Rice in the Shadow of Skyscrapers

Policy Choices in a Dynamic East and Southeast Asian Setting

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IRRI

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Foreword

This compendium of policy notes is the result of cooperation between the Food and Agriculture Organization of the UN, The World Bank and the International Rice Research Institute. Across Asia, rice is food for the largest segment of the human family. These policy notes seek to contribute to the ongoing policy dialogues and debates about rice and food security in East and Southeast Asia and to better informed decision-making. The aim of this compendium is to synthesize and reframe a large body of recent literature into a readily-accessible format for public officials, business leaders, members of civil society and other stakeholders in the policymaking process. While the focus of the publication is on the rice sector in East and Southeast Asia, many of its key findings and conclusions will also be of interest to policymakers addressing similar challenges associated with staple food in other regions.

The role of rice in East and Southeast Asia is shifting along with broader societal changes including changing economic structures, demography (including rapid urbanization), rising incomes and major changes in food consumption patterns. Nevertheless, the political economy of rice remains exceedingly complex within the region. Governments continue to employ an array of instruments to realize or balance among differing objectives and address the interests and pressures of different stakeholders. Rice remains closely tied to food security imperatives, but increasingly also to improving the incomes of rice producers, realizing commercial trade objectives, and, more recently, lowering the environmental footprint of agriculture in major rice-growing areas.

With broader changes in society, the relevance and efficacy of some traditional policy instruments related to rice are being questioned. The

costs, benefits and distributional implications of policies (or public investment patterns) are being reconsidered, along with the possibility of alternative approaches. While the rice production and marketing conditions and food security calculus vary considerably among countries, policymakers remain keen to learn about the approaches and experiences of others.

This compendium seeks to support and nurture this learning process and thereby contribute to more effective and efficient policies and programs. It is part of ongoing efforts of the three sponsoring organizations to fight poverty and improve food security in East and Southeast Asia through research, sharing of knowledge, strategy development, technical assistance and boosting investments in rice-related infrastructure and management systems.

Collaboration on this Policy Note series has involved 20 authors from the three sponsoring organizations and other partner institutions. The work was initiated and led by Steven Jaffee (Lead Rural Development Specialist, Global Agriculture Practice, The World Bank) and David Dawe and Nuno Santos (Senior Economist and Economist, respectively, FAO) who identified the major themes and contributing authors and edited the series.

In addition to the lead authors of the notes (who in certain instances also reviewed other notes given their fields of expertise), the editors wish to thank the following reviewers: Stephan Baas (Natural Resources Officer, Climate, Energy and Tenure Division, FAO), Francesco Tubiello (Natural Resources Officer, Climate, Energy and Tenure Division, FAO), Martin Gummert (Senior Scientist, Post-harvest Development, IRRI), Hermann Pfeiffer (Agronomist, Investment Centre Division, FAO), and Michael Morris (Lead Agricultural Economist, World Bank). The notes were ably edited by Bill Hardy. The views expressed are those of the authors and do not necessarily represent those of the three partner organizations.

Lastly, the editors wish to thank Shyam Khadka (Chief, Asia and Pacific Service, Investment Centre Division, FAO), Patrick Labaste (Practice Leader, Global Agriculture Practice, The World Bank), Suzanne Raswant (earlier Chief, Asia and Pacific Service, Investment Centre, FAO) for their overall support and guidance throughout the preparation process, and Egle De Angelis (Program Assistant, Asia and Pacific Service, Investment Centre) for her trustworthy assistance in the formatting and publication process.

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Abbreviations and Acronyms

ACIAR	Australian Center for International Agricultural Research
AERR	ASEAN Emergency Rice Reserve
AFSR	ASEAN Food Security Reserve
AMS	Aggregate Measure of Support
AoA	Agreement on Agriculture
APTERR	ASEAN Plus Three Emergency Rice Reserve
ASEAN	Association of Southeast Asian Nations
AWD	Alternate Wetting-and-Drying
BAAC	Bank of Agriculture and Agricultural Cooperatives
CAVAC	Cambodia Agricultural Value Chain Program
CNY	Chinese Yuan
CoA	Committee on Agriculture
DDSR	Dry direct-seeded rice
EAERR	East Asia Emergency Rice Reserve
EBA	Everything But Arms
ET	Evaporation and Transpiration
FAO	Food and Agriculture Organization
G2G	Government to Government
GAP	Good Agricultural Practices
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GHG	Greenhouse Gas

GIZ	Gesellschaft für Internationale Zusammenarbeit (German Federal Enterprise for International Development)
GR	Green Revolution
ICT	Information and Communication Technology
IDE	Institute of Developing Economies
IDR	Indonesian Rupee
IEFR	International Emergency Food Reserve
IFPRI	International Food Policy Research Institute
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
LCC	Leaf color chart
LIRP	Low-income, resource-poor
MASSCOTE	Mapping Systems and Services for Canal Operations Techniques
MDG	Millennium Development Goal
MIC	Minimum Import Commitment
MKD	Mekong River Delta
MoU	Memorandum of Understanding
NFA	National Food Authority
NGO	Non-Governmental Organization

