p_w. Her level of utility also depends on the quantity of goods h purchases, but it is assumed that changes in his expenditures have no effect on the quantity of goods and leisure she purchases. h’s expenditures are a function of the prices of the goods he purchases, p_h, and the returns to his labor from rice production, w_r, since men can cultivate rice independently of their wives. This, w’s threat payoff is given by $U^w = U^w [Y_w (w_s, p_w), x_w (w_s, p_w), Y_h(w_r, P_h)]$, where Y_w and xw are the quantities which maximize U^w given (w_s , p_w). Her threat payoff can be represented by an indirect utility function $U^w = V^w(w_s, p_w, w_r, p_h)$ to emphasize that it is price dependent. Similarly, h's threat payoff is given by $V^h(w_s, p_w, w_r, p_h)$.

The optimal quantities of income and leisure w and h would purchase in the event of cooperation are determined by maximizing the Nash product of h's and w's gain from cooperation (where N is assumed to be strictly quasiconcave):

$$(4) \quad N = [U^w(Y_w, Y_h, x_w) - V^w(w_s, p_w, w_r, p_h)]$$

$$[U^h(Y_w, Y_h, x_h) - V^h(w_s, p_w, w_r, p_h)]$$

subject to the full income budget constraint

$$(5) \qquad p_w Y_w + p_h Y_h + w_r(x_w + x_h) = w_r(T_w + T_h).$$

The Nash household utility function given by (4) depends on the price of leisure, w_r, and the goods prices, p_w and p_h. If a utility function is price dependent, the associated demand equations do not in general have the usual neoclassical properties. In particular, the Slutsky substitution matrix need neither be symmetric nor negative semi-definite (Pollack, McElroy and Horney). As McElroy and Horney show for the Nash utility function, a change in one of the arguments of the threat payoffs twists the indifference map and changes the level of utility associated with each point of the indifference map. The failure of the Nash household utility function to satisfy the neoclassical restrictions confirms one's intuitive suspicion that when household members have different preferences household demand does not exhibit the rationality of an individual consumer.

Economists have taken two approaches to the construction of a household decision rule which satisfies the rationality postulates of neoclassical consumer preference theory. The first approach drops the Arrow nondictatorship condition, and the second weakens the informational constraints imposed by Arrow's impossibility theorem. The Arrow nondictatorship condition is violated if one household member's preferences determine the allocation of household resources and income or if all members have the same preferences (in which case any member of the household is an Arrow dictator).

As an alternative to the dictatorial household decision rule, Samuelson proposed the household social welfare function $U = U[u^1(x), u^2(x), \ldots, u^m(x)]$ where u^i is the utility function of the i^{th} household member defined over a vector of consumption goods x. The necessary optimality condition requires interpersonal comparisons of utility. Income (and time) are allocated among household members such that the weighted marginal utilities of all members' consumption are equal. Some mechanism is required, however, for maintaining the optimal distribution of income and time. Either one household members' interdependent utility function must dictate the intrahousehold allocation of income and time, or all household members must have identical interdependent utility functions. Thus, the household social welfare function still requires dictatorship in the Arrow sense, by fiat or consensus, albeit at a higher logical level.

However powerful (and benevolent) one household member may be, it is unlikely that his or her power is exercised absolutely. It is equally unlikely that all household members have identical preferences regarding the intrahousehold terms of exchange, particularly when the terms of exchange are unequal as they often are. A more realistic conceptualization of intrahousehold dynamics is thus in order. The premise of this paper is that the terms under which goods, income, and services are exchanged among household members can be better represented by a mixed-interest cooperative game model which assumes that household members benefit from an exchange of goods and services but have different socially constructed preferences regarding the intrahousehold terms of exchange. The threat payoffs reflect the existing disparities in the social and economic status of various household members. Their specification is a means, therefore, of incorporating intrahousehold power relations into the household utility function.

Massa household allocative inefficiency

The neoclassical model of the household assumes that household members do not have conflicting interests over the allocation of time and income (or if they do, that such conflicts are resolved by the imposition of one member's utility function). This assumption implies that joint rationality will always prevail when the household is presented with new economic opportunities. The bargaining model, on the other hand, predicts that resources will be efficiently allocated only when household members cannot rationally (i.e. according to the mutually observed bargaining rule) expect other members to make further concessions. This suggests that the married Massa women allocate their labor inefficiently because they are holding out – striking as it were – for a higher rate of compensation.

As became apparent through interviews with men and women and observations, there is frequent and sometimes pronounced conflict between men and women over the division of income from rice production. Men have traditionally had the right to appropriate any income earned by their wives. Men's interest in using their wives' income, usually for the purchase of livestock for bridewealth payments, conflicts at the margin with women's interest in using the income to purchase consumer goods which have become increasingly more available and socially necessary since the advent of rice cultivation. Furthermore, the conflict over remuneration is not unique to the SEMRY project (Etienne, Guyer).

However, some households have apparently been able to compromise on a sufficiently high rate of compensation that allocative efficiency obtains. The more allocatively efficient households appear to be structurally differentiated from the inefficient ones. Senior wives from polygynous households and women whose husbands still owe bride-wealth to their wives' families seem to be over-represented in the allocatively efficient group of married women. (The evidence for the latter category at this point is indirect, however.) A husband who still owes bridewealth is under a great deal of pressure (as is his wife) to complete the transfer of the bridewealth cattle. He can ill-afford to dispute his wife's right to compensation since he needs the additional income that he receives from his wife's labor on a second rice field. Similarly, a husband may also be less inclined to dispute the right of his senior wife to compensation, given the higher status generally accorded a senior wife whose many years of labor have aided him to accumulate enough cattle to marry two or three other women. It is precisely the households in which the husband is struggling to acquire a second wife that there is likely to be the greatest conflict between husband and wife over the division of income from rice production and the greatest probability, therefore, of allocative inefficiency.

The aim of this paper has been to challenge the neoclassical assumption that conflict over the distribution of effort and reward has no effect on household resource allocation. It sets out the framework for an alternative model of the household based on mixed-interest cooperative game theory which, unlike the neoclassical model, explains how the intrahousehold terms of exchange are determined. If conflicts between household members over the intrahousehold terms of exchange are not resolved, however, then joint rationality need not prevail, as the data on Massa women's labor allocation suggest. The challenge for economists is to understand the dynamics of the bargaining process by which an almost-noncooperative game is transformed into a cooperative one. It is crucial to understand the factors which influence the time span over which convergence to the equilibrium terms of exchange takes place in order to make predictions about household resource allocation in response to agricultural change. Assuming that household resource allocation is dictatorially determined may be analytically convenient, but more attention on the part of economists to the process by which household members arrive at a division of labor, leisure, income and goods may point out the inadequacies of such an assumption – not only for households in Africa but for others as well.

Notes

The field research on which this paper is based was carried out in the SEMRY project area from December 1980 through to January 1982 under USAID contract AID/afr-c-l610. The comments of G. Hart, M. McPherson, P. Peters and L. Salinger on this paper are greatly appreciated.

1 The sample consists of 24 married women randomly chosen from one village in the project area and stratified into two groups of 12 women on the basis of whether their households cultivated less than a half hectare of rice per active worker. These women were interviewed every other day to increase the accuracy of the labor allocation data to compensate for the small sample size. Their labor allocation was standardized to ten-hour days to reflect the average length of women's workday in rice production.

2 Households generally hire labor to replace ill household members, when they want to finish a task quickly, etc., but only about 10 per cent of the total labor input is provided by hired labor, mostly female. Women may take several days off from working on their husbands' fields to work as hired labor when they need to earn cash. Otherwise, they are expected to work on their husbands' fields when they are not working on their own sorghum fields. The only married women who worked more than several days as hired labor were those whose husbands gave them little compensation for their labor the preceding year.

3 Labor is occasionally hired for sorghum cultivation in villages which are located at some distance from the rice fields. People from these villages have little incentive to take advantage of the higher wage rate paid for transplanting because of the time required to walk to the rice fields.

4 The sample of widows consisted of 12 women from the same village as the sample of 24 married women described above. Several of the 12 were actually married women who were the effective heads of their households since their husbands were quite old or otherwise incapacitated.

5 Married and widowed women have the same number of children residing with them: 1.4 and 1.6 respectively ($t = .42$), so that their subsistence needs were approximately the same.

6 In the context of the household, joint rationality implies that the household operates on its production possibility frontier. This means, for example, that the household allocates its labor time to maximize household income.

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25 Improved rice varieties in retrospect and prospect

Gurdev S. Khush

Rice varieties grown in the tropics and subtropics in the earlier years of this century were tall, photoperiod sensitive, non-responsive to fertilizer and were by and large susceptible to common diseases and pests. These varieties were grown in rice monoculture without any fertilizer and were planted with the onset of monsoons and harvested after the rains had stopped. Thus these varieties occupied the fields for 6-8 months. Under the conditions of low management, diseases and insects rarely became serious. However, population increases led to the cultivation of rice during the non monsoon seasons in several countries and non-photoperiod sensitive varieties were developed. These traditional photoperiod sensitive and non-sensitive varieties were of tall stature (150-170 cm) and lodged when fertilizers were applied. Lodged crop generally yields less than the non-lodged crop. Thus when fertilizers are used on the tall traditional varieties their yields are actually lower than the unfertilized crop.

This defect of the tall rice varieties was rectified by developing short statured varieties with sturdy stems exemplified by IR8 and similar varieties developed by national rice improvement programs. These varieties have short stature (90-100 cm), high tillering ability, sturdy stems, dark green and erect leaves and respond to nitrogen fertilizers.

Moreover, these are photoperiod insensitive and can be planted any time of the year in the tropics and subtropics. The grain/straw ratio in the improved varieties is 0.45:0.55 as compared to 0.30:0.70 in the old varieties. Moreover the improved varieties produce greater biomass than traditional varieties. Owing to their greater capacity for biomass production, favorable grain straw ratio and nitrogen responsiveness, improved varieties have much higher yield potential as compared to traditional rice varieties. These earlier improved varieties mature in 130-145 days.

The drawbacks of the earlier improved varieties were their poor grain quality and susceptibility to diseases and insects. Immediate attention was paid to the improvement of grain quality and varieties like IR20, IR22 and IR24 with grains which have better appearance and higher milling recovery were developed. These were followed by IR26 which has multiple resistance to major diseases and insects. Attention was then shifted to developing varieties with shorter growth duration and a series of short duration varieties with high yield potential and multiple disease and insect resistance such as IR28, IR30, IR36 and IR50 which mature in 105-110 days, were developed (Tables 25.1 and 25.2).

Table 25.1 Main characteristics of IR varieties.

Variety	Recommended for	Growth duration (days)	Height (cm)	Grain quality: Amylose content	Gel temperature	Grain size and appearance
IR5	Rainfed	140	130	High	Intermediate	Med. long bold
IR8	Irrigated	130	100	High	Low	Long bold
IR20	Irrigated	125	110	High	Intermediate	Med. long slender
IR22	Irrigated	125	90	High	Low	Long slender
IR24	Irrigated	120	90	Low	Low	Long slender
IR26	Irrigated	130	100	High	Low	Med. long slender
IR28	Irrigated	105	100	High	Low	Long slender
IR29	Irrigated	115	100	Glutinous	Low	Long slender
IR30	Irrigated	110	100	High	Intermediate	Med. long slender
IR32	Irrigated	140	105	High	Intermediate	Long slender
IR34	Irrigated	130	125	High	Low	Long slender
IR36	Irrigated	110	85	High	Intermediate	Long slender
IR38	Irrigated	125	100	High	Intermediate	Long slender
IR40	Irrigated	120	100	High	Intermediate	Med. long slender
IR42	Irrigated	135	110	High	Low	Med. long slender
IR43	Upland	125	110	Low	Low	Long slender
IR44	Irrigated	130	110	High	Low	Long slender
IR45	Upland	125	100	High	Intermediate	Long slender
IR46	Rainfed	130	110	High	Intermediate	Long slender
IR48	Irrigated	140	120	Intermediate	Low	Long slender
IR50	Irrigated	105	90	High	Intermediate	Long slender
IR52	Rainfed	115	95	High	Low	Long slender
IR54	Irrigated	120	95	High	Low	Long slender
IR56	Irrigated	110	90	High	Low	Long slender
IR58	Irrigated	100	80	High	Low	Med. long slender
IR60	Irrigated	108	95	High	Low	Long slender

Table 25.2 Disease and insect reactions of IR varieties in the Philippines.

Variety	Growth duration (days)	Blast	Bacterial blight	Grassy stunt	Tungro	BPH biotypes 1	2	3	GLH	Stern borer	Gall midge
IR5	140	MR	S	S	S	S	S	S	MR	MS	S
IR8	130	S	S	S	S	S	S	S	MR	S	S
IR20	125	MR	R	S	MR	S	S	S	MR	MR	S
IR23	125	S	R	S	S	S	S	S	S	S	S
IR24	120	S	S	S	S	S	S	S	MR	S	S
IR26	130	MR	R	S	MR	R	S	R	MR	MR	S
IR28	105	R	R	R	R	R	S	R	R	S	S
1R29	115	R	R	R	R	R	S	R	R	S	S
IR30	110	MS	R	R	R	R	S	R	R	MR	S
IR32	140	MR	R	R	R	R	R	MR	MR	MR	S
IR34	130	R	R	R	R	R	S	R	R	MR	S
IR36	110	R	R	R	R	R	R	MR	MR	MR	R
IR38	125	R	R	R	R	R	R	MR	R	MR	R
IR40	120	R	R	R	R	R	MR	S	MR	MR	R
IR42	135	R	R	R	R	R	R	S	MR	MR	R
IR44	130	MR	R	S	R	R	R	MR	MR	MR	S
IR46	130	R	R	S	R	R	R	R	MR	S	S
IR48	140	MR	R	R	R	R	R	S	MR	S	S
IR50	105	MS	R	R	R	R	R	MR	R	MR	S
IR52	115	MR	R	R	R	R	R	S	R	MR	–
IR54	120	R	R	R	R	R	R	S	R	MR	–
IR56	110	R	R	R	R	R	R	R	R	MR	–
IR58	100	R	R	R	R	R	R	R	R	MR	–

S = susceptible, R = resistant, M = moderately

National rice improvement programs similarly developed short duration varieties such as Ratna, Chandina, BG34-8 and TN73-2. The short duration varieties have been widely accepted and their large scale adoption has led to crop intensification in many irrigated and rainfed areas. Early maturing IR36 is now the most widely planted variety of rice in the world and is planted to more than 10 million ha. of rice land annually. No other variety of any food crop has been planted that widely before.

To date improved rice varieties have been primarily adopted on the irrigated lands or under some of the rainfed environments with optimum rainfall and good water control. Approximately 50 per cent of the rice area in South and Southeast Asia is not irrigated and only traditional varieties are grown in these areas. The twin challenges of rice improvement which rice breeders are now facing are:

(a) continued yield stability under irrigated environments, further increase in the yield potential, reduction in the growth duration and further improvement of grain quality of varieties for irrigated conditions; and

(b) development of improved varieties for the unfavorable environments.

Future rice varieties for favorable environments

Major emphasis will continue on the development of varieties with even shorter growth duration. Breeding lines which mature in 95-100 days have been developed. These are 10-15 days earlier than IR36 and produce high yields. However, their per day productivity is much higher (Table 25.3). During the dry season of 1981 at IRRI farm, the yields of IR42 (135 days), IR36 (108 days) and IR58 (100 days) were quite similar but the per day productivity (kg/day) was 60, 80 and 98 respectively. It is anticipated that short duration varieties will be planted to most of the lands with irrigation and good water control.

Table 25.3 Yield of promising early maturing lines in replicated yield trials conducted during 1981 dry and wet seasons at IRRI, Plant Breeding Department.

Selection	Growth duration (days)	Dry Season		Wet Season	
		Yield (t/ha.)	Yield per field day (kg.)	Yield (t/ha.)	Yield per field day (kg.)
IR8455-78-1-3	100	6.2	79	4.6	59
IR9729-67-3	100	7.2	92	5.1	65
IR9752-71-3-2 (IR58)	98	7.5	98	4.7	62
IR15429-268-1-2	97	6.8	91	5.1	68
IR19729-5-1-1-2	97	6.1	81	4.3	57
IR19735-5-2-3-2	100	6.5	83	4.9	63
IR19743-25-2-2-3	96	6.4	86	4.6	62
IR19743-40-3-3-2	97	5.8	77	4.6	61
IR19746-28-2-2-3	97	6.0	80	4.5	60
IR36 (check)	108	6.9	80	4.7	55
IR42 (check)	135	6.8	60	4.8	42

Improved cultural practices such as higher plant populations, high levels of fertilizers, good water management and weed control meant for higher production unfortunately also encourage the build up of disease and insect organisms. Thus at higher levels of productivity disease and insect problems become serious. Varietal resistance has been adopted as the basic component of the integrated disease and insect control strategies and varieties with multiple resistance to as many as four diseases and four insects have been developed (Table 25.2). However, some of the insects and diseases such as brown planthopper and blast are quite variable and develop new biotypes or races which overcome resistance. Thus development of varieties with diverse genes for resistance and identification of new genes for resistance will continue to demand major attention from rice improvement scientists.

Most of the improved varieties have high amylose content. However, varieties with intermediate amylose content are preferred in all the countries of South and Southeast Asia. It is hoped that most of the improved varieties of the future will have intermediate amylose content and will be much more palatable. Improved aromatic varieties will also be available.

Research on the ways and means of improving the yield potential of improved varieties will continue. Further yield increase will occur through improvement in the crop growth rates resulting in higher biomass production and improvements in grain straw ratio of 0.45:0.55 in the present varieties to 0.55:0.45 in the future varieties. F_1 hybrids with better growth rates and better grain straw ratio will also become available.

Rice varieties for unfavorable environments

Improved short statured varieties are not suitable for unfavorable environments which include rainfed lowland, deepwater, tidal wetland and upland areas. Efforts are under way to develop improved plant type prototypes and test them under particular environments. However, widely adapted improved varieties for these environments are still not available. Concerted efforts for raising the productivity of these environments through the development of improved cultivars and management practices will continue.

Discussion following

Women are the main harvesters of ratoon rice in the Philippines. As a consequence of double cropping, ratoon rice is decreasing. How is the ratoonability of new IRRI varieties and what work is IRRI doing with ratoon rice?

Of the IR varieties, IR28, IR56 and IR58 have the best ratoonability. We are regularly screening our advanced breeding lines for ratoonability. To date we have been unable to find good ratooners.

Farmers often grow a small area of the local variety for quality reasons. How does IRRI involve consumers in their research so that new varieties are more palatable?

All the advanced breeding lines are evaluated by a consumer panel and only those with acceptable ratings are considered for varietal release.

How does IRRI allocate resources to different breeding programs such as hybrid, upland, deepwater, etc.?

We have five rice breeders at IRRI. One breeder works on irrigated rice, one on rainfed lowland rice, one on deepwater rice, one on upland rice and one on hybrid rice.

Explain how amylose affects cooking quality.

Varieties with high amylose content cook dry and fluffy. Varieties with low amylose content are sticky when cooked. However, varieties with intermediate amylose content cook moist and are not sticky and are therefore preferred by consumers in tropical and subtropical Asia.

26 Hybrid rice

S. S. Virmani and Amanda Te

Background

Hybrid breeding technology exploits the phenomenon of hybrid vigor i.e., the tendency for the offspring of crossed varieties to have greater productivity or superior performance than the parental varieties. It involves raising commercial crop from F_1 (first filial generation) seeds.

Hybrid rice technology aims to increase yield potential of rice varieties beyond the level obtained by improved plant type semi-dwarf varieties. Focus on breeding rice varieties for higher yield potential is essential as the land:per person ratio is decreasing with increasing population, and we need to grow more on less land to meet the world food demand during the next two decades. Besides, the cost of irrigation is getting higher and, therefore, agricultural development experts suggest increasing rice production potential in the existing irrigated area.

This technology has been successfully developed and used in the People's Republic of China, where about 6 million ha. are currently planted to hybrid rices and hybrids have shown about 20 per cent higher yields than the best semi-dwarf commercial varieties under irrigated conditions. Hybrid-rice varieties currently used in China are not suited to the tropics, however. The success of hybrid rice in China encouraged IRRI to intensify research on hybrid rice in 1979 with the objective of exploring the prospects and problems of using this technology to increase rice yield potential in the tropics.

The technology

Rice, being a strictly self-pollinating crop. requires specific genetic tools to develop F_1 hybrids. These include: cytoplasmic-genetic male sterile (CMS) (A), maintainer (B) and restorer (R) lines. Breeders breed and/or select 'A' and 'R' lines to develop the desired hybrid combinations. Once these combinations are developed, their seed has to be produced in bulk quantities to supply the farmers. The hybrid seed production involves three steps: multiplication of 'A' lines; multiplication of 'B' and 'R' lines; and production of hybrid (A x R) seed. Multiplication of 'B' and 'R' lines is done in the same manner as with the conventionally bred varieties; however, multiplication of 'A' line and production of hybrid (A x R) seed required specialized methods.

Research at IRRI, in collaboration with some national rice improvement programs has shown the yield superiority of the F_1 hybrids over check varieties by a margin of 14 to 34 per cent in trials conducted at IRRI farm and 7 to 48 per cent in trials conducted in collaborating countries, i.e. Indonesia, India, and South Korea. F_1 hybrids were also found superior to check varieties for productivity per day. The available genetic tools (CMS, maintainer and restorer lines) essential to develop F_1 rice hybrids need to be adapted to tropical conditions. Techniques of CMS line multiplication and hybrid seed production as practised in China appear to be adaptable in the tropics. Given adequate support, it should be possible to develop and/or identify suitable parental materials and hybrid combinations within 3-4 years. However, it may take up to 5 years to perfect and adopt the seed production technology for hybrid rice in the tropics. If everything works well, rice hybrids should reach farmers in the late 1980s or early 1990s.

The problems

The major difficulty in the acceptance of hybrid rice technology is the necessity to buy hybrid seed every crop season and its extra cost. The extent to which the labor-intensive and time-consuming techniques of hybrid seed production developed in China can be adopted elsewhere is uncertain. In the absence of comprehensive analytical data on hybrid rice seed production and cultivation in China, many countries are skeptical about the economics of hybrid rice. Besides, many rice producing countries do not have an efficient organizational set-up to produce, certify and market hybrid seed.

Potential economic impact

Results from China and IRRI have established clearly that hybrid rices yield higher than the non-hybrid varieties and therefore can help countries to increase their rice production in irrigated areas. However, whether or not this yield advantage can be translated into economic advantage depends to a large extent on the price of rice. This has been shown in a study on economics of hybrid rice in China.

Higher yield in hybrid rice may also provide opportunities for increased women's participation in harvest and post-harvest operations.

Hybrid seed production is labor intensive, and some of the operations such as flag-leaf cutting could be done by women. This could result in increased employment opportunities for rural women. Besides, hybrid seed is more expensive, and there is every incentive to economize on the seed rate. Consequently, good seed bed preparation and transplanting operations will be necessary components of hybrid rice cultivation. In areas experiencing labor shortage during the planting season, a shift to hybrid rice technology may not be an attractive proposition. However, since women contribute most of the labor in transplanting, the adoption of hybrid rice could mean the preservation of women's present source of income or even an expansion of their employment opportunities.

Since hybrid seeds are usually more expensive, farmers with cash-constraints, both large and small, may not be well disposed to its adoption.

Conclusion

Hybrid rice technology could be adopted under irrigated conditions where farmers are already getting high yield and can provide the necessary inputs and where the labor cost is not high. Prospects of adoption would depend on the magnitude of the yield advantage obtained, the cost/benefit ratio using hybrid versus pure line seeds, and the efficiency of seed production, certification and distribution agencies available in the country.

Discussion following

What kind of national level institutional infrastructure is most appropriate to the introduction and spread of hybrid rice technology?

Introduction and spread of hybrid rice technology would require an organized seed production, certification and distribution program in a country. This responsibility can be assigned to public sector institutions (for example: National Seeds Corporation and Provincial Seeds Corporations in India). The foundation seed production of the parental lines can be done at the Government Seed Farms under strict supervision of the staff of the National Seeds Corporations. The certified hybrid seed can be produced by registered seed growers under the guidance and supervision of the staff of National Seeds Corporation. The latter would also certify the purity of hybrid seeds and would market the pure seed at a premium price. This price would take into account the seed production cost, the profit of the seed producers and overhead charges of the National Seed Corporation.

The responsibility for hybrid seed production can also be given to a private sector seed company which will produce the hybrid seed under their supervision through selected seed growers. They will have to ensure seed purity in order to remain in business.

Ideally, both public and private sector institutions can be asked to produce hybrid seed as they would provide check and fair competition for each other.

What is the role of the private sector in hybrid seed production and distribution?

The private sector can undertake hybrid seed production more efficiently provided the Government takes necessary measures to ensure that the situation is not exploited.

How can the woman’s role be maintained in either government or private enterprise in hybrid rice production?

There is no doubt that hybrid rice seed production would require an increased labor force. Since certain operations viz., careful transplanting of the parental lines, clipping of the flag leaves, supplementary pollination by ‘rope pulling’ or ‘stick’ method, harvesting and post-harvest handling of seed can be done better with a female labor force, in all probability both government and private enterprise should use an increased female labor force for hybrid rice seed production.

What is the likely cost of hybrid rice and, if it is high, how will this be accepted by the farming community?

In China the price of hybrid rice seed ranges 6-10 times that of seeds of non-hybrid varieties. Outside China, hybrid seed may cost about that much depending upon the labor wages in a country. The extra investment on hybrid seed would depend on what extent seed rate of hybrid may be reduced. It may range between US $30-40 per hectare. If the hybrids can outyield the non-hybrid varieties by a margin of about 1 t/ha. (equivalent to $150-200), the extra cost of hybrid rice seed may be acceptable to the farmers.

Is it possible that the unique political and social structure in China make it possible to introduce hybrid rice there, but that the situation will be different in other countries?

No. India is growing F_1 hybrids of corn, sorghum, pearl millet and cotton quite extensively under a democratic set up. Hence, in my view. there is no relationship between the success of hybrid technology and the political and social structure in a country. The key factor to the introduction of F_1 rice hybrids in India and other developing countries would be the extent of yield advantage of hybrids in the farmers' field vis-a-vis the extra cost of hybrid seed.

What types of additional labor are involved and how can the different types of activities be allocated among men and women?

Additional labor in hybrid rice technology is involved primarily in operations of hybrid seed production. These include staggered transplanting, better agronomic management, flag leaf clipping at flowering. spraying of gibberellic acid, supplementary pollination, separate harvesting of male and female parents, cleaning and bagging of hybrid seed. These operations can be done both by men and women. Depending on the demand and supply of women's labor in a given situation, the hybrid rice technology could affect women's employment opportunities.

27 Wet-seeded rice

K. Moody and V.G. Cordova

Introduction

Wet seeding (sowing pregerminated seed onto puddled soil) which is a major system of rice (*Oryza sativa* L.) culture in Sri Lanka (De Datta, 1980) is also used in other parts of the tropics and subtropics. It is increasing in importance in a number of countries in southeast Asia including Malaysia, Thailand, and the Philippines.

Wet seeding is not a new method of crop establishment. Before transplanting became the accepted practice of growing rice under wetland conditions in the Philippines, wet seeding was traditionally used by farmers (Imperial, 1980). In the Bicol region in the Philippines, wet seeding has been practised since pre-hispanic times (Mandac et al., 1982). The shift to transplanting occurred because of the problems with weed control in wet-seeded rice. Recently, because of increased labor costs and the introduction of herbicides which are effective for weed control in wet-seeded rice there has been an increasing trend to revert back to wet seeding as a method of rice crop establishment. However, Mandac et al. (1982) noted that wet seeding was not a recent response to labor shortages or higher labor costs in rainfed areas of Bicol but suspected that the decision to wet seed or transplant was principally determined by biophysical, not economic parameters.

Castin and Moody (1979) estimated that the total area sown to wet-seeded rice in the Philippines was in excess of 400,000 ha. In the Western Visayas, land planted to wet-seeded rice in 1980 increased by 9 per cent over that planted in 1979 (Arceo and Mercado, 1981). In Central Luzon, the percentage of farmers sowing wet-seeded rice increased from less than 2 per cent in 1979 to 16 per cent in 1982 (Cordova, unpublished).

In the Muda irrigation project area on the northwest coast of Peninsular Malaysia, wet seeding has been introduced in 4 per cent of the area independently by the farmers during the dry season because of increases in production costs and shortage of labor for transplanting (Sugimoto et al., 1983).

Wet seeding of rice will become an increasingly attractive alternative to transplanted rice as the cost of labor rises, as less expensive selective herbicides become available, and as water control improves (De Datta, 1977).

Landscape position

Mandac and Flinn (1983) reported that in rainfed areas in the Bicol region, a significantly higher proportion of rice grown on the plateau was wet seeded while a significantly higher proportion of the plain and bottomlands was transplanted. For the first crop, 72 per cent of the plateau was wet seeded and 90 per cent and 75 per cent of the plain and bottomlands, respectively, was transplanted. For the second crop, 80 per cent of the plateau was wet seeded while 45 per cent and 50 per cent of the plain and bottomlands, respectively, were transplanted. Thus, while cropping patterns consisting of two transplanted rice crops in sequence dominated on the bottomlands and two wet-seeded rice crops in sequence dominated on the plateau, cropping patterns consisting of two transplanted crops in sequence and transplanted rice followed by wet-seeded rice occurred with equal regularity on the plain.

In Miag-ao, Iloilo, Philippines rainfall and landscape position influenced crop establishment method (Chawla et al., 1982). For example, in the plain, farmers were prepared to wet seed unless they were in areas of flooding. On the terraces, farmers tended to transplant traditional cultivars.

Land preparation

Land preparation operations are essentially the same for transplanted and wet-seeded rice. Levelling of the field is more important in wet-seeded rice than in transplanted rice as developing rice seedlings can be killed or greatly retarded in their growth when ponding of water occurs (Moody, 1977b). However, in the Philippines, the time spent for land preparation for wet-seeded rice is less than that for transplanted rice (Magbanua et al., 1977; Roxas et al., 1978,) (Table 27.1). De Datta (1982) stated that where rainfall distribution is good and farmers can puddle the field quickly and thoroughly, it is often desirable to wet seed rice.

In rainfed fields, the duration of water in the field is directly correlated to the quality of land preparation.

Table 27.1 Comparison of labor inputs (days per hectare) for wet-seeded and transplanted rice. Camarines Sur, Philippines, 1980/81. (Adapted from Mandac et al., 1982).

Activity	First Crop Wet-seeded	First Crop Transplanted	Second Crop Wet-seeded	Second Crop Transplanted
Land preparation	25.7	38.0	17.1	24.5
Planting	1.5	22.8	1.3	10.8
Weeding	4.4	9.6	1.0	0.5
Harvesting and threshing	16.3	24.4	20.4	26.6
Fertilizer and chemical application	0.6	1.1	0.7	0.8
Others	6.0	7.5	2.6	6.5
Total	54.5	103.4	43.1	79.7

Water management

Prior to seeding, excess water is drained from the field to ensure good seedling establishment. Excess water in the field at planting affects rice seed germination and seedling establishment. Germination may be affected further if the water is muddy. The settling mud may cover the seed and cause reduced emergence (Mabbayad and Obordo, 1970).

Heavy rains causing flooding of the field before the seedlings have rooted in the mud may result in floating of the seed which will reduce plant stand. In rainfed areas, the farmer is reluctant to drain water from his field because of the uncertainty of rainfall (Moody, 1982). By so doing, he may subject his crop to drought at a critical growth stage.

Good field drainage and good water control are essential for wet-seeded rice establishment.