NMR	Nutrient Manager for Rice
NPK	Nitrogen Phosphorus Potassium
NRPC	National (Thailand) Rice Policy Committee
NSW	New South Wales
O&M	Operation and Maintenance
OECD	Organization for Economic Co-operation and Development
PH	Post Harvest
PMT	Proxy Means Test
RML	Reuters Market Light
RSP	Runoff, Seepage and percolation
SSC	Saturated Soil Culture
SSNM	Site-specific nutrient management
T&V	Training and Visit System
THB	Thai Baht
TPDS	Targeted Public Distribution System
USDA	United States Department of Agriculture
WB	World Bank
WTO	World Trade Organization

Introduction and Objectives

Steven Jaffee, David Dawe, Nuno Santos
and Samarendu Mohanty

The (changing) setting

In many countries of East and Southeast Asia, rice plays a very significant role in society, typically accounting for the largest single share of food calories and food expenditure, playing an important role in the agrarian system and livelihoods of a majority of farmers, being a leading user of land and water resources, and featuring heavily in local cultures and traditions. As an illustration, the share of rice in total cereal production is very high in the region: around 43 percent in East Asia and 86 percent in Southeast Asia versus around 28 percent for the world. Moreover, the region is the world's leading rice producer. Using FAO estimates for 2012, East and Southeast Asia accounted for about 60 percent of the world's paddy rice production (with China alone accounting for around 28 percent). In the region, rice is also an important traded commodity, with the region featuring several of the world's leading rice exporters (such as Viet Nam and Thailand) and importers (such as China, the Philippines and Indonesia). Overall, the region accounts for at least 44 percent of total world rice exports and at least 19 percent of total imports.

Yet, the role of rice is changing in Asia along with broader changes in society, including changes in agrarian and broader economic structures, demographic shifts (including urbanization), rising per capita income and major changes in food consumption patterns. Rice as a share of agricultural Gross Domestic Product (GDP), rural employment, food calories and food expenditures is falling – in some places slowly; in others more rapidly. Between 1961 and 2007, the share of rice in agricultural production in East Asia declined from 19 to 8 percent, while in Southeast Asia this decline was from 40 to 32 percent. During the same period, rice's contribution to national GDP fell from 7 percent to less than 1 percent in East Asia and from 15 percent to 4 percent in Southeast Asia (Timmer, 2010). The agricultural labour force is becoming older, and women's role in farm

management is increasing.

Hence, we employ a regional metaphor of rice being produced under a widening shadow of skyscrapers. In most of East and Southeast Asia, manufacturing, construction and services have been growing at a fast pace. For many countries, visions for the future tend to highlight gleaming buildings and high-tech industries. Rice is considered a necessity, a staple food, a source of livelihood for many poor (or near poor) households and an object of considerable cultural and social importance, yet it is rarely cast as a growth engine in a modern economy. In the economic realm, rice has thus been overshadowed. The past decade has seen significant conversion of agricultural land for urban and industrial uses and increased competition between these and agriculture. Work and career opportunities are drawing many rural people to cities, including the younger, now better educated, generation.

Nevertheless, the political economy for rice remains very significant and complex in most Asian countries. Governments continue to employ an array of instruments to realize or balance among different objectives and address the interests and pressures of different stakeholders. Rice remains closely tied to national and sub-national food security imperatives, yet other important objectives relate to improving the income/standard of living of rice producers, realizing commercial trade objectives and, more recently, lowering the environmental footprint of agriculture and agro-industry. For some countries, the trade in rice is considered an important element of foreign policy and inter-regional cooperation. In some countries, rice and rice-related policies are heavily factored into national politics. Table 1 identifies some of the most common types of instruments used. This is an illustrative rather than exhaustive list and, indeed, some of the Policy Notes that follow include attention to additional policy/program instruments.

With broader changes in society, the relevance and efficacy of some traditional policy instruments related to rice are being questioned. The costs, benefits and distributional implications of these policies (or public investment patterns) are being reconsidered as is the potential value of alternative approaches. Although the production and market conditions and food security calculus vary considerably among countries, policymakers remain keen to learn about the approaches and experiences of others.

Table 1: Some common instruments used by governments to realize objectives related to rice (policies, regulations, investments, financial initiatives)

Production and supply	Rice markets and trade
Land-use planning and/or restrictions	Facilitation (or restriction) of foreign direct investment in milling
Land concessions to investors	Concessional credit lines for millers
Land sales and rental restrictions	State-owned enterprise milling/trading
Investments in irrigation and irrigation services	Public grain reserves
R&D on improved rice varieties/agronomic practices	Subsidized food distribution program
Agricultural extension and training services	Inter-regional/provincial movement restrictions
Input subsidies (or taxes)	Rice fortification initiatives
(Facilitation of) seed multiplication	Energy subsidies for rice millers/agri-businesses
(Facilitation of) mechanization services	Upgrade of port infrastructure
Regulation of pesticide distribution/use/storage	Trade facilitation and promotion services
Concessional finance to farmers	Export bans or quantitative restrictions
Minimum prices or administrative price support	Tariffs/other restrictions on rice imports
Technical/financial support to farmer cooperatives	Government-to-government trade contracts

Source: Author's own calculation.