Cultivar grown

In Miag-ao, almost all the traditional cultivars were transplanted while modern cultivars were both transplanted and wet seeded (Chawla et al., 1982). De Datta (1981) stated that early maturing rice cultivars (about 100-day duration) were preferred for wet-seeded rice. Such cultivars should have excellent seedling vigor and good tillering capacity.

Seeding rate

The amount of seed used is usually greater for wet-seeded rice than for transplanted rice. Optimum seeding rates for wet-seeded rice range from 50 to 100 kg/ha. (Xuan and Ross, 1976).

In Miag-ao, the savings in labor as a result of wet seeding more than offset the cost of increasing the seed rate from 50 kg/ha. for transplanted rice to 75 kg/ha. when the crop is wet seeded (Chawla et al., 1982). In Central Luzon, seeding rates are higher and differences between wet-seeded rice and transplanted rice are greater. Cordova (unpublished) found that the seeding rate for transplanted rice was 113 kg/ha. and that for wet-seeded rice was 203 kg/ha.; the cost of seed being $13.91 higher for wet-seeded rice. In contrast, in Malaysia, the average seed rate for wet seeding was 27.3 kg/ha. (Sugimoto et al., 1983).

Seeding rates used in wet-seeded rice are generally high to help control weeds. In the Philippines, rates of 150 kg/ha. are not uncommon and rates as high as 400 kg/ha. have been used (Moody, 1977a). Moody (1977b) reported a significant decrease in weed weight as the seeding rate increased from 50 to 200 kg/ha. Broadleaf weeds were the most affected by the increase in seeding rate and sedges the least affected. Even though the use of such high rates may not be economic, the farmer is reluctant to use lower rates because of increased problems with weeds. The introduction of herbicides with broad spectrum weed control will probably result in a reduction in seeding rate.

Planting

Wet seeding reduces substantially the labor required for planting. It eliminates the use of seedlings and related operations such as seedbed preparation, care of seedlings, pulling, transporting, and transplanting seedlings (Arceo and Mercado, 1981). With wet seeding, rice seeds are soaked in water for 24 hours and then incubated for at least 24 hours before sowing them usually by broadcasting onto the well-puddled soil.

In Miag-ao, establishment of transplanted rice took an average of 18.4 man-days/ha. while for wet seeding the time taken was considerably less (Chawla et al., 1982).

In rainfed rice in the Bicol region, three operations (land preparation, transplanting, and harvesting and threshing) accounted for more than 80 per cent of the labor used (Table 27.1). Minimal quantities of labor were used for crop maintenance (Mandac et al., 1982). Labor use for the first transplanted rice crop was 103.4 days/ha. Significantly less labor (54.5 days/ha.) was used for the first wet-seeded crop mainly because transplanting is more labor intensive than wet seeding. In the second crop, labor inputs were less than for the first crop, the transplanted crop required 79.7 days/ha.; the wet-seeded crop 43.1 days/ha. (Mandac et al., 1982).

When averaged over both crops, planting wet-seeded rice required 20.4 days/ha. less labor than transplanted rice; a saving of $27.82 at present wage rates. Cordova (unpublished) found similar results for Central Luzon, Philippines.

Straight row planting facilitates the removal of weeds either by the use of a rotary weeder pushed between the rows or by allowing hand weeders to distinguish easily between weeds and rice. A hand pushed rotary weeder reduces weeding time by about 50 per cent.

In Malaysia, yields from a row-seeded crop were equal to those from a broadcast-seeded crop on an organic clay soil. However, on a heavy clay soil, yields were lower when the crop was row-seeded (Wah et al., 1982). The locally available seeder was not sufficiently versatile to permit its use on a wide variety of soil types.

At IRRI, the Department of Agricultural Engineering is developing a row-seeder for wet-seeded rice. This is still in the experimental stage. Estimated cost of manufacture in the Philippines is about $.55.

Pests

Rodents and birds

According to Mabbayad and Obordo (1970), rats and birds pose the greatest menace to germinating wet-seeded rice. This problem may be significant if only a few farmers sow wet-seeded rice. If, however, a large number of farmers respond to the labor scarcity and cost involved in transplanting rice by wet seeding then the problem caused by rodents and birds would be greatly reduced. High seeding rates are also used to compensate for damage by these pests.

Insects

In Victoria, Laguna, Philippines, in the 1981/82 dry season, green leafhopper populations were higher in wet-seeded rice than in transplanted rice, whereas brown planthopper and white-backed planthopper populations were about the same for both types of rice culture (IRRI, 1983a). This suggests the possibility of more green leafhopper transmitted tungro incidence on wet-seeded rice than on transplanted rice.

In Central Luzon, the cost of insecticide applied by the farmers is greater for wet-seeded rice than for transplanted rice (Table 27.2).

Table 27.2 Farm size, input use, and yield of transplanted and wet-seeded rice. Central Luzon, 1982 wet season. (Cordova, unpublished)

	Wet-seeded	Transplanted	t-test
Farms (no.)	22	114	
Total area (ha.)	35.86	205.20	
Area per field (ha.)	1.33	1.03	2.19*
Area per farm (ha.)	2.17	1.69	2.44*
Nitrogen applied (kg/ha.)	69.6	66.0	0.36
P_2O_5 + K_2O applied (kg/ha.)	22.9	19.8	0.40
Fertilizer cost ($/ha.)	44.82	43.90	0.14
Herbicide cost ($/ha.)	7.22	3.55	4.60**
Insecticide cost ($/ha.)	15.35	9.37	3.38**
Pre-harvest labor (days/ha.)	39.9	65.2	5.82**
Total labor (days/ha.)	75.1	95.2	3.42**
Yield (t/ha.)	4.3	4.0	1.02
Labor producitivity (kg/day)	58	42	

* Significant at 5 per cent level
** Significant at 1 per cent level

Weeds

The only universal pests in rice are weeds exceeding a tolerable level in nearly all seasons. Because they are found in all fields in all crops it is necessary to invest in weed control practices to reduce yield losses caused by weed competition. Many techniques can be used to reduce either directly or indirectly the weed problem in rice. No matter what technology is used, the aim is to prevent yield loss and to control weeds. The recommended weed control technology should be flexible and alternative recommendations should be given in case farmers cannot follow one recommendation for some reason or other. However, weed control is only a part of successful crop management. Weed control alone will not produce a good crop.

A major constraint to the wider adoption of wet seeding is weed competition. Weed competition is greater in wet-seeded rice than in transplanted rice because of the similarities in age and morphological characteristics of grassy weeds and rice seedlings. Yield losses due to uncontrolled weed growth were on average 9 per cent greater in wet-seeded rice than in transplanted rice in trials conducted at IRRI over the past 20 years (Moody, 1983).

In Iloilo, Roxas and Genesila (1977) found that farmers spent an average of 14.7 days/ha. weeding wet-seeded rice and only 6.2 days weeding transplanted rice in the wet season. During the dry season, the time spent weeding decreased to 9.2 days and 3.2 days, respectively. Thus, weeds were a greater problem in wet-seeded rice and during the wet season.

Many authors including De Datta and Bernasor (1973), Chang and De Datta (1974), and Subbiah and Morachan (1976) have reported on the difficulty in hand weeding wet-seeded rice when it is broadcast. This is because the hand weeders damage the rice as they move through the field and they fail to remove some of the grassy weeds or they remove rice instead because of the difficulty in distinguishing grassy weeds from rice. Cordova (unpublished) reported that in Central Luzon 52 per cent of the farmers surveyed hand weeded transplanted rice whereas only 37 per cent of the farmers hand weeded wet-seeded rice.

Herbicides are the only practical alternative for weed control in wet-seeded rice when it is broadcast. It is more difficult to find suitable pre-emergence herbicides for weed control in wet-seeded rice than in transplanted rice because the rice and the grassy weeds are at the same stage of development in wet-seeded rice (De Datta and Bernasor, 1973). Consequently, the rice plant and the grassy weeds may, in many instances, show the same degree of susceptibility to the applied herbicide.

Herbicide selectivity in wet-seeded rice can be improved by reducing the rate of herbicide applied, adjusting the application time, applying crop safeners (Mabbayad and Moody, 1983), applying split herbicide applications, and applying herbicide combinations.

Pre-emergence herbicide treatments that effectively control weeds in wet-seeded rice in the Philippines include Butralin [4-(1,l-dimethylethyl)-*N*-(1-methylpropyl)-2,6-dinitrobenzene amine], piperophos (*S*-2-methyl-piperidinocarbonyl methyl *0* *0*-dipropy1 phosphorodithioate)- dimethametryn [2-(1,2-dimethylpropylamino)-4-ethylamino-6-methylthio-1,3,5-triazine] (De Datta and Bernasor, 1973), butachlor (*N*-butoxy-methyl-a-chloro-2',6'-diethylacetanilid) (De Datta and Bernasor, 1971, 1973; Arceo and Mercado, 1981; Cadag and Mercado.

1983; Mabbayad and Moody, 1983), thiobencarb (*S*-4-chlorobenzyl diethylthiocarbamate) (De Datta and Bemasor, 1971, 1973), and thiobencarb-2, 4-D (2,4-dichlorophenoxy acetic acid) (Navarez et al., 1979). The recommended time of application of most of these compounds is 6 days after seeding (DAS). Propanil (3',4'-dichloropropionanilide) and propanil-fenoprop [(±)-2-(2,4,5-trichlorophenoxy) propionic acid] are postemergence herbicide treatments that have performed well across a range of water regimes (Navarez et al., 1979).

Contrary to popular belief, at least in the Philippines, granular herbicide formulations are not much more expensive than liquid formulations. Application of butachlor, the most widely used herbicide in wet-seeded rice, at 1 kg a.i./ha. costs $15.41 for the granular formulation and $14.62 for the liquid formulation, a difference of only $0.79. Granular herbicides have the advantage that they do not necessarily require special equipment for application. With some practice the farmer can broadcast them uniformly in the field. The cost of herbicide applied by farmers in Central Luzon is greater for wet-seeded rice than for transplanted rice (Table 27.2).

Crop damage is usually not observed or is only transitory when propanil or herbicide combinations with propanil are applied post-emergence. However, rain within 2-3 hours after its application may wash some of the herbicide off the weeds and reduce its effectiveness. Also, propanil is incompatible with carbamate and organo-phosphate insecticides and should not be applied within 14 days before or after application of these insecticides to avoid crop damage. In the Philippines, the cost of application of propanil at 3.0 kg a.i./ha., the recommended rate, is $34.08 which is more than twice the cost of applying butachlor. This may limit its widespread adoption by farmers.

Difficulties with weed control in wet-seeded rice are compounded in uncontrolled moisture conditions. In rainfed areas, farmers are reluctant to drain their fields prior to or after herbicide application because subsequent rainfall is uncertain, especially early in the wet season (Moody, 1982). Severe stand reductions might occur in wet-seeded rice if more than 50 per cent of the rice plant is submerged in water at or soon after herbicide application (Moody, 1977b). Even commonly used herbicides such as butachlor might be troublesome under such conditions. Moody (1982) reported that a 30 per cent stand reduction may have little effect on grain yield. However, farmers are very reluctant to use herbicides that cause crop damage even though yield may not be reduced.

Lodging

Wet-seeded rice has a greater tendency to lodge than transplanted rice because root anchorage is poor (Castillo, 1962). Stems are also weaker because of the higher seeding rates used.

Field duration

For early-maturing cultivars (<110 days) transplanted rice is harvested 3-5 days earlier than wet-seeded rice, for medium-maturing cultivars transplanted rice is harvested 1-2 days earlier while late-maturing cultivars are harvested at the same time (Cia, pers. comm.).

Yield

Yields similar to those obtained with transplanted rice have been obtained with wet-seeded rice in research stations (Table 27.3) and on farmers' fields (Table 27.2, Chawla et al., 1982). To obtain high yields with wet-seeded rice, precise water management, good weed control and optimum fertilizer management are necessary (De Datta, 1981). In the Bicol province, yields of wet-seeded rice were significantly lower than those of transplanted rice (Mandac et al., 1982). Moisture stress, as opposed to crop establishment method, accounted for the significant yield difference between transplanted and wet-seeded rice; wet seeding was most frequently used on fields with higher moisture stress levels.

Table 27.3 Yield of transplanted and wet-seeded rice when no fertilizer was applied as affected by season. (Adapted from IRRI, 1983b)

	Yield (t/ha.)	
Season	Transplanted	Wet-seeded
Dry[a]	4.8	4.8
Early wet[a]	4.2	4.4
Late wet[b]	3.5	3.3

[a] Average of 15 consecutive crops.
[b] Average of 14 consecutive crops.

Turnaround time

In rainfed areas, long turnaround times (the interval between harvesting of one crop and the planting of the next in a cropping sequence) result in crops being planted too late in the wet season for dependable production. For example, in Iloilo province, when two wet-seeded rice crops were grown in sequence there was a yield loss of 0.7 t/ha. for each 10-day delay in planting of the second rice crop (Roxas et al., 1978). Wet seeding was chosen by farmers as the method of second crop establishment by the majority of the farmers because of its cost advantage.

Magbanua et al., (1977) reported that turnaround time was 10 days less (16 days vs. 26 days) when the second rice crop was wet-seeded than when it was transplanted.

Cropping intensity

In Miag-ao, Iloilo, with single cropping, 77 per cent of the area was transplanted and 23 per cent wet seeded, with double cropping, 31 per cent was transplanted and 69 per cent wet seeded (Table 27.4). Farmers who double cropped had in general, better water control and higher levels of fertilizer application than those who single cropped (Chawla et al., 1982). Farmers who wet seeded planted earlier than those who transplanted (Roxas et al., 1978; Mandac et al.. 1982).

Table 27.4 Area (%) planted to different cultivars and establishment method for single and double cropped rice. Miag-ao, Iloilo, Philippines. (Adapted from Chawla et al., 1982.)

	Single cropping		Double cropping	
Cultivar	Transplanted	Wet-seeded	Transplanted	Wet-seeded
IR36	33.8	17.3	30.3	62.9
Other IRs	1.2	1.8	0.6	6.2
Kinarabaw	17.9	–	–	–
Camoros	11.9	1.3	–	–
Other locals	12.6	2.1	–	–
Total	77.4	22.5	30.9	69.1

Discussion following

Labor for transplanting and weeding is usually provided by women. With wet seeding and the use of herbicides, employment for women would be eliminated. This is a concern particularly in areas of high population density.

In Columbia, which is highly mechanized, people are reverting to transplanting. They hire women at rather low wages to do the transplanting and save on the cost of herbicides. Do we want to take a step backwards and simply assume that putting women into the field to transplant is a good thing?

Employment for women could be eliminated by the use of wet seeding and herbicides if there were no employment alternatives for their labor. In our Central Luzon survey some farmers reported that they were having difficulty in getting transplanters because of the increasing demand for women workers in home industries for the domestic and primarily for the export market. With this employment, women can work at home and at the same time look after the household chores.

Why are farmers moving to wet seeding, because it seems to have so many disadvantages compared to transplanting?

The major reason why farmers are moving to wet seeding is the reduction in the amount of labor required. Based on the data which we presented a farmer requires about 20 days/ha. less labor for planting with wet seeding than transplanting.

In the Bicol region in the Philippines the main reason why farmers in rainfed areas are adopting wet seeding is to reduce the labor requirement. Women are still employed for weeding because very little herbicide is used. We need to understand the dynamics behind the adoption of a new technology.

What are the residual effects of herbicides?

To my knowledge, in the tropics, there is no residual carryover of herbicides from the rice crop to the succeeding crop.

Is there any detrimental effect of herbicides on human health?

Certain precautions must be taken when applying herbicides. These should be indicated on the container. Provided these precautions are followed, I can see no health hazards from herbicides.

In India, there is the problem of herbicide drift from rice treated with 2,4-D to cotton which is a susceptible crop. Is there any research being conducted on the problem of herbicide drift?

Herbicide drift from rice treated with 2,4-0 to an adjacent crop can occur. I know of no work that has been done on this subject in the tropics. In a situation where it is likely to occur, 2,4-D should not be used for weed control in rice, and other herbicides will have to be used. One has to be aware of the situation and take the necessary steps to avoid it. In the U.S., there are restrictions as to how close to a susceptible commercial crop such as cotton, grapes, tomatoes, and okra, hormone-type herbicides, including 2,4-D can be applied to rice.

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28 Biological nitrogen fixation in wetland rice

J.K. Ladha, I. Watanabe and P.A. Roger

Modern rice varieties have contributed significantly to total food production in developing countries. However, the high yielding varieties require heavy application of nitrogen fertilizer which is an expensive input in rice production. In many developing countries, fertilizer is subsidized in order to encourage its usage together with modern rice varieties, although subsidies put a burden on the national budget. On the other hand, a large number of farmers in Asia do not use or use low levels of nitrogen fertilizer because it is either not available or too expensive. In such a situation, the question arises: how is soil fertility in wetland paddy soils maintained over the years even though a substantial amount of nitrogen is removed by the rice crop, or is lost by leaching, denitrification, and ammonia volatilization? Long term fertility trials with rice in Japan and the Philippines suggest that as much as 50 to 75 kg N per ha. is added every year to wetland rice fields (Greenland and Watanabe, 1982). Some of this nitrogen comes from exogenous sources like rainfall, irrigation water, and atmospheric ammonia but biological nitrogen fixation is recognized to be the major source.

Biological nitrogen fixation refers to the property of a few microorganisms to utilize nitrogen from the air, to incorporate it in their cells and to release it in the soil as organic nitrogen through excretion or decomposition after dying.

Compared with dryland soils, wetland rice soils have a high N_2 fixing potentiality. This is because the wetland rice field is a complex eco-system comprising water and soil, photic and non-photic zones, oxidized and reduced environments. This diversity permits all the major groups of N_2 fixing organisms to grow in wetland rice fields. Nitrogen fixing microorganisms in rice fields comprise :

(a) heterotrophic bacteria associated with the rice plant and free-living heterotrophic and phototrophic bacteria in the soil;
(b) free-living phototrophic blue-green algae ; and
(c) symbiotic blue-green alga *A. azollae,* associated with *Azolla.*

Experiments have been conducted at IRRI, employing the acetylene-reduction technique, labeled nitrogen technique, and Kjeldahl technique to ascertain nitrogen balance. These experiments suggested that a significant amount of dinitrogen is fixed in rice fields by these N_2 fixing microorganisms and that a part of it is rapidly utilized by the rice plant.

Blue-green algae are photosynthetic organisms which can grow in the presence of water, inorganic salts, CO_2 from the air and sunlight. All heterocystous and few non-heterocystous blue-green algal species possess the capacity to fix atmospheric nitrogen. They are commonly found in the photic zone (floodwater, soil water interface and epiphytically on rice plant and weeds) of most wetland rice fields. Generally their growth in the rice fields is limitrd by low pH, P deficiency and grazer population (Roger and Kulasooriya, 1980; Grant and Alexander, 1981).

Heterotrophic N_2 fixing bacteria occur in almost all the environments of the rice field, including the submerged parts of the rice plant but are especially active and numerous in the rhizosphere of the rice plants and on the organic debris in the soil. A wide range of nitrogen fixing bacteria occur in rice fields (Watanabe and Furusaka, 1980). Ladha et al. (1982; 1983) and Barraquio et al. (1983) isolated and identified several nitrogen fixing bacteria from rice fields. They found that *Pseudomonas, Azospirillum, Enterobacter* and *Klebsiella* are N_2 fixing bacteria commonly associated with many rice varieties.

The amounts of nitrogen fixed by blue-green algae and bacteria in rice paddy soils and the extent to which nitrogen fixed by them can support rice growth are still, in general, imprecisely known. This is due to methodological problems in measuring nitrogen fixation in the field. The findings summarized by Roger and Kulasooriya (1980) suggest that annual nitrogen fixation by blue-green algae in rice fields may range from 0 to 70 kg/ha. Experiments on algal inoculation of the rice fields showing a beneficial effect on grain yield have been reported in China, Egypt, India, Japan, Philippines and the USSR. However, algal inoculation technology is still at an experimental level in most of the rice growing countries.

In the case of bacterial nitrogen fixation associated with the rice plant and rhizosphere a few studies have been made to quantify the amount of nitrogen fixed. The values vary from 5 to 15 kg N fixed/ha./crop. Several bacterial inoculation trials in grasses and upland crops with *Azospirillum* have produced variable results. In India, Subba Rao (1979) reported positive effects on rice yield after *Azospirillum* inoculation in several sites. However, more systematic and detailed long-term bacterial inoculation studies are needed.

The so-called *Azolla* is in fact a symbiotic association between a water fern and a N_2 fixing blue-green alga. *Azolla* has world-wide distribution and comprises six species: *A. filiculoides, A. microphylla, A. caroliniana, A. mexicana, A. pinnata* and *A. nilotica* (Lumpkin and Plucknett, 1982). The algal symbiont, which is similar in all *Azolla* species, belongs to Nostocaceae and is referred as *Anabaena azollae* (Ladha and Watanabe, 1982). In some rice fields *Azolla* occurs indigenously while in others it can be introduced by inoculation.

Azolla has been used as a green manure in wetland rice culture for centuries in Northern Vietnam and Southeastern China (Lumpkin and Plucknett, 1982). However, the attention of scientists has only recently been drawn towards *Azolla. Azolla* can be grown before and/or after rice transplanting. Under favorable conditions, *Azolla* can accumulate 40-120 kg N/ha. in 30 days. Nitrogen contribution by *Azolla* can be substantially enhanced by growing a second or third crop of *Azolla* after the first crop is incorporated (see Watanabe, 1982). The effect of *Azolla* as green manure was tested in the International Network of Soil Fertility and Fertilization Evaluation for Rice organized by The International Rice Research Institute. In 1979, field experiments were conducted at 12 sites in 5 countries. Positive responses of *Azolla* incorporation over no nitrogen control were obtained in 10 sites, the effect on yield of growing *Azolla* and incorporating it before and after transplanting was equivalent to that obtained from applying 60 kg N/ha. as chemical N fertilizer. When *Azolla* is grown and incorporated 4-6 times in between wide rows of rice (53 cm) alternately with narrow rows (13 cm), a grain yield equivalent to that obtained from 70-100 kg N/ha. chemical nitrogen is obtained (Watanabe, 1982).

For the rapid growth of *Azolla* a continuous supply of water soluble phosphorus is required, therefore split application (1-3 kg P_2O_5 ha./4 to 7 days) is more efficient than basal application. *Azolla* damage by insects could be a serious problem in summer. The application of insecticide is recommended to control *Azolla* pests. Kikuchi et al. (1982) made a survey for the economic evaluation of *Azolla* use in rice farming in the Philippines. Their study suggested that in areas where environmental conditions are favorable for *Azolla* growth the economic return from its adoption was more than $35/ha. at 1981 prices; that the economic potential of *Azolla* could be greater in countries where the labor is cheap; and that the possible susceptibilitity of *Azolla* to insects and pest may be a problem for its adoption in some regions.

Legumes green manures, fix nitrogen through symbiotic bacteria (*Rhizobium* spp.). They are certainly the first N_2 fixing system that has been used in rice cultivation. Experiments at IRRI and in India have shown that incorporating one crop of legumes is equivalent to the application of 30 to 80 kg N fertilizers. Despite a high potential, usage of legume green manure has been abandoned for various reasons including the preference for a pulse crop and the additional work in incorporating green manures.

Table 28.1 summarizes the actual status of N_2 fixation in rice cultivation.

Table 28.1 Actual status of N_2 fixation in rice cultivation.

Nitrogen-fixing organisms in rice fields	Potentialities in Kg N/ha.*	Possible use proved	Technology available	Usage by farmers
Legumes	30-80	+	+	+
Azolla	30-60	+	+	+
Blue-green algae	30	+	±	±
N_2 fixing bacteria in soil; N_2 fixing bacteria associated with rice	10-30	+	–	–
Photosynthetic bacteria	?	–	–	–

* These values are tentative estimates.

Conclusion

In modern farming systems the importance of biological nitrogen fixation is often overshadowed by fertilizer N. However, biological nitrogen fixation is vital to subsistence farming, which does not use fertilizer N, and comprises a large part of rice cultivation in Asia. The apparent potential of N_2 fixing organisms as alternative or additional sources of nitrogen for rice are high and exceeds their present utilization. Reasons for underutilization include ecological and socioeconomical limiting factors, and lack of technology development. Research on biological nitrogen fixation is essential because nitrogen fixation is the alternative to chemical N fertilizer, which requires large manufacturing facilities, energy supplies and financial investment. Such facilities and resources will not be available in many developing rice growing countries in the immediate future. Furthermore, rising energy costs and uncertain fuel supplies may make chemical N fertilizer more expensive in future. Biological nitrogen fixation is an important, biologically safe nitrogen source that will retain economic viability in the future.

Discussion following

How does application of nitrogen fertilizer affect growth of nitrogen fixing organisms in the soil?

The combined forms of nitrogen are well-known inhibitors of biological nitrogen fixation. However, the application of nitrogen fertilizer enhances the growth of microorganisms, in general.

How much nitrogen can be contributed through biological nitrogen fixation from *Azolla*?

Under favorable conditions, *Azolla* can accumulate 40-120 kg N/ha. in 30 days. However, this figure can substantially be enhanced by growing a second or third crop of *Azolla* after the first crop is incorporated.

Can legumes be used in rotation with *Azolla*?

I think it can be used. However, to my knowledge there is no published information on the use of legumes in rotation with *Azolla.*

Could you elaborate on the use of *AzoIla* as a technique for weed control?

Azolla rapidly forms a cover in transplanted rice fields and thereby limits light availability for the growth of weeds. Dr. Moody and his colleagues have reported a substantial reduction of weed growth in the rice fields.

What is the impact of nitrogen fixation on upland rice?

The contribution of biological nitrogen fixation in upland rice is much less than the wetland rice. However, I must say that not much attention is being given to nitrogen fixation research in upland rice.

On the west coast of India, land is sloping and soils are acidic. We find that *Azolla* and blue green algae grow very well in the laboratory, but not in the farmers' fields. What is the reason for this?

There are several limiting factors associated with the growth of blue-green algae and *Azolla* like acidic pH, phosphorus deficiency, pest problems, water availability, etc. The study of these factors might solve the question of why the *Azolla* and blue-green algae failed to grow.

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29 Integrated pest management for rice in Asia

James A. Litsinger

Losses in Asia from insect, disease, weed, and vertebrate pests that attack rice are difficult to quantity. Chronic pests – weeds, most leaf-feeding insects, stem borers, most fungal diseases – annually reduce yields but their numbers are considered normal and are routinely controlled or are tolerated. Acute pests – rats, blast, virus and bacterial diseases, leafhoppers and planthoppers – occur in epidemic proportions infrequently but cause great economic concern to the regions affected and their control is difficult.

Pest epidemics have been recorded since rice was cultivated by man. Pests such as rats, blast, armyworms, locusts, and brown planthoppers have historically challenged rice farmers who have responded with highly creative pest control measures.

Historically epidemics were associated with severe weather conditions such as extreme temperature fluctuations, drought, typhoons, or floods, which in the case of rats and insects suppressed natural enemies and for diseases allowed the organisms entry into the plant.

In recent history, the need to intensify rice production to feed a rapidly expanding population has brought about rapid changes in rice production technology and many of these changes have created greater frequencies of pest epidemics.

The expansion of farm land planted to rice has aided pests whose populations were greatly lowered during the dispersal phase of their life cycles through failure to find a suitable host. It has also allowed isolated pests to expand their range into new areas, and increase the number of pest species from those that transferred from wild hosts to rice as their natural habitats became replaced.

New irrigation systems have allowed dry season rice cropping to unleash pests whose numbers were annually depressed during a rice-free dry season, and favored aquatic pests with more sustained water delivery to paddies.

Development of new varieties has replaced traditional varieties – which had been selected by farmers for stable resistance particularly against diseases – with modern varieties possessing narrower-based and less stable resistance, and increased those pests favored by high tillering plant types. This development has also allowed year round cropping by introducing photoperiod insentivity and increased the yield potential, therefore making it more economical to attempt pest control measures that before would have been unprofitable.

Fertilizer usage has increased with the development of fertilizer-responsive varieties which in turn has increased pest abundance. Weeds also take up the fertilizer and grow faster than rice. Insects multiply faster from better nutrition. Fertilizer increases the plant's susceptibility to diseases. Higher yields feed more rats.

Pesticide use has expanded in response to more pest problems and the higher profits that could be realized from proper use. Farmers however often misuse pesticides: the wrong pesticide is chosen, or it is applied on a calendar-based schedule without regard to pest numbers. Sometimes rates of application are too low, and sometimes not enough water is used to thoroughly cover the plants. The misuse of pesticides may fail to kill the target pest and increase either its numbers (resurgence) or those of a formerly minor pest (secondary pest outbreak). It may also cause pesticide resistant populations, or seriously harm the farmer or nontarget organisms during application in the environment either directly or indirectly.

The pest problems brought about by the introduction of new technology are by no means unique to rice. All too often however the immediate solution to a pest problem has been to apply pesticides repeatedly.

The concept of pest control changed with the advent of modern synthetic pesticides which were inexpensive, quite easily applied, and gave immediate results. During the pesticide era, the concept of control meant eradication where total elimination of pests was sought.

The concept of eradication has now been replaced with the term management where the goal is to lower pest populations below levels that are uneconomical to control. Low pest populations are tolerated. The 'economic injury level' is that at which the pest population is large enough to cause crop losses greater than the cost of control. The 'economic threshold' is that level of the pest population at which control measures should be taken to prevent pest numbers from reaching the economic injury level.

Integrated pest management is a strategy or plan that utilizes various tactics or control methods – cultural, plant resistance, biological, and chemical – in a harmonious way. Control actions are based on frequent scouting of pests.

Integrated pest management depends on multidisciplinary ecological strategies to weigh the effect of each tactic as parts of the agro-ecosystem to produce the least disturbance and loss of yield over the long run.

No pest control strategy increases potential yields. It can only ensure that the maximum yield physiologically obtainable in a particular field and season will not be significantly reduced by pests.

Implementation of integrated pest management strategies

Implementation of integrated pest management strategies begins with farmers in their communities and is developed in the community: in the process farmers learn to recognize and deal with their own problems. By building their own strategies farmers learn how to gather information, make decisions, and execute them.

At the same time, those who are implementors learn how to listen, obtain information from outside sources, and communicate that information to farmers in a usable form. This process requires a long term commitment, of more than five years per village, as farmers need to experience each situation themselves as part of the learning process.

Site selection

Integrated pest management reverses the concept of developing national recommendations derived from research results in a limited number of sites. Rather the regional sites become the focal points.

One or several neighboring villages with a history of pest problems should be selected as farmers will be more receptive. Focusing on one or several villages allows concentration on the social processes of strategy building, not the recommended tactics themselves.

Team formation

Teams are formed at regional and national levels involving research, surveillance, and extension organizations. The national team acts as a coordinating body and supports the regional team financially, logistically, and technically. At least one formal meeting should be held each year where the regional team reports its results to the national team.

The regional team should minimally have strong research and extension components. The extension service should have a history of working with the farmers in the site area. Additional team members can be an economist, agronomist, and surveillance officers.

The regional team is directly involved in data gathering and interacts with farmers. One person is selected as a coordinator who should live as close as possible to the target villages. The role of the site coordinator is to be a communication bridge between the various agencies and personnel working at the site and to make decisions involving use of shared resources.

Once the regional team is formed, a meeting should be held in each of the villages in order to describe the purpose of the program to the farmers and their leaders. If the farmers are receptive, several of their leaders should become a part of the regional team. Before any work is started, the farmers should be supportive of the integrated pest management program. If the farmers do not voice support for the program, another site should be selected.