Objectives, audience and approach

This Policy Note compendium seeks to contribute to improved policy and programmatic decisions by governments within East and Southeast Asia in relation to rice and food security. This is done by highlighting some key principles and synthesizing country-specific or comparative evidence pertaining to a broad array of policies that have been designed to promote rice productivity and production, enhance rice farmer income, meet the needs and preferences of domestic consumers and otherwise influence rice market development and trade. The Policy Notes typically raise questions about the efficacy, continued relevance and/or trade-offs associated with particular policies and suggest various reform, technical or programmatic options.

The primary audience of this work consists of policymakers, their advisers and other officials dealing with matters related to food security, rice productivity and sustainability, staple food market development and trade. A secondary audience consists of development partners and practitioners who are active in supporting rice-based agricultural systems and value chains and/or demand-side measures to ensure food and nutritional security.

This Policy Note series has involved no new research. Rather, the effort has focused on teasing out the main principles, findings and policy implications highlighted in a recent body of technical and analytical work pertaining to one or more countries in the region, certain dimensions of rice-based production and market systems, and government interventions. Over the past three years, teams from the World Bank, FAO, the International Rice Research Institute (IRRI) and other agencies have generated an array of studies offering important insights into the dynamics of rice in East and Southeast Asia and the effectiveness (or otherwise) of numerous policy interventions. Yet, much of this empirical or strategic work has been inaccessible to many policymakers, due to its length, its technical complexity or other factors. Many research or policy studies focused on one country (or, more narrowly, on one particular scheme within a country) aren't widely available or known among decision-makers in other countries.

The effort has thus involved synthesizing and reframing some of the state-of-the-art policy analysis and agronomic work, putting it into a condensed and readily accessible form. Most of the Notes draw upon and contrast experiences of more than one country. Some focus on technical, usually production-related challenges and opportunities; others focus on ways in which governments have or could influence or supplement rice markets. Rather than provide prescriptions, the Notes lay out several policy options. Although the Notes are evidence-based, limited use is made of tables, graphs and statistics in order to facilitate reading, with topical references or suggestions for further reading provided at the end of each.

Most of the contributors to this series are staff of the World Bank, FAO or IRRI, although several others are colleagues working in Asian research or academic centers.

Road map

The series consists of 18 Policy Notes. The first three provide a broad context, addressing trends in rice demand, providing insight into the roles of geography and demography in influencing trade patterns, and examining the links between climate change and rice production. The Notes that follow are grouped into two sets. A first set of seven Notes covers production-related themes: land use, agricultural, technical and irrigation services, mitigating environmental risks, and addressing post-harvest (PH) losses. The second set of eight Notes covers topics related to markets and trade, as well as the bigger picture of consumer welfare.

References and further reading

Timmer, P. 2010. Food security in Asia and the changing role of rice. Occasional Paper No. 4, The Asia Foundation. Available at: http://asiafoundation.org/publications/index.php?q=occasional+paper.

Broad Setting

Outlook for Rice Demand, Supply and Trade

Ramesh Sharma

The perceived limit to producing food for a growing global population has been a longstanding source of debate and analysis. FAO's perspective studies, the "Agriculture Towards 20XX" series, date back to the 1970s. The price spikes of 2007–2008 and 2011 brought these concerns to prominence again – one response being FAO's organizing in 2009 a high-level expert forum called *How to Feed the World in 2050*. Among other things, the forum highlighted concerns over food security due to factors such as growing linkages between energy and food markets, and climate change.

Rice is different from other cereal crops in several ways. It may be subject to greater price shocks because of factors such as the very high concentration of production and consumption in Asia, and a thin international market. Studies also point to a deceleration in the growth rate of rice consumption (especially relative to maize) as incomes rise and diets diversify. Rice production is also relatively more intensive in using scarce resources such as land and water. Given these distinctive characteristics, it is helpful to examine what various studies have to say about the long-term outlook for demand and supply for rice in particular.

Long-term outlook for rice demand and supply

Outlook for rice demand

The question asked in all outlook studies is whether or not rice consumption will shrink in the coming decades and, if so, how rapidly. Because all outlook studies adopt population projections from other sources (usually the UN Population Division), the key difference across the various analyses is projections of future consumption in per capita terms. Table 1 collates four sets of these estimates for 2030 and 2050 (the "middle" or "best judgment" estimates in the studies, some of which also provide alternative projections). The table also

shows total global consumption, based on the UN's latest population projections (which were not used by all of the studies, as some were conducted before the release of the latest population projections).

There is a consensus in the outlook literature that per capita rice consumption *at the global level* will decline over time, although total demand could rise due to population growth. It is also agreed that the main reason is declining per capita consumption in Asia, notably in China and India, and the very large weight this region has in the global average. Elsewhere, per capita consumption may not decline, or may even increase. This may be especially true for Africa.