Site description

Information on the biological, physical, sociological, and economic aspects of the target area will be needed to develop pest management strategies.

Extension workers and researchers who have worked at the site should be consulted about soil, weather, and agronomic features as well as pest problems. It is important that the team learns how to grow rice crops that achieve the agronomic potential for the site. An agronomist team member is needed to provide this information and may undertake on-site agronomic trials to confirm the technology.

The economist should perform a baseline survey to determine farmers' crop production practices, tenure status, labor arrangements, varieties used, cost of credit, labor and agrochemical usage to calculate costs and returns from rice production. This information is useful for researchers to decide what technology to test in field trials and price structures to evaluate technology performance.

More focused farmer surveys should be performed to determine systematically the key pests as perceived by farmers and the control measures they use. Farmers' pest control methods should be evaluated for their suitability along with newer technology.

Prices for agrochemicals should be gathered from local outlets.

Trials conducted at the site by each pest discipline should quantify yield losses and identify the key pests responsible for those losses so that control strategies can be focused on actual problems.

Research design of pest management strategies

The basic philosophy is to start with an understanding of the farmers' crop production and pest control practices. Field trials and other on-site data gathering activities will pinpoint key pests and quantify economic losses. A pest management strategy will include the following steps:

1 Make an assessment of the known technology to combat the key pests.
2 Determine what features of the farmers' production and pest control practices might economically be changed to produce profitable stable yields.
3 Assess cultural control methods. Can any be fitted into the fanners' system? Discuss these ideas in farmers' meetings and determine the scope for introducing these ideas. Such meetings may lead to a field trial to test potential practices or to community wide adoption of synchronous planting.
4 Resistant varieties not being grown by farmers can be discussed, as farmers may have very good reasons for not growing them. A field trial designed to test the yield of and pest reaction to resistant varieties may be undertaken.
5 Measures to encourage natural enemies of pests should also he discussed and assessed with farmers, such as pointing out that certain pesticides cause pest resurgence and indiscriminate use of pesticides may cause more harm than good.
6 The efficacy and profitability of pesticides (fungicides, herbicides, rodenticides, insecticides) should be verified at the site. Economic threshold values for insect pests should be determined by on-site field trials.

Testing

Separate trials should be carried out by each discipline. The farmers should agree to help with the trials. Land should not be rented but the cost of inputs for growing the crop can be given to the farmer cooperators who in turn will grow and maintain the crop except for those operations involving the pest discipline. The farmer retains the yield and bears the risks from crop damage from sources outside of the management of the trial, e.g. stray livestock, drought, and floods.

Treatments are replicated on different farms in order to expose the technology to a realistic range of variation that exists between farms.

The trials are conducted at the time the crop is grown by the farmers. It is desirable that the farmer cooperators plant the trials over the existing range of planting dates at the site.

Verification trials differ from experiment station trials in that only proven technology is tested. The following trials need to be undertaken:

(a) Variety trial to evaluate pest resistance particularly diseases and yield potential;
(b) Insect control trial to measure yield loss in each growth stage and determine economic thresholds; information on yield loss helps in the interpretation of treatments which will establish economic thresholds values (Figures 29.1 and 29.2),
(c) Weed control trial to measure yield loss and test weed control practices; and
(d) Rodent control trial to measure population levels and test the suitability of baits and bait holders as well as control practices.

Evaluation

Each of the trials should be conducted over several seasons and several years until the research team is satisfied that the technology is suitable. Economic analyses on the pest control technology should include costs and returns and benefit cost ratios. Returns (profit) should exceed the levels farmers receive from their current pest control practices. The benefit cost ratios for material inputs should be higher than two, meaning that there should be at least a two to one rate of return from investment costs. The economist member can evaluate the technology for the team.

Extension

Only after the regional and national integrated pest management teams have tested and formulated an integrated pest management strategy can this information be extended to farmers throughout the target area.

The farmers themselves must be given the technological information to be able to diagnose field problems and make management decisions. The function of a national pest surveillance network is to predict epidemics from acute pests, monitor the development of biotypes and

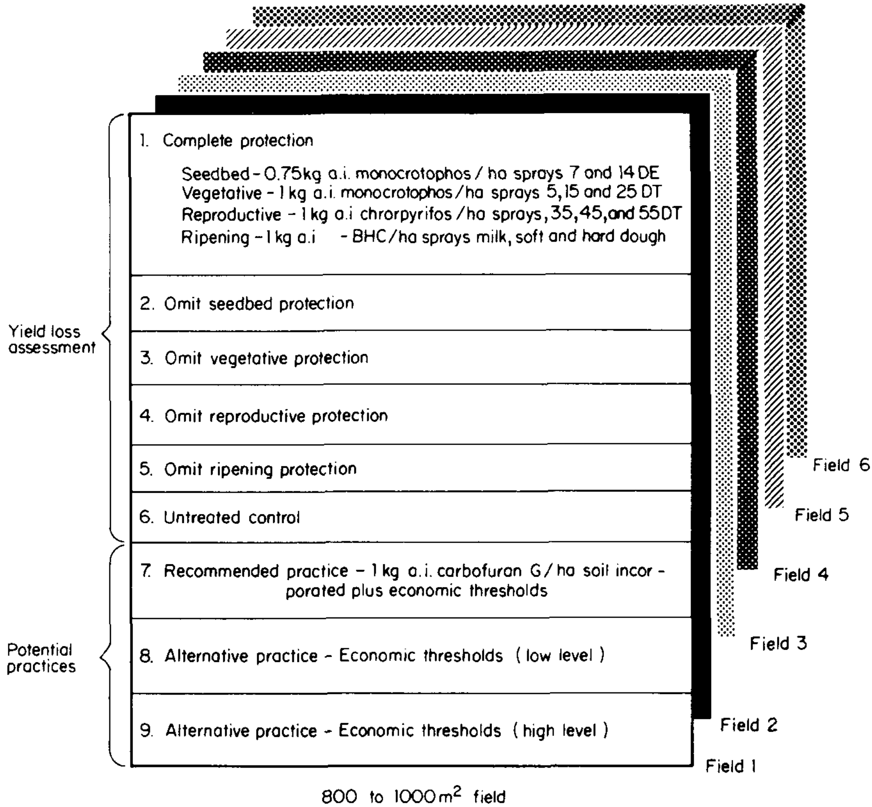

Figure 29.1: Experimental design for yield loss assessment and determination of the optional insect control recommendation for transplanted rice.

races resulting from new pest resistant varieties, participate in the introduction of exotic natural enemies into the country, handle mass rearing and release of indigenous natural enemies, and monitor the development of pesticide-resistant pest populations.

Farmers' classes

The first step is to hold farmers' classes in several villages (or village units in more populated locations) weekly for an entire crop season. The technical information is explained in the weekly subject matter sessions lasting 1-2 hours each. Each session involves a short lecture, with demonstrations if possible, followed by question and answer periods and then field exercises.

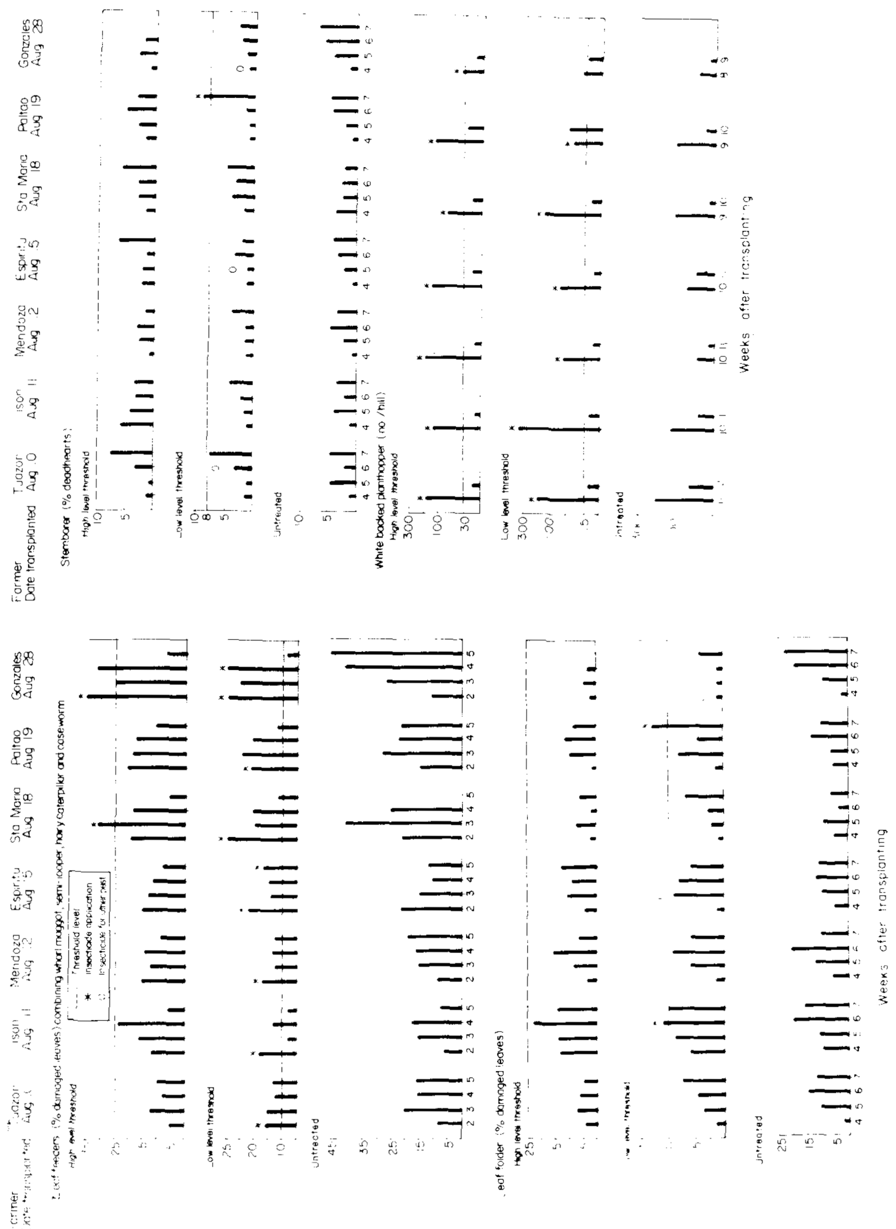

Figure 29.2 Insect pest population in high and low economic threshold level treatments showing the number and timing of insecticide applications by farmer replication when the threshold levels were reached. Nueva Ecija, 1982 wet season.

Before classes begin, a general meeting inviting all farmers in the village should be called by the regional team to explain the purpose of the classes. The farmers then decide where and when the classes will be held and what subjects to cover. The subjects should include all aspects of crop production, as the extension officer has broader responsibilities than strictly pest management. After this meeting it is no longer necessary for the research members of the team to be directly involved at the site other than to diagnose problems and prescribe solutions to field problems that trouble the extension officer.

The extension officer will organize each weekly class and present the information to the farmers. The attitude of the extension officer toward the farmers and how the classes are conducted are critical to the success of the implementation process.

Classes are only an initial step in the farmers' learning process. Through the classes the farmers should become exposed to new knowledge in such a way to evoke their curiosity and create a desire on their part to continue to attend weekly meetings about succeeding crops to learn more. If farmers' attendance declines at meetings, the extension officer must visit the farmers in their homes more frequently to create social bonds between them.

Farmers will not be able to assimilate sufficient information over a period of only one crop season no matter how well the information is presented. There is no need for elaborate training aides such as movies, color slides, or handouts. A blackboard is helpful, however. Written quizzes or examinations where farmers are put on the spot should be avoided. Therefore the extension officer conducting the classes should have sufficient social and technical skills to develop a solid rapport with farmers and gain their respect. The farmers' opinions and ideas should always be respected and they should not be discouraged by an air of superiority from the extension officer. The extension officer should always be punctual in attending the classes, as frequent absences will cause disillusionment among the farmers to the detriment of the program.

Follow-up meetings

Farmers learn to diagnose pest problems and make control decisions through being subjected to experiences where they are not told what to do but rather have to think on their own. The extension officer on the other hand cannot meet with each farmer in the village so it is important that existing farmers' organizations, which are composed of farmer groups; be utilized. Organizations where farmer groupings are based on field location, such as irrigation organizations, are ideal.

After the farmer classes are over, the extension officer should meet with farmer leaders during succeeding crop seasons. Each farmer leader should represent about 20 farmers. These follow-up meetings, again held weekly at a pre-designated time, could rotate among the homes of the farmer leaders.

Before each weekly meeting the farmer leaders need to meet with their membership either jointly or individually where they will scout their fields to diagnose problems and arrive at solutions together. Group decision making is an important aspect of the learning process. However, the farmers will not carry out any field operations such as pesticide application until after the weekly follow-up meeting with the extension officer.

Each follow-up meeting lasts 1-2 hours. Half the time is spent in the home of one of the farmer leaders and the other half in a short verification field tour. The farmer group leaders first report to the extension officer the problems they diagnosed and the actions that they believe should be taken. The extension officer only notes down the problems and the farmers' solutions but does not pass judgement until they adjourn to the field tour. There the problems are shown to the extension officer who confirms or rejects the farmers' problem diagnoses and solutions. If the extension officer sees problems overlooked by the farmers during the field tour these are pointed out.

There is a discussion in the field and the farmers learn a little more. Farmers in Pamacpacan (Table 29.1) can be compared with those in Malabon Kaingin (Table 29.2). Malabon Kaingin farmers correctly identified 94 per cent of their pest problems after three seasons whereas Pamacpacan farmers identified less than half of their pest problems. The problems brought out in the follow-up meetings do not deal only with pests but cover all crop production problems. These small lessons learned each week however must focus on problems as they naturally develop in the field.

The extension officer should be responsible only for technology and should not be directly involved in a credit program as this will significantly detract from his or her effectiveness.

The extension officer needs the support of the regional and national integrated pest managment teams to confirm problem diagnoses and to interject the latest technologies for further solutions.

As the farmers' capabilities in problem diagnosis and decision making progress over several crop seasons, the frequency of follow-up meetings may be reduced to twice a month and eventually to only two or three meetings per crop season. Because pest problems and solutions change with time there will be a continual need for the extension officer always to maintain scheduled visitations to each village. Each extension officer can readily cover 6-10 villages or village units.

Table 29.1 Weekly farmers leaders' report to entomology research assistant cum extension technician. Pamacpacan,[a] Jaen, Nueva Ecija, wet season 1982.

Week after sowing[b] (no)	Farmers' assessment		Technicians' assessment [c]	
	Problem	Decision	Problem	Decision
5	Whitish damaged leaves	Apply insecticide	Whorl maggot	+
	Worms	Apply insecticide	Caseworm	+
	Yellowing of leaves	Apply insecticide	Bacterial leaf streak	Do not apply insecticide
	Sunted growth	Apply fertilizer and insecticide	Zn deficiency	Apply $ZnSO_4$
	Deadheart	Apply insecticide	+	Insecticide unnecessary
6	Leaf folder	Apply insecticide	+	Insecticide unnecessary
	Stemborer	Apply insecticide	+	Insecticide unnecessary
	Stunted growth	Apply nitrogen fertilizer	Zn deficiency	Apply $ZnSO_4$
7	White moths	Apply insecticide	Caseworm	Insecticide unnecessary
	Leaf cutter	Apply insecticide	Caseworm	Insecticide unnecessary
8	Yellowing of leaves	Apply fertilizer	Bacterial leaf streak	Fertilizer unnecessary
	Rat damage	Use acute rat poison	+	Use chronic rat poison
9	Moths	Apply insecticide	Leaf folder	Insecticide unnecessary
	Rat damage	Continue baiting	+	Change bait holder to prevent bait shyness
10	Leaf folder	No insecticide needed	+	+
11	Leaf folder	No insecticide needed	+	+
		Problems (no.)	16	16
		Farmers' correct responses	44%	25%

[a] No previous farmers' class or follow-up meeting.
[b] Weeks 1-3 seedbed, 4-7 vegetative, 8-10 reproductive, 11-12 ripening.
[c] + = technician agreed with farmers' decision.

Table 29.2 Weekly farmers leaders' report to entomology research assistant cum extension technician. Malabon Kaingin.[a] Jaen, Nueva Ecija, Philippines, wet season 1982.

Week after sowing[b] (no.)	Farmers' assessment		Technician's assessment[c]	
	Problem	Decision	Problem	Decision
5	Caseworm	Apply insecticide	+	+
	Leaffolder	Apply insecticide	+	Insecticide unnecessary
	Leaf streak	Do not apply insecticide	+	+
	Rat damage	Rat baiting	+	Use chronic rat poison
6	Leaffolder	Insecticide unnecessary	+	+
	Leaf streak	Do not apply insecticide	+	+
	Rat damage	Apply poison	+	Use chronic rat poison
7	Leaffolder	Apply insecticide	+	+
	Leaf streak	Do not apply insecticide	+	+
8	Leaffolder	Insecticide unnecessary	+	+
	Leaf streak	Do not apply insecticide	+	+
	Stemborer	Insecticide unnecessary	+	+
9	Stemborer	Insecticide unnecessary	+	+
	Leaf streak	Do not apply insecticide	+	+
10	Hoppers	Apply insecticide	Whiteback planthopper	+
	Leaffolder	Insecticide unnecessary	+	+
11	Leaffolder	Insecticide unnecessary	+	+
		Problems (no.)	17	17
		Farmers' correct responses	94%	82%

a Farmers' class 1979, weekly follow-up in 1980 and 1982 dry season.
b Weeks 1-3 seedbed, 4-7 vegetative, 8-10 reproductive, 11-12 ripening.
c + = technician agreed with farmers' decision.

Discussion following

How difficult is it to determine the economic threshold for particular insects attacking rice?

Field trials need to be undertaken where two threshold levels are compared in actual practice. After several years a practical level can be determined.

The main problem in India is the packaging of inputs including insecticides. The farmer cannot purchase insecticides in very small quantities suitable for use on small farms and in situations where cash is a constraint.

Normally pesticide companies respond to this problem by offering small packs to farmers.

30 Two examples of emerging mechanization technologies at IRRI

Amir U. Khan

Introduction

Until the 1960s, rice production in tropical Asia was almost totally non-mechanized. In the late 1960s scientists at IRRI and elsewhere demonstrated that it was possible to raise rice yields several-fold in tropical Asia. These developments were leading to significant changes in rice production and many countries that had chronic deficits of rice were looking forward to self-sufficiency.

The shorter growing season of the new high yielding varieties permitted the raising of two or three crops a year. Traditional methods were often not adequate to provide the level of intensive cropping that was needed, specially in the irrigated double cropping areas. Most rice producing countries had high population densities yet many studies had indicated that demand for farm labor was quite seasonal. Often labor shortages were beginning to occur during the land preparation, transplanting, harvesting and threshing seasons. It was becoming obvious that if the Asian farmer was to keep his land in near continuous production, some degree of agricultural mechanization would have to be introduced.

In Asia, medium size landholdings of 2 to 3 ha. constitute a major segment of the total land under paddy cultivation. Such farms are generally too large for the traditional manual or animal-powered equipment but are too small for the 30+hp tractors and farm machines that are generally available from the industrialized countries.

In most Asian countries considerable potential existed for the manufacture of simple low-cost agricultural equipment. Lack of appropriate machinery designs that could be manufactured with low volume fabrication methods was however a major bottleneck to the growth of this important sector. The virtual non-existence of industrial R&D and the grossly inadequate level of agricultural machinery research in the public institutions in most Asian countries prompted the Institute to play a more active role in this important area.

The International Rice Research Institute established its Small Farm Machinery Development Program in 1967. This program was primarily a market-oriented one, with a major focus on providing demand oriented small farm machines through indigenous low volume manufacturing channels to the 2 to 10 ha. Asian rice farmers. Over the last sixteen years, many new machinery designs that originated from this program have been locally produced and popularly used in many rice growing countries of Asia. This paper briefly discusses two important examples of IRRI mechanization technologies: the axial flow threshers which have already achieved considerable commercial success, and deep placement fertilizer applicators which are currently under development and show promise of widespread acceptance in Asia.

The axial flow thresher

Work on the development of paddy threshers at IRRI was started in 1967 (Khan et al., 1967). Prior to this period, most rice farmers in Asia were using manual methods for threshing paddy. In the Philippines, some large McCormick type threshers were locally produced by a few small metalworking firms (Khan, 1971). These threshers were used primarily in Central Luzon by a few large farms and contract thresher operators. These huge machines were 3-4 tons in weight, and were powered by large 60 hp tractors. A total investment of approximately US $15,000 to $17,000 was required to own the thresher and tractor. The machines had a threshing output of 0.6 to 1.5 tons of dry paddy/hr. These machines were not suited for threshing freshly harvested high moisture paddy.

Owing to the limited number of contract thresher operators in Central Luzon, farmers had to wait a long time before their crop could be threshed. Consequently the practice of drying the crop in the field and then stacking it in *mandalas* to await threshing was common. This resulted in excessive grain damage and loss due to spoilage, inclement weather, rodents and insects. The McCormick threshers had high threshing and separating losses which ranged from 5 to 6 per cent. In those days the sight of women gleaning grain from a threshed straw pile was quite common all over Central Luzon. Small head stripping type paddy threshers, that had become popular in Japan, were not acceptable in Asia because of their low threshing output and high price.

The Institute recognized the need for suitable rice threshers and directed its engineering efforts towards the development of low-cost threshers which could be used by small farmers and contract operators for threshing freshly harvested paddy. The threshers had to be light in weight and fairly mobile for easy transport from one field to another. The design had to be simple for production by small decentralized metalworking shops in most developing countries.

Our early attempts were focused on developing hold-on type threshers since such machines were well suited for threshing wet paddy and did not displace too much labor from threshing. The first thresher, developed at IRRI in 1967, was a hold-on type drum thresher (Khan et al., June 1968) which was powered by a 4 hp air-cooled gasoline engine. The machine (Figure 30.1) had a 6 ft. long wire loop type threshing drum and a rotary cleaner for improved separation and cleaning under wet crop conditions. Five operators could thresh 300 to 450 kg. per hour by simultaneously holding paddy bundles against the rotating wire loop drum. This resulted in threshing labor efficiency of about 60-90 kg./man-hour. The machine performed well with freshly harvested high moisture crop. Twenty-one drum threshers were commercially produced by G.A. Machineries (GAMI) Inc., Bulacan. Some of these machines were evaluated in the Philippines and other countries but the market response was not very encouraging. The machine was somewhat heavy and cumbersome for moving from one field location to another. Based on this experience, a lightweight hold-on type table thresher was developed at IRRI (Khan, June 1970). This machine (Figure 30.2) used a unique radial flow principle and had a flat threshing surface. This machine was powered with a 4 hp engine and had a weight of 170 kg. The machine had a threshing output of 350 to 400 kg/hr. with 4 operators but the grain cleaning quality was not satisfactory. The circular design was light but cumbersome to transport on levees while moving from one field to another. A few table threshers were commercially produced by Messrs. Oberly & Co., Quezon City, Philippines, but the market response was not encouraging.

Figure 30.1: Hold-on type IRRI drum thresher developed in 1967–69.

Figure 30.2: Hold-on type IRRI table thresher (1967–71).

The experience of these two hold-on threshers convinced IRRI engineers that farmers were demanding a higher threshing output which hold-on type threshers could not provide. Thus by 1970, the stage was set for the development of throw-in type high output threshers at IRRI. Considerable efforts were directed from 1970-75 to develop a large tractor P.T.O. operated axial flow thresher (Khan et al., December 1970) to replace the McCormick threshers. This thresher (Figure 30.3) project however had to be abandoned owing to concerns that the machine would displace excessive labor. Efforts were therefore directed to develop a small engine driven lightweight throw-in type axial flow thresher. This machine was successfuly developed over a two-year period and eventually served as the basic design that has revolutionized paddy threshing in many Asian countries.

The first prototype engine powered throw-in IRRI axial flow thresher (Figure 30.4), Model TH-7, was designed and tested at IRRI in 1972 (Khan et al., 1972). This thresher was powered by a 7 hp air-cooled gasoline engine. It was improved through repeated field tests in many parts of the Philippines during 1972-73. The machine could thresh wet paddy and had a threshing output of one ton of paddy per hour with a threshing loss of less than 1 per cent. By June 1973 IRRI was ready to release this thresher for commercial production but manufacturers were reluctant to produce a new thresher for which there was no established market. Newspaper advertisements were placed by the Institute in the Manila papers and the author had to make many door-to-door calls on manufacturers in the Manila area to solicit interest in its production. Finally, firm orders for the supply of a few machines were placed by IRRI with two manufacturers to encourage commercial production.

These commercially produced threshers were extensively evaluated in late 1973 in Bulacan and Southern Nueva Ecija area (Nichols et al., December 1973) for performance and durability. Each machine was used for threshing 100 tons of paddy before it was taken down for checking and assessment of design weaknesses. During the testing phase, the test areas were subjected to two severe typhoons and the machines performed well under extremely wet and inclement weather. This impressed many local farmers who showed considerable interest in purchasing such machines. By early 1974, a third IRRI prototype was quickly fabricated (Duff et al., June 1974) which incorporated many improvements that were based on the field tests.

The two manufacturers were encouraged to sell the axial flow threshers in the Philippines for which a market had started to develop. As sales started to increase more manufacturers started the production of the IRRI threshers. By mid 1974, five companies were producing the axial flow thresher in the Philippines. Drawings were sent to other countries and single prototype machines were fabricated by manufacturers in Sri Lanka, Indonesia, Pakistan, Korea and Vietnam.

At this stage many manufacturers in the Philippines were starting to modify the basic IRRI design. They were beginning to offer attractive sales features such as engines with larger power ratings, suspension springs, shock-absorbers and pneumatic tyres for better transport on roads. IRRI purchased several threshers from manufacturers and sent these to other parts of the Philippines to popularize these machines as well as to cooperating industrial extension projects in other countries. By late 1974, eight companies were producing the axial flow thresher in the Philippines and these firms were having difficulty keeping up with the thresher demand. By June 30 1975, the axial flow thresher was being produced by 15 companies in 5 countries (Khan et al., June 1975). While the number of manufacturers was increasing rapidly, many poor quality machines were beginning to be offered by manufacturers who were not as quality-conscious.

At this stage, a manufacturer who was producing IRRI threshers of an excellent quality installed a flat oscillating screen (Figure 30.5) to replace the original rotary screen of the IRRI design. This improved grain-straw separation and made the machine more compact. The oscillating screen feature was liked by farmers and was quickly copied by other manufacturers. Gradually many manufacturers, who were not as quality conscious, were forced out of the market. By 1976 two firms in the Philippines, Kaunlaran Industries, San Pablo City, and C/B Crafts, San Rafael, Bulacan, had taken the lead in manufacturing IRRI threshers of excellent quality. These firms started with very humble beginnings, employing 2 to 3 workers and went on to become major thresher manufacturers with 40 to 100 employees and multi-million peso capitalization within a few years. The two firms still produce large numbers of threshers in the Philippines; however, additional firms are also producing IRRI threshers of comparable quality. By 1977, over 2,000 IRRI axial flow threshers (McMennamy et al., 1977) had been produced commercially in the Philippines. Most of these were used by relatively large farms, farmer cooperatives and custom thresher operators.

Surveys and field studies at IRRI (Toquero et al., 1974) revealed that the high initial cost (US $1,700-$2,000) and lack of field mobility during the wet season were factors restricting wider acceptance of the TH-7 threshers. It was observed that during the wet season, whenever field conditions were poor, the harvested crop had to be carried out of the paddy field to a thresher located on firm ground. This excessive handling of the crop required considerable labor and caused high handling losses of about 2-7 per cent.

It was therefore decided to develop a smaller portable version of the

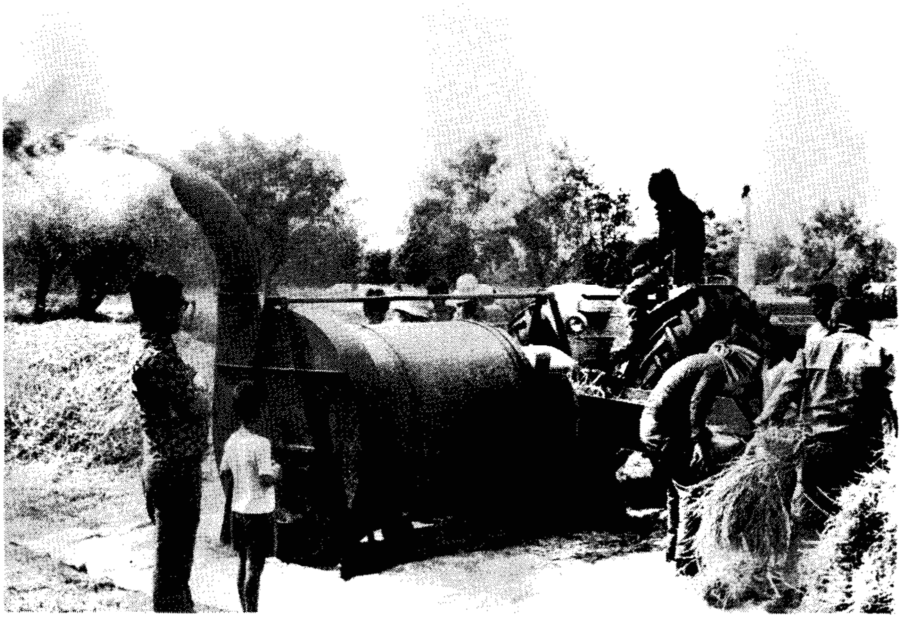

Figure 30.3: Throw-in type IRRI axial flow P.T.O. powered thresher (1969-75).

Figure 30.4: Throw-in type engine powered IRRI axial flow thresher model Th-7 (1972-76).

Figure 30.5: Commercially produced throw-in type IRRI axial flow thresher with oscillating screen.

Figure 30.6: Throw-in type IRRI portable thresher (1976-77).

IRRI axial flow thresher with a threshing capacity of about 400 kg hr., a price of about US $550 and a weight of less than 100 kg. Such a machine (Figure 30.6) was developed during 1976-77 (McMennamy et al., 1977). The machine performed well with a threshing output of 400 kg/hr. It was able to double labor efficiency as compared to traditional threshing methods which resulted in only 40 to 70 kg. of threshed grain/manhour. This portable thresher, TH-6, was light enough to be carried into wet fields by four operators thus eliminating the need for transporting the crop out of the field to far away locations for threshing. The portable thresher was commercially introduced in 1977 and gained rapid popularity, especially in the Iloilo, Pagsanjan, Zambales and Lanao areas of the Philippines. The large axil flow threshers continued to gain popularity in the Nueva Ecija, Laguna, Bulacan and Pampanga areas of the Philippines.

Simultaneously with the thresher developments that were going on in the Philippines, efforts were made by IRRI in 1975 and 1976 to introduce the IRRI TH-7 axial flow thresher in Thailand. Manufacturers in Thailand were quick to start fabrication of IRRI threshers. Thai manufacturers are highly innovative and it was not too long before many Thai manufacturers had introduced many design modifications to suit local crop and weather conditions. There is no question that the maximum number of innovative design changes were introduced by the Thai manufacturers to the basic IRRI axial flow thresher design. For this reason, one finds a much wider variety of axial flow threshers in Thailand than in the Philippines.

As of 1981 approximately 8,700 and 4,300 large and portable axial flow threshers had been sold in the Philippines and Thailand respectively by cooperating IRRI manufacturers. By the end of 1982 an estimated 20,000 IRRI axial flow threshers had been commercially produced by cooperating IRRI and other manufacturers in the Philippines. Production of IRRI type threshers in Thailand has been estimated to be about 18,000 units by the end of 1982.