For 2030, Table 1 shows a remarkable closeness in projected global per capita consumption, at about 55 kg/year. But, the estimates vary markedly for 2050, with a range of 39 to 56 kg/year. Both the FAO studies and Abdullah *et al.* (2005) project a similar level, 51 kg/capita, down 4 kg/capita from 2030, or about 200 g/year during 2030 to 2050. The Timmer *et al.* (2010) and Rejesus *et al*. (2012) outlooks provide contrasts. The former judge 2050 consumption to be around 40 kg/capita, or 16 kg below the 2030 level, a rate of decline of 665 g/year between 2030 and 2050, which is in sharp contrast to Rejesus *et al*'s projection that rice consumption will not decline.

All the studies agree that income growth and urbanization will eventually lead to lower per capita consumption – the disagreement is over when this will happen. Among the outlook studies, Timmer *et al.* is both fully focused on rice and treats the structural drivers of rice consumption in detail. The main driver of the striking decline in this study relative to the others is the small (or negative) and shrinking income elasticities of rice demand.

Table 1: Long-term outlook for global rice consumption

	Per capita rice consumption (kg/year)			Total amount (million mt) (calculated with 2012 UN population projections)		
	Actual	Projected				
	2009-11 1/	2030	2050	2009-11	2030	2050
FAO AT 2050 (2006 & 2012)	56.3	55.0	51.0	389	463	487
Abdullah, Ito & Adhana (2005)	56.3	55.3	50.7	389	466	484
Timmer, Block & Dawe (2012)	56.3	52.4	39.1	389	442	374
Rejesus, Mohanty & Balagtas (2012) 2/	56.3	55.3	56.1	389	466	536

1 Numbers in 2009–2011 column are actual consumption levels as reported in FAO's Food Outlook, intended here as a common base for comparing with the projected values, which are from various studies as noted.
All numbers in the table are in terms of milled rice.

2 Rejesus *et al*. seem to project total rice use (which is about 66 kg/year). In order to make this projection comparable with the other three studies, the Rejesus *et al*. numbers are expressed here as rice consumption as food (85 percent of total use, as in Food Outlook).

Source: Author's own calculation.

Note: The total amounts in the last three columns of the table are computed values for this note by multiplying projected per capita consumption by the 2012 UN population projections for 2030 and 2050. In this way, rather than showing projected values from the studies that use different population numbers, the comparison of the total rice demand is not affected by different population numbers used by the studies.

Timmer *et al*. (2102) also provide estimates of the growth of rice demand in various regions of the world. They conclude that the share of Asia in the global total will fall considerably between now and 2050 (from 88 percent to 75 percent) while that of Africa will more than double (from 6 percent to 15 percent). They stress, however, that *great uncertainty* exists in assessing the demand outlook for Africa. Finally, the Timmer *et al* analysis also stands out in that it adjusts its projections of rice consumption to account for the yield and price effects of climate change. These adjustments lead to a slight lowering of total rice demand in 2050 relative to a scenario without climate change.

Outlook for rice supply

The outlook for rice production growth reviewed below is based on the *FAO AT2050* study. The overall outlook for yield growth of all 34 crops covered in that study is, at the global level, for a more than halving of the average annual rate of growth over the projection period compared with the historical period: 0.8 percent per year during 2005/07–2050 against 1.7 percent per year during 1961–2007. For developing countries, the slowdown would be from 2.1 percent to 0.9 percent. This slowdown in yield growth is a gradual process that has been under way for some time and is expected to continue in the future.

This overall slowdown is a pattern common to most crops covered in that study with only a few exceptions (e.g. soybean). For cereals, the slowdown is forecast to be particularly pronounced relative to non-cereals. Among the cereals, as summarized in Table 2 below, the slowdown in paddy yield during 2006–2050 is similar to that in wheat and maize if one compares the ratio of the growth rate during 2006–2050 with that during 1962–2006 (the ratio is about 0.33, i.e. percentage yield growth in the future will be about one-third of that in the past). The study also reports that paddy yields would have been 6.5 t/ha if the past linear trend continued to 2050, instead of 5.3 t/ha as shown in the table. The production growth rates show that rice production growth slows down the most relative to wheat and maize, mainly because of the sharp reduction in the paddy growing area.

Table 2: FAO AT2050 projections of yield and output

	YIELD (t/ha)			PRODUCTION (mmt)		
	1962	2005/07	2050	1962	2005/07	2050
Paddy	1.9	4.1	5.3	230	644	827
Wheat	1.1	2.8	3.8	235	614	858
Maize	2.0	4.7	6.1	210	736	1,178
All cereals 1/	1.3	2.9	3.9	843	2,069	3,009
	GROWTH RATE % p.a. 2/		GROWTH RATE % p.a. 2/			
	1962- 2006	2006-2050	1962-2006	2006-2050		
Paddy	1.75	0.58	2.34	0.57		
Wheat	2.12	0.69	2.18	0.76		
Maize	1.94	0.59	2.85	1.07		
All cereals 1/	1.82	0.67	2.04	0.85		

1 When listed separately, rice yields and production are stated in paddy terms. When included with wheat and maize, rice is added in milled rice terms. This follows international conventions.

2 These are annualized growth rates computed for this note based on the projected values (top four rows in the table).

Source: The projected values are from Table 4.12, page 127, of FAO AT2050 (2012) while annualized growth rates are computed for this note.