Work on developing a larger tractor powered version of the IRRI axial flow thresher was undertaken in 1980 in Pakistan. A 40-60 hp tractor power take-off operated multicrop thresher was developed by the IRRI-PAK Program in Pakistan (Khan, June 1981). This machine (Figure 30.7) can thresh paddy and wheat and can chop and bruise wheat straw into small pieces for animal fodder. This thresher is now being commercially produced in Pakistan. At the present time IRRI threshers and their adapted versions arc being commercially produced in six major rice producing countries of Asia; Philippines, Thailand. Indonesia, India, Pakistan and Sri Lanka.

In 1981, F. Juarez et al. (1981) made a comparative analysis of IRRI threshers by surveying 260 and 101 thresher users in Thailand and the

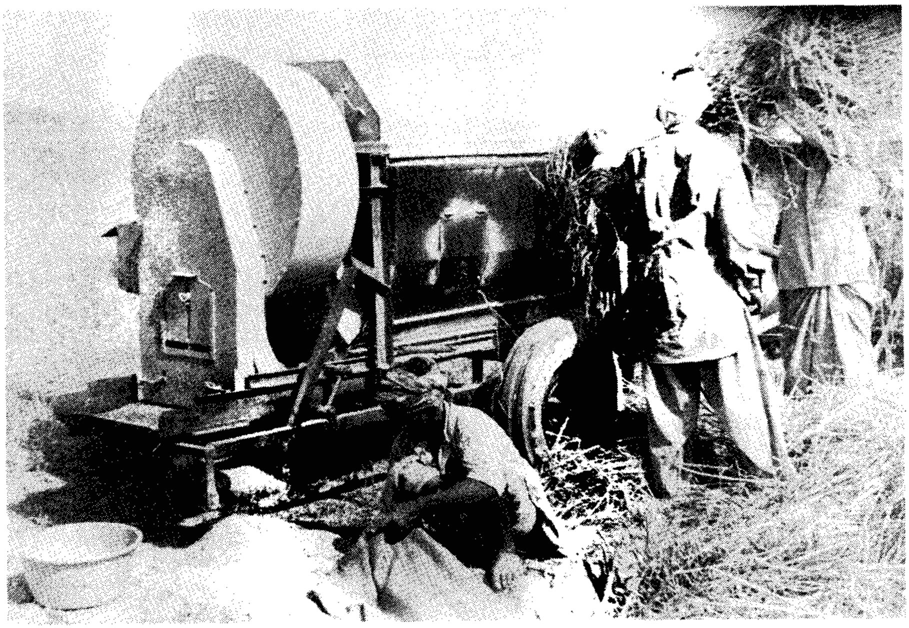

Figure 30.7: Tractor P.T.O. powered IRRI-PAR multi-crop thresher (1980-81).

Philippines respectively and arrived at the following conclusions:

The adoption of mechanized threshing in Thailand and Philippines has been rapid over the last 2-4 years. The first adoption of the rice thresher in Thailand was in Chachoengsao province in 1975. It was an IRRI-designed large axial flow type. In the Philippines, the first owner was in Laguna Province in 1974, also of the large type from IRRI. It was later followed by the portable Bicol type non-IRRI designs in 1975 and the portable IRRI-design in 1976. In both countries, use of these machines has spread widely in areas with relatively good irrigation and those that are double-cropped.

The original source of innovation was IRRI, which was followed by production of local manufacturers and then diffusion to the first buyers who were mostly larger farms. Contract services by these owners for extra income became common so that use of the machine spread rapidly even to non-owners. In the Philippines, users had reached 75% of the farmers in the irrigated villages surveyed in 1978 and 45% in the rainfed areas one year after introduction. A follow-up survey in 1981 registered 100% users.

Contracting rather than cooperative ownership, was the main method in which machine services were availed by farmers who had not the capital to buy a machine. In Thailand, the average contract charge in 1978 is $2.5–$3.4/ton. These were paid in cash. In the Philippines, contract charges were paid in kind at 5.5%–6% of the gross production. The charge rate in Thailand covers only the semi-skilled labor cost of operating a thresher (or the machine operator), fuel and oil cost, transportation cost and the machine service charge. The customers had to provide their own 5-6 laborers for threshing. In the Philippines, these laborers are included in the rate.

Thresher owners, therefore, benefitted from two sources: one from own farm use and another from off-farm contracting services. The present value approach indicated a high profitability for thresher investments. Expectations of profitability in future investments were also high in Thailand. In the survey areas of the Philippines, however, future investment was less favorable because of limited opportunities for custom work due to the large number of threshers already in use.

All users gained from thresher adoption. The two main benefits were the net cost savings and/or the reduction of losses.

The net present value of total benefits from thresher renters and users, ranged from $7 to $18/ha. for medium farms in Thailand and from $1.0 to $18/ha. for those in the Philippines. The average gains per farm ranged from $32 to $82/ha. in Thailand and $3 to $120/ha. in the Philippines.

Increases in fuel costs make thresher investment in Thailand more profitable because of the relatively higher fuel consumption of tractors for threshing. In the case of the Philippines, increases in fuel costs make thresher investments more unprofitable because traditional threshing does not use fuel. As maintenance cost increases, thresher investment becomes more unprofitable.

Deep placement fertilizer applicators

Farmers in Asia have not been able to make full use of fertilizers to boost their rice yields owing to poor fertilizer use efficiencies. As early as 1941, Shioiri in Japan explained the mechanics of loss of surface applied ammonia in flooded soils and recommended the deep placement of ammonium fertilizers. Many studies at IRRI and other institutions have consistently demonstrated that fertilizer use efficiency in wetland rice production could be almost doubled by placing fertilizer in the reduced soil layer at depths ranging from 5 to 15 cm.

Prilled urea is the most popular fertilizer material used for rice production in Asia. Over the last decade an unusually large number of deep placement applicators have been developed for prilled urea in Japan, China and at IRRI. The performance of these machines has been erratic. This has led to the belief that prilled urea is not a suitable fertilizer material for deep placement and consequently urea briquettes and urea supergranules have been developed.

The Institute is fully aware of the immense benefits that could accrue to rice farmers in Asia through deep placement of fertilizer and is placing a high priority on the development of such fertilizer applicators. Last year a review of deep placement applicator development worldwide was undertaken by the author to gain a better understanding of the deep placement applicator problem.

As an initial step, a systematic effort was made to define precisely the deep placement problem. This led to the development of a set of criteria for technical and commercial acceptability (Khan, September 1982) of applicators. In order to gain a better understanding of the deep placement phenomenon, a series of laboratory experiments were conducted. which led to the significant findings that conventional methods of fertilizer placement result in a large transfer of fertilizer to floodwater. The technical criteria for applicators were subsequently revised to reflect the new findings. Efforts were then made to optimize separately the designs of the three major components of applicators in the laboratory, i.e., the fertilizer metering, conveying and furrow closing mechanisms.

Twenty new deep placement applicator concepts were then proposed (Khan, November 1982) out of which six were selected for intensive design and development efforts. This led to the development of five new applicators. These applicators, two for prilled urea, one for both prilled and forestry grade urea and two for USG were designed with the objective of minimizing the transfer of N to floodwater. A brief discussion of the study of N transfer to floodwater, which served as the basic foundation for the successful development of deep placement applicators, is included in this paper.

Mechanics of N transfer to floodwater

Fertilizer use efficiencies in upland farming (unflooded conditions) have been reported to be 50 to 60 per cent (Craswell and Velk 1979) when those obtained under wetland farming conditions are generally 30 to 50 per cent (Prasad and De Datta, 1979). The reasons for this wide difference in fertilizer use efficiencies were not well understood. Experiments conducted in Pakistan (Ross, 1980) report a 60 per cent recovery of applied nitrogen by rice crop when fertilizer was incorporated in dry conditions and followed by flooding. More recently, Bhatti et al., (1983) report that fertilizer incorporated in dry soil and followed by flooding increases paddy yields by 1 to 2 tons/ha. over conventional broadcasting of fertilizer in flooded soils. One can conclude from the results of these two studies that flooding, after the fertilizer has been incorporated, is not the cause for reducing fertilizer use efficiencies in wetland farming. Since fertilizer use efficiencies under unflooded upland farming conditions are quite high, it was hypothesized that the low fertilizer use efficiencies in wetland farming were perhaps due to the presence of water during the time the fertilizer was being applied.

This observation led to two laboratory studies in the IRRI Agricultural Engineering Department to evaluate different avenues of N transfer to floodwater during deep placement of fertilizer in flooded soils. Prilled urea was used in the first study (Khan et al., April 1983) as this material was considered to be most susceptible to N transfer to floodwater due to its small granule size. Similar experiments were later repeated with both prilled urea and urea supergranules (Mahmood, 1983).

The findings of these two studies indicated that during deep placement most of the fertilizer was not deposited in the soil but was transferred to floodwater (Figure 30.8). The two main channels for fertilizer transfer to floodwater during deep placement were dissolution of fertilizer during transit from the water surface to the furrow bottom (43-75 per cent); upward movement of fertilizer granules or solution to the floodwater during furrow closing (up to 29 per cent). These two

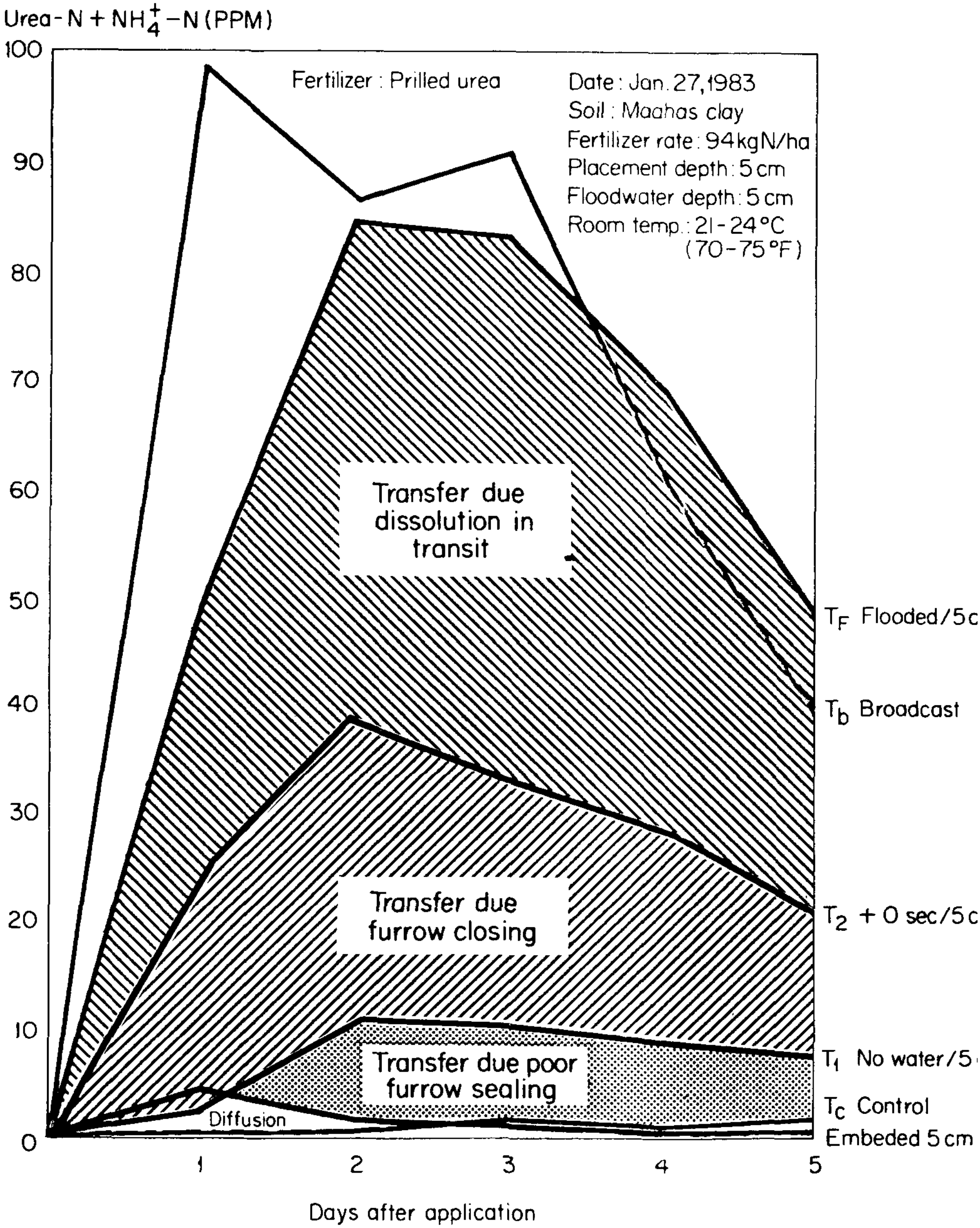

Figure 30.8: Major avenues for N transfer to floodwater during prilled urea placement at 5 cm depth in flooded Maahas clay (Ag. Eng'g.).

Figure 30.9: Spring auger applicator-prilled urea.

Figure 30.10: Spring auger applicator attachment for IRRI trans-planter-prilled urea.

Figure 30.11 : Oscillating plunger fertilizer applicator-prilled and forestry grade urea.

Figure 30.12: Rolling presswheel applicator — USG and forestry grade urea.

Figure 30.13: Inclined press-wedge applicator – USG.

transfer avenues were so significant that in some cases N transfer to floodwater during deep placement was almost close to that of broadcast application. Transfer due to poorly sealed furrows or due to diffusion through puddled soils was relatively small.

With these findings, it was felt that the key to improving fertilizer use efficiency in wetland cutlivation was to minimize N transfer to floodwater. Such an approach would maximize retention of fertilizer in the soil where it would be less vulnerable to volatilization losses. It was concluded from this study that minimizing fertilizer-water contact, during all three phases of fertilizer placement – transit, placement and covering – would be an effective method for improving fertilizer use efficiencies in flooded paddies. The general approach of minimizing N transfer to floodwater was followed in the development of the following five new applicators (Khan et al., June 1983) at IRRI:

(a) Spring Auger Applicator – Prilled Urea (Figure 30.9),
(b) Spring Auger Applicator Attachment for IRRI transplanter – Prilled Urea (Figure 30.10);
(c) Oscillating Plunger Fertilizer Applicator – Prilled and Forestry Grade Urea (Figure 30.11);

(d) Rolling Presswheel Applicator — USG & Forestry Grade Urea (Figure 30.12);
(e) Inclined Press-wedge Applicator — USG (Figure 30.13).

Comparative performance of applicators

In December 1982, three deep placement applicators were evaluated in Maahas clay plots at lRRI by measuring the amount of N transfer to floodwater. The plots were settled for ten days after puddling. The results of this test (Table 30.1) indicate that prilled urea can be just as good a fertilizer for deep placement as other forms of urea.

Table 30.1 N transfer to floodwater with 3 fertilizer deep-placement machines, 1982 test.

Machine	Fertilizer material	Total N (ppm) in flood water — 24 hours after application	Machine performance rating
Straight auger	Prill	16.47	1
Deep plunger* (intermittent)	USG	34.37	2
Rolling presswheel	Forestry grade	38.63	3

* This machine was developed earlier and had given best performance in tests conducted during 1981-82. However it has some drawbacks which limit is commercial acceptability.

During the 1983 dry season three of the five new applicators were evaluated at the IRRI research farm in yield trials under a collaborative project between the Agronomy and Agricultural Engineering departments. The results of these tests are given in Table 30.2

The performance of the three new machines, Nos. 1, 2, and 3, in these tests was quite satisfactory and most machines compared favorably with hand placement of USG, which was previously considered to be the most efficient deep placement method at IRRI.

A more advanced yield test was also conducted under a collaborative arrangement between the IRRI Agronomy and Agricultural Engineering departments during the 1983 dry season at IRRI and at the Maligaya Research Station on only those machines that had exhibited a promising performance in 1982. Two levels of fertilizer were applied on IR-36 paddy variety in that test. The results are summarized in Table 30.3.