Note: Changes in area are not shown in the table. Rice area shrinks slightly between 2006 and 2050 (158 million ha to 155 million ha), while wheat area rises slightly and maize area increases considerably.

Medium-term outlook for international rice trade and prices

This review is based on three studies: the OECD-FAO Outlook, the USDA Outlook and projections from the Arkansas Global Rice Model (Arkansas Outlook, 2013). All three provide insights into the evolution of rice trade over the next decade. At the aggregate level, the outlook is for rice trade to expand considerably to 46 million metric tonnes in 2022, or by an extra 9 million metric tonnes from 2013, raising the trade to consumption ratio to 8.2 percent from 7.5 percent in 2013. At the level of individual countries, the three analyses differ markedly for some major exporters and importers but show similar outlooks for others. It seems that assumptions made about

the future path of rice policies (domestic and trade) are the main reasons for the different outlooks.

Thus, for example, all three projections show fairly similar import volumes for the sub-group consisting of Iran, Iraq and Saudi Arabia (these imports are mainly basmati rice). The main reason for the similarity is that these countries have only minimal trade policy interventions that affect imports. Likewise, outlooks for rice imports by Japan and the Republic of Korea are similar because almost identical import assumptions are made for these countries (based on their World Trade Organization (WTO) - committed import quotas). Finally, all three projections expect sub-Saharan Africa to import large amounts of rice in 2022, between 12 and 14 million metric tonnes (although this differs sharply from a projection by AfricaRice that finds that Africa would import only 5 million metric tonnes at the end of the next decade if all the ongoing efforts in rice production materialize).

By contrast, the three outlooks differ notably for imports by Indonesia and the Philippines. It seems that the difference is due to assumptions made about the extent to which these countries meet their self-sufficiency targets. Outlooks also differ markedly for China, with some seeing China importing large amounts of rice as in 2012 and 2013, while others treat the recent high amounts of imports as temporary.

Regarding exports, the outlooks show similar views for Viet Nam, Pakistan and the United States of America, but differ markedly for Thailand and India. For Viet Nam, projected exports in 2022 are in the 8 to 10 million metric tonnes range, and it seems that none of the three studies assume any restrictive policies. For Thailand, outlooks differ substantially (exports in 2022 range from 6.3 to 12 million metric tonnes), depending on what is assumed about the continuation or otherwise of the current paddy pledging scheme. As with Thailand, projections of India’s rice exports in 2022 differ markedly (in a range of 5.3 to 9.4 million metric tonnes). Assumptions made about India’s exportable surplus in the face of its new National Food Security Act seem to be the main reason for these differences.

In terms of international rice prices, the most recent OECD-FAO Agricultural Outlook projects that average prices during 2013–2022, after adjusting for inflation, will be slightly higher than prices during 2003–2012, but lower than they were in 2010–2012. Any such price projection is of course subject to a great deal of uncertainty.

Conclusions

The main conclusions on the long-term outlook can be summarized as follows. First, there is a consensus that per capita consumption of rice *at the global level* will decline over time, although total demand could rise through 2050 due to population growth. Total consumption will shrink in Asia and rise in Africa. For rice exporters, one piece of good news is that the population is projected to grow faster in precisely those countries where food consumption is currently inadequate and rice demand is more likely to rise with income growth.

Market economies are demand-driven; thus, supply growth will ultimately be determined by consumer demand. Thus, a second conclusion is that yield growth will slow down in the coming decades, not just for paddy but also for wheat and maize. However, the growth in paddy production is likely to decelerate the most, relative to other cereals, due to the reduction in paddy area and because growth in rice demand will be weaker than that for maize and wheat. Despite these considerations, however, it will nevertheless be a real challenge to meet future rice demand and preserve the environment given climate change and looming scarcities of land, labour and water. In order to meet this demand, a multi-pronged approach is necessary: more effort in agricultural research to maintain and increase yields, better transport infrastructure and logistics, and more private-sector investment to reduce post-harvest losses and improve milling rates.

Third, further challenges and uncertainties come from climate change and growing linkages between food and energy markets. The international rice market is likely to remain more thinly traded than other cereal markets, making it susceptible to production shocks or erratic changes in government trade policies. Lastly, none of the reviewed outlook studies modeled rice demand and supply differentiated by variety and quality. Other studies show that demand is

shifting towards higher quality rice. Key questions are how supply will adjust to this demand, and what kind of public support (e.g. research, pricing policy) and infrastructure is needed to facilitate this shift. Are current rice price policies supportive of that shift? Answers to these questions are important and should be part of future outlook studies.

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Rice Self-Sufficiency: Nature versus Nurture

David Dawe

Introduction

Southeast Asia is the hub of the world's rice economy. As a region, it has been a net exporter of rice for most of the past 110 years (the exception being some years between 1967 and 1978). It has two of the world's top three exporters, but also has two countries that, from time to time, have each been the largest importer in the world. Why are some countries in this region self-sufficient in rice, but others not? Is this primarily attributable to geography and demography? Or, to policy? And, for countries that are not self-sufficient in rice, what are some of the potential consequences of policies that try to achieve greater self-sufficiency by restricting rice imports and thereby artificially raising domestic rice prices?

Evidence

People in the traditional rice-importing countries (Indonesia, the Philippines, Malaysia) eat less rice and more wheat per person than do people in the traditional exporting countries. Since a country is self-sufficient when production exceeds consumption, lower rice consumption gives those countries a head start in achieving self-sufficiency. Yet, because those countries are not usually self-sufficient in rice, the explanation for why some countries import rice must be found on the supply side, not the demand side.

On the supply side, each one of the exporting countries in Southeast Asia (Thailand, Viet Nam, Myanmar, Cambodia and Lao PDR) has more production per person than each of the aforementioned importing countries. Perhaps surprisingly, the reason for higher per capita production in the exporters is not higher yield. In fact, importing countries have slightly higher overall yield than do the exporting countries, partially because a

higher percentage of rice land is irrigated in the importing countries.[1]

Rather, the exporting countries have much more rice area per person. But why is this the case? What agro-ecological and demographic factors are important? Do these countries have a larger proportion of their land surface area used for agriculture? Is more of their cropland better suited for rice than alternative crops? Are they able to plant multiple crops on the same land in any given year? Or, do they have lower population densities?

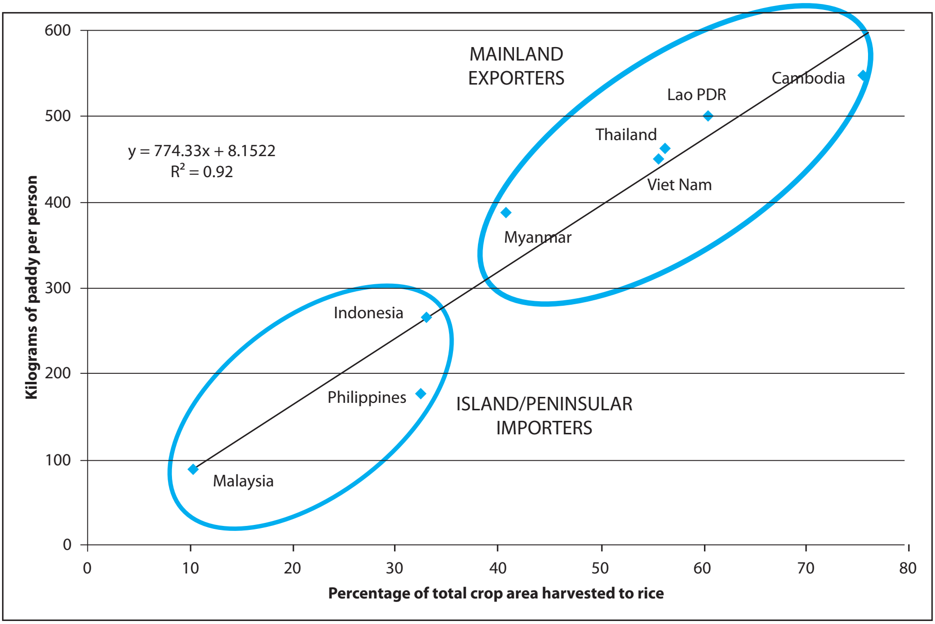
The evidence indicates that the proportion of total crop harvested area devoted to rice – a measure of the suitability of land for growing rice – is the most important factor explaining rice production per person across countries. In fact, the two variables correlate almost perfectly (the R^2 of a simple linear regression is 0.92; see Figure 1). Thus, the importers are all in the lower left of the figure, while the exporters are in the upper right. Other variables are less important. For example, the amount of land available per person is similar for many pairs of importers and exporters: in Indonesia and Thailand (0.76 and 0.74 hectare per person, respectively), in the Philippines and Viet Nam (0.33 and 0.36 hectare per person, respectively) and in Malaysia and Myanmar (1.18 and 1.37 hectares per person, respectively).

Geography is the reason why some countries have more land suitable to growing rice. A common feature of the five countries in the upper right of Figure 1 is that they are all situated on the Southeast Asian mainland, while the countries in the lower left are islands or peninsulas. Why should this make a difference to a country's status as an exporter or importer? The answer is that the countries on the mainland have dominant river deltas that provide ample water and flat land (important for easier control of that water). Such an environment is particularly suitable for cultivating rice, which, unlike wheat and maize, has a semi-aquatic ancestry and is thus particularly sensitive to water shortages. These river systems also allow for lower-cost transportation of rice over medium and long distances, thereby facilitating exports.

1 Viet Nam is an exporter, but it also has the highest average yield in the region. Among the exporters, Viet Nam has the tightest land constraints, so it naturally gravitates towards land-saving innovations.

The importance of geography can also be seen at the sub-national level: southern Thailand, a narrow peninsula, produces insufficient rice to feed its population and must "import" from the rest of Thailand, while Central Luzon in the Philippines, fed by the Pampanga River, produces more than enough rice for its own needs and "exports" rice to Manila. Other key rice importers in Asia are also islands or peninsulas: Japan, Korea and Sri Lanka.

Figure 1. Rice production per person versus share of crop area devoted to rice, ASEAN countries



Sources of raw data: FAO (2014) and USDA (2014) – see Dawe (2013) for more details.