The test gave a similar yield for the three new machines at two locations in the Philippines.

The tests conclusively proved that prilled urea is just as efficient a material as USG or dissolved urea. Since farmers in Asia commonly use prilled urea, the only commercially available fertilizer material, chances

Table 30.2 Preliminary yield tests, 1983 dry season, IRRI agronomy dept.

Machine	Fertilizer material	Fertilizer Kg/N ha.	Grain yield	Efficiency Kg rough rice /kg N
1) Straight Auger ¾″	Prill	78	5.9	28
2) Auger with transplanter	Prill	82	5.6	23
3) Rolling presswheel	Forestry grade	84	6.0	26
4) Deep plunger (intermittent)*	USG	84	5.5	21
5) Transplanter with liquid*	Dissolved urea	83	5.9	26
6) Hand placed	USG	87	5.9	24

* These machines were developed earlier and had given promising performance in tests conducted in 1981-82. These machines, however, have some drawbacks which limit their commercial acceptability.

for successful commercialization of prilled urea applicators are considerably better than for USG or dissolved urea.

All the five new machines were again tested at the IRRI Research Farm in May 1983 by the Agricultural Engineering Dept. by evaluating the N transfer to floodwater. The results are shown in Table 30.4.

All five new machines have indicated encouraging performance as their N transfer values have been less than 25 ppm, a value that was agreed by agronomists and plant scientists at IRRI to be acceptable. The two prilled urea applicators, the auger and the oscillating plunger resulted in a lower N transfer to floodwater than even the hand placement of USG. The five machines are now being further tested and improved through yield trials during the 1983 wet season in cooperation with the following groups:

(a) IRRI Agronomy Department at the IRRI Farm and the Maligaya Research Station;
(b) IRRI Training and Technology Transfer Department at various research stations and farmers' fields in the Philippines;
(c) IRRI Agricultural Engineering Department in nine farmers' fields in Laguna Province; and
(d) Ministry of Food and Agriculture, Govt. of the Philippines at the various research sites.

It is hoped that by the end of the 1983 wet season, the machines will have been sufficiently improved for extensive farmer trials in the Philippines. If the trials prove conclusive, the designs will be released during 1984 to manufacturers for limited test marketing in selected

Table 30.3 Advanced tests, 1983 dry season, IRRI agronomy department.

Machine	Fertilizer material	IRRI Research Farm Fertilizer rate Kg N/ha.	Grain yield tons/ha.	Fertilizer efficiency Kg rice/ kg N	Maligaya Research Station Fertilizer rate Kg N/ha.	Grain yield tons/ha.	Fertilizer efficiency Kg rice/kg N
Straight auger ¾″	Prill	67	6.0	21	58	5.6	36
Deep plunger (intermittent)*	USG	53	6.0	27	51	5.5	39
Transplanter with liquid*	Dissolved urea	64	5.7	17	54	5.1	30
Hand placement	USG	58	5.9	22	58	5.9	41
Straight auger ¾″	Prill	108	6.5	18	80	6.3	35
Deep plunger (intermittent)*	USG	82	6.1	18	79	5.9	30
Transplanter with liquid*	Dissolved urea	90	5.9	14	76	5.7	29
Hand placement	USG	87	5.6	11	87	6.4	34

* These machines were developed earlier and had exhibited promising performance in 1981-82. These machines, however, have some drawbacks which limit their commercial acceptability.

Table 30.4 N transfer to floodwater with different fertilizer deep-placement techniques, 1983 test.

Machine	Fertilizer material	Total N (ppm) in flood water – 24 hours after application	Machine performance rating
Straight auger ¾" surface closure	Prill	3.3	3
Straight auger ¾" with underground closure	Prill	2	1
Rolling presswheel with underground closure	Forestry grade	11.6	7
Rolling presswheel with underground closure	USG	6.7	5
Inclined press-wedge	USG	14.8	8
Oscillating plunger with underground closure	Prill	2.4	2
Auger ¾" on transplanter	Prill	8.7	6
Deep plunger (intermittent)*	USG	6.2	4
Hand placement	USG	6.7	5

* This machine was developed earlier and had given promising performance in tests conducted in 1981-82. However, it has some drawbacks which limit commercial acceptability.

areas and for extensive field evaluation and demonstration in the Philippines. Simultaneously, efforts will be made on conducting preliminary evaluation in selected rice growing countries of Asia through cooperating organizations.

Conclusions

The experience of the IRRI axial flow threshers indicates some of the benefits that could accrue to farmers through appropriate machines. The IRRI program highlights the importance of a commercial approach to technology development. Development of farm machines without adequate regard to commercial introduction is a luxury that most developing countries cannot afford. Unfortunately, many developing countries' research institutions consider the development of a technology as an end in itself.

The close interaction of the private manufacturing firms and a Public Sector International Agricultural Research Center, without any financial involvement, was an unusual example of cooperation which helped in the delivery of modern threshing technology to small farmers in Asia. The contributions of the cooperating IRRI thresher manufacturers, especially those with innovative skills and quality consciousness were essential links in the technology transfer chain. The original IRRI thresher designs were invariably modified and adapted by manufacturers to suit their markets and production facilities. In many ways the thresher manufacturers helped to develop and adapt the IRRI technology and served as extension agents for popularizing the machines developed by IRRI.

The second example, of deep placement fertilizer applicators, offers greater challenges to IRRI engineers and high potential benefits for rice farmers. Let us hope that the fertilizer applicators that are now being developed at IRRI will help to improve paddy yields and raise the standards of living of small farmers of Asia.

Both examples clearly illustrate the complexities of the machinery development process and the many years of dedicated efforts that are required for developing commercially viable technologies. Hopefully, agricultural policy-makers will recognize this special aspect of engineering research and provide adequate resources to their National Engineering Research Institutions. Most of these institutions are now struggling with inadequate resources for commercial type research and development activities.

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Appendix: Recommendations of the Women in Rice Farming Systems Conference 26–30 September 1983

Issues

Women throughout the world play a significant role in rice farming at the production and postharvest phases. Their specific roles vary widely depending upon ecological, economic, sociological, and religious factors. Rural women are often thought of as a homogeneous group, but it is important to recognise that women from different socio-economic strata have different interests and problems.

Conventional economics views the household as a homogeneous unit in which resources and income are shared euqally by all family members. Available evidence, however, suggests that intrahousehold distribution of resources and income vary by age and sex, and that often men and women enjoy different economic status within a household. Their expenditure preferences may also differ. Therefore it is important to ensure that women have greater access to income. Additional income for them will help increase total family income and thereby improve the nutrition and well-being of children in particular.

In some areas where rice is an important staple, a considerable percentage of rural women belong to landless labor families and depend on daily wages for income. Those women tend to suffer most when labor is displaced as a result of modernization. Long hours of work at home and outside (referred to as the double day) make time-saving and drudgery-reducing technologies necessary for women-specific occupations. Technological development programs, however, should be planned and introduced so that landless, wage-labor women can also benefit from active participation in the new technologies.

Although it is now widely recognized that women make important contributions to agriculture, little has been done to make women more productive through extension and input supply services. The goal of increasing agricultural output necessitates specific programs and policies for women to enable them to play their roles more effectively. Programs and policies will vary from country to country and between regions within a country, depending on the local situation.

Some examples of programs that governments, CGIAR institutions, academic, and voluntary agencies can initiate, with the help of appropriate bilateral and multilateral technical assistance agencies where necessary, follow.

Action research projects

Action research projects are intended to assess the feasibility of achieving through appropriate packages of technology, input supply and marketing, services and public policies, the following aims:

1. Diversified opportunities for producing income within and outside the home.
2. Reduction of drudgery for family farm women who are overworked due to their dual productive and reproductive roles. Care should be taken to ensure that one group of women does not benefit at the expense of another group. For example, poor rural women from landless households should not suffer as a result of the introduction of a technological innovation that benefits landowning families.
3. Increased productivity and demand for labor to ensure greater opportunities and stable income for women who work as wage labor.

To prepare suitable action research projects, a project preparation group consisting of national experts, representatives of donor agencies, and IRRI could be formed. The group should plan projects according to priorities perceived by women themselves, and should utilize the knowledge and skills of local women. Action research projects should be designed so that their impact could be measured at the end of 3 years. As a preliminary step in the project formulation exercise, a portfolio of available opportunities for generating additional on-farm and off-farm employment should be prepared. Among on-farm opportunities, special attention should be given to multiple cropping, mixed farming, renewable energy sources, and biomass utilization. Off-farm employment should include village industries and the services sector. The projects, prepared in consultation with farm women of the concerned areas, should be structured so that they can become self-replicating. External inputs, if any, should be self-eliminating.

Action research projects serve three important goals. First, they help to identify the socioeconomic and sociocultural factors responsible for the success or failure of projects intended to improve the quality of life of farm women. Second, they have a demonstration value for illustrating what can be done by using the best available know-how and technology. Third, action research projects could be used as a training ground for imparting new skills.

Those who plan and execute action research projects should work with humility, listen to and learn from local women, and avoid publicity that leads to expectations that cannot be realized. Successful projects can have a large impact, because to the rural poor seeing is believing.

Social science research network

IRRI should organize a network of cooperative research among social and natural scientists, policy makers, extension workers, and grass roots organizers to stimulate the growth of research programs with the following aims:

1. Evaluate existing research on women's participation in rice farming systems from the socioeconomic and technological viewpoint.
2. Assess the impact of technological change on the poorest women. Of particular importance is the need to emphasize the interconnections between earnings, employment, work burden, nutrition, and health.
3. Examine the social, economic, and political factors that lead to sex and class biases in the development of technological change.
4. Analyze the impact of government agricultural policy at the macrolevel on women at the microlevel.
5. Evaluate the sex and class implications of existing and emerging technologies in their regional context.
6. Undertake documentation and analysis of successful and unsuccessful grassroots experiences of women organizing to gain access to the benefits of technological change, including the factors that inhibit or favor the growth of women's organizations striving to increase women's access to inputs, training opportunities, and marketing facilities.
7. Assess the institutions that structure the flow of information, credit, and technology to women, especially to the poorest of them.

This work will provide the basis for development of the following methods for impact analysis and constraints analysis.

Impact analysis

A method for measuring the impact of new technologies and development projects on women needs to be developed. The impact analysis should distinguish between the benefits to women in farm households and to women wage laborers. Where the displacement of women labor is likely, the analysis should indicate the likelihood of alternative employment opportunities. That will help in planning, training, and retraining programs. Indices for qualitatively and quantitatively measuring the impact of new technologies should be developed. There should be standardized procedures for carrying out impact analyses for:

- research projects to develop new technology, and
- development projects using the best available technology.

The methods of analyzing the potential impact of research and development projects will vary.

Constraints analysis

The constraints methodology used at IRRI has examined the technical and economic constraints to the adoption of new rice technologies. Extension of that methodology to include social, educational, and institutional constraints is needed, as women are likely to suffer more from these constraints. In the development of constraints analysis methods, flexibility is required to allow for region- or country-specific variations, and within any country or region the methods should differentiate between the village level and the household level. Methods developed under these guidelines could be used as a planning tool for the design, monitoring, and evaluation of action research projects as well as for more conventional research projects and programs.

Action by different agencies

National governments

Government policies in different countries must be examined in terms of:

1. opportunities for knowledge and skill acquisition by rural women through appropriate training to increase their efficiency;

2. supplementing income-generating activities for women combined with necessary support services such as credit and marketing facilities,
3. personnel policies for the greater employment of women in research, extension, and input supply;
4. greater participation of female professionals in conferences on agriculture and farming systems, and at the policy formulation level;
5. effective use of the training and visit (T&V) system of knowledge transfer to reach women in households wherever the T&V system has been introduced, and increasing the involvement of women as extension agents in technology transfer programs;
6. impact on women's land ownership and tenancy rights,
7. providing women with ownership of new technologies by organizing producers' cooperatives or other forms of women's organizations,
8. recognition of the important contribution of women to rice farming systems, adoption of programs to enhance their current role, and raising awareness among women and men of the important role that women play in agriculture;
9. sensitization of the scientific community and extension personnel to the problems of women involved in agriculture; and
10. continuous monitoring of the impact of agricultural and rural development programs and policies on women.

Government policies vary from country to country and depend upon economic factors and sociopolitical ideology. Nevertheless, in the formulation of government policies, explicit recognition should be given to the specific needs of rural women. Many development projects in agriculture (mechanization, irrigation, etc.) have worked to the disadvantage of women by increasing their workload (in the case of family farm women), by displacing them from traditional employment opportunities (in the case of agricultural wage labor women), or in some cases, depriving them of ownership or use rights to land.

To increase female literacy, steps should be taken to provide the family an economic stake in children attending school. In many developing countries, children, particularly girls are unable to attend school regularly because they have to care for the younger children. Also, child labor helps supplement household income. Where the problem is acute, a Food for Learning program could be initiated with assistance from the World Food Program of the Food and Agriculture Organization of the United Nations or from bilateral programs such as the Title III Food for Development Program of the United States of America. In addition, technologies for children's tasks such as scaring birds, and fetching fuel, wood, and water need attention so that children from poor families can attend school.

In summary, governments should give explicit recognition to the pivotal role women could play in accelerating the pace of agricultural progress and agrarian prosperity. Even illiterate women rapidly master new skills. The active involvement of women from the planning stage of farming systems improvement programs will help ensure the success of the projects and help avoid unanticipated hardships.

Role of CGIAR and TAC

The CGIAR should organize for senior policy makers an inter-center seminar on Women in Farming Systems Improvement based on the work in all IARCs. All CGIAR members could be invited to participate so that donors can contribute to the organization of action research projects of the kind recommended.

The Technical Advisory Committee (TAC) to CGIAR should add the following to the Terms of Reference and Guidelines for external program reviews of the IARCs: Examine the research and training programs of the institute in relation to their potential impact on women-specific occupations with a view to diversifying employment opportunities, generating additional income, and reducing drudgery.

While the external quinquennial reviews may help to assess the situation, the Centers themselves could monitor progress during their annual program reviews.

IRRI

Several concrete actions were proposed at this Conference. To ensure prompt follow-up action on the recommendations, it is suggested that IRRI set up a task force for initiating steps to implement them. In addition to IRRI staff members, the task force may consist of a cross section of the expertise represented at the Conference. The work of the task force can be carried out largely by correspondence. With the help of the task force, IRRI should develop procedures for undertaking impact and constraints analyses, and circulate them for comments to all those concerned, including members of CGIAR and UN agencies.

IRRI should also stimulate research on the development of improved technologies for women, because current technology development programs generally tend to ignore women's needs and their role in farming. Technology needs of women will vary from country to country. Therefore research will have to be site- and situation-specific. IRRI can begin to identify women's needs and to determine research priorities and strategies. Also, IRRI should organize a trainers' training program for those engaged in imparting new skills to farm women in rice growing areas.

The general goal of technology development at IRRI is to maximize rice yields. Technologies that meet this goal are not always those that also maximize farm income or wage income for the landless. Although IRRI's principal clientele are small rice farmers, it is also necessary to consider the impact of technology on the employment of rural women. In this regard, it will be useful to classify technologies according to their economic viability at different wage rates and whether they will affect women's cultivation tasks. Technologies that can help improve real wages and income should receive priority.

Women in farm households can benefit from farm machinery and all rural women can benefit from domestic labor-saving technologies. No information is readily available on improved machinery suitable for women engaged in agriculture. Initially, a separate section on agriculture machinery suitable for women could be included in the newsletter published by the Regional Network for Agricultural Machinery (RNAM), University of the Philippines at Los Baños.

In addition to that step, IRRI should bring out a twice a year newsletter on research relevant to women in rice farming systems. This newsletter could be linked to a copublication network by making the information available in many languages. Regional correspondents could be designated in consultation with national research systems and FAO regional offices.

Finally, each IARC can maintain a directory of researchers in its region who are working on women's concerns in agricultural modernization. Once the directory is computerized, it can become readily available to all interested.