In addition to this geographic pattern is a consistent temporal pattern. Malaysia, Indonesia and the Philippines have been importing rice for more than a century, while the other countries have been exporting for most of that time (Figures 2a and 2b). There are, of course, some exceptions for both groups, but these exceptions were due to "revolutionary" events. The Philippines and Indonesia both became self-sufficient for a short period of time in the 1980s,

and even exported small amounts of rice. This achievement was due to the Green Revolution (GR) package of high-yielding varieties, irrigation and fertilizer, which was adopted earlier in these two countries than in the exporting countries. On the exporters' side, Viet Nam was a rice importer for a period of time in the 1960s, 1970s and 1980s due to the war and highly repressive farm policies.

Policy implications

Thus, in terms of achieving rice self-sufficiency, island countries have a natural disadvantage. Less of their land is suited to growing rice and, as a result, they cannot compete at the margin with the mainland rice exporters. On the best land, operating with the best technology, farmers in different countries are relatively similar. But the importing countries simply have less of that land than do the exporting countries.

Figure 2a. Net trade status, consistent rice importers, 1904–2010

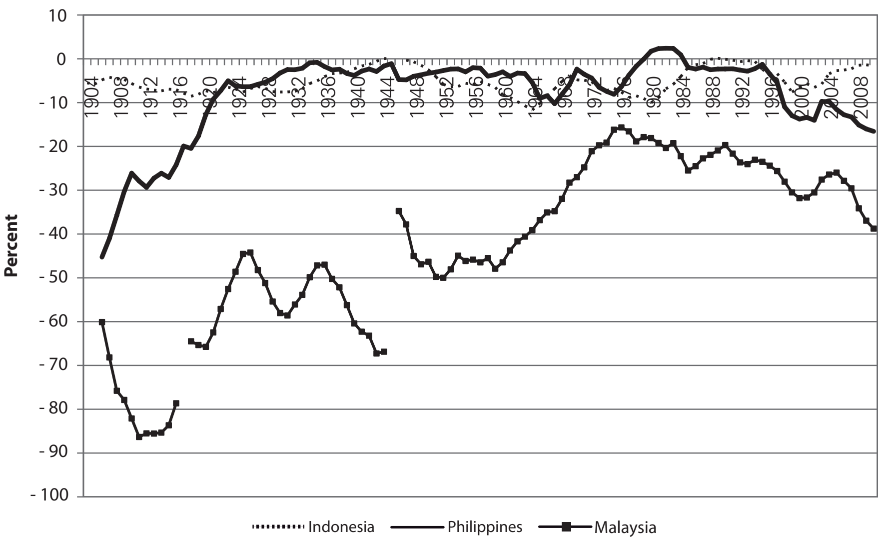
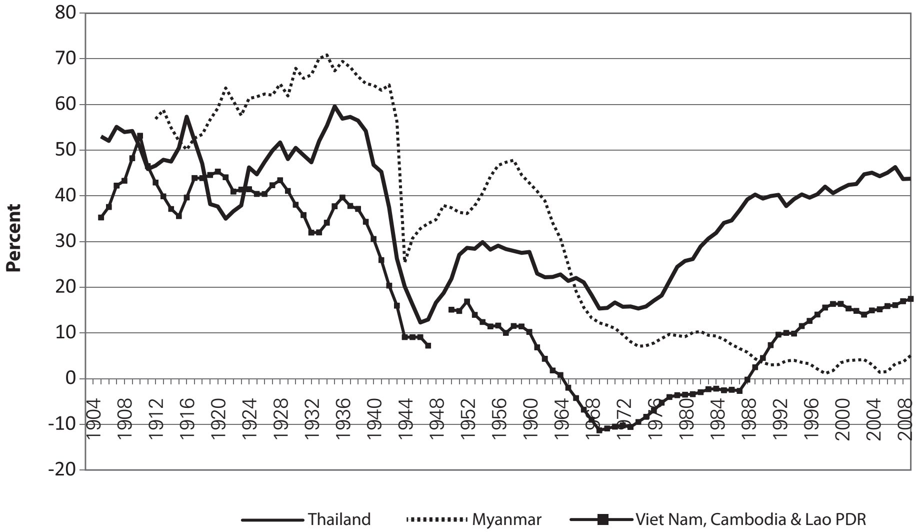


Figure 2b. Net trade status, consistent rice exporters, 1904–2010



Sources of raw data: Rose (1985), FAO (2013), USDA (2013).

Notes: Values shown are lagged five-year moving averages in order to smooth fluctuations. When imports exceed exports (net trade is negative), net trade is expressed as a percentage of consumption. When exports exceed imports (net trade is positive), net trade is expressed as a percentage of production. This convention avoids reporting values greater than 100 percent (in absolute value). Gaps indicate missing values.

Should the importing countries try to mimic the exporting countries and increase the proportion of cropped area devoted to rice? The problem with such a strategy is that there is a very good reason why fewer farmers grow rice in the importing countries – namely, other crops are more profitable. Forcing farmers to grow rice will reduce their income, which will work against household food security.

Thus, the importers face a trade-off between national self-sufficiency and household food security. A drive toward self-sufficiency can be good policy if it is based on efforts to improve productivity by investing in agricultural research and extension that leads to better crop varieties, improved agronomic practices and more farmer knowledge. But, if self-sufficiency is achieved through trade restrictions and the resultant higher domestic prices, then substantial costs are involved.

Domestic rice prices in importing countries have indeed been consistently higher than the price of rice that is available on the world market, even after taking into account the transport costs from exporters. Maintaining consistently high domestic prices (relative to the price available through imports) has a number of consequences, other than the standard efficiency losses commonly measured by economists.

First, high rice prices tend to increase poverty among most rice-importing Asian countries. Although there are many poor farmers and many poor consumers, the balance of evidence indicates that, among Asian rice importers, the poorest 20 percent of the population consumes more rice than it produces, which means that higher prices reduce their effective purchasing power. Because many rice farmers are poor, this result may appear counterintuitive. But it is important to remember that there are many other groups of people in the countryside besides rice farmers: the rural landless, tenant farmers who may not benefit from high prices and farmers of other crops (e.g. maize farmers in the Philippines are extremely poor). And, of course, there are also the urban poor, who grow very little, if any, rice. Conversely, those who benefit from high prices are the farmers with large amounts of surplus to sell on the market, who tend to be wealthier than other farmers – farmers with a quarter hectare of land or less do not produce enough rice to sell on the market, so they don't benefit from higher prices.

Second, high prices leave less money available to spend on food with more nutritional value than rice (see the Policy Note on "Rice and Nutritional Security: Some Connections and Disconnections"). Higher rice prices reduce effective purchasing power, leaving less money available to spend on foods with essential vitamins, minerals and amino acids that are lacking in rice. Given the high "hidden hunger" due to micronutrient deficiencies around the region, and the increasing recognition of the importance of good nutrition for human development, high rice prices can impose a substantial cost.

Third, although the timing will vary from country to country, it is inevitable that per capita rice consumption will eventually decline (see the Policy Note on "Outlook for Rice Demand, Supply and Trade"), as increasingly wealthy consumers demand a wider diversity of foods. Given this eventual decline (it is already taking place in many countries), it is important that farmers also diversify their production. Although many farmers, especially those with low-lying land, must continue to grow rice during the wet season, diversification is usually possible in the dry season. High rice prices impede this natural and essential diversification process.

Fourth, because rice is a major expenditure item for workers, high domestic rice prices lead to high wages and thereby erode competitiveness in an increasingly globalized economy. Finally, high domestic prices of rice encourage consumers to shift some of their diet away from rice and towards wheat. To some extent, this is helpful, as it reduces reliance on rice. Nevertheless, at least in Southeast Asia, no wheat is produced, so reliance on imported cereals is not reduced, but only shuffled from one crop to another. To the extent that world wheat prices are uncorrelated with world rice prices, this dietary diversification reduces risk. Yet, global rice and wheat prices are highly correlated.

These arguments suggest that achieving self-sufficiency through trade restrictions can have large costs in terms of harming consumers and overall agricultural sector growth. Given the large numbers of people in East and Southeast Asia who are still suffering from poverty, chronic hunger and micronutrient deficiencies, the human costs of allowing rice prices to rise to high levels should be given careful consideration.

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Rice, Climate Change and Adaptation Options

Zhijun Chen and Beau Damen

Introduction

Rice cultivation relies on certain conditions, especially land, water, temperature and radiation. Climate change will alter these conditions and have complex implications, both negative and positive. Rice also contributes to Greenhouse Gas (GHG) emissions. Although the importance of climate change adaptation and mitigation in the rice sector has been widely recognized, implementation of appropriate strategies has remained limited or segmented. A major constraint is the lack of good understanding by policymakers about the interactions between climate change and rice cultivation, which leads to a lack of proper mainstreaming of climate change considerations in sector strategies and development activities. It is therefore important to improve policymakers' understanding of regional and local trends in climate change, their implications for rice systems and value chains, possible adaptation and mitigation options, and the key policy issues to be addressed.

Trends in climate change

The climate is changing. According to the Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report, Asia has seen the following key trends and impacts. First, warming and increasing temperature extremes have been observed across most of the Asian region over the past century and at a rate of 0.14–0.2°C per decade across Southeast Asia since the 1960s. Second, changes in precipitation have been characterized by strong variability, with both increasing and decreasing trends in different parts and seasons of Asia, such as increased rainfall in the wet season and decreased rainfall in the dry season in the Lower Mekong River Basin in the past 30–50 years. Third, sea-level rises were reported at significant

rates in the western tropical Pacific over the period 1993–2010, and also associated with sea-water intrusion and coastal inundation and salinization, especially in Southeast Asia.

The projected trends and impacts of climate change suggest that warming is very likely in all land areas of Asia in the mid- and late twenty-first century. Under the highest GHG emissions scenario (RCP8.5), temperature rises may exceed 2 °C over Asia by the mid-twenty-first century when compared with the late twentieth century baseline. By the late twenty-first century, they may exceed 3 °C over South and Southeast Asia and exceed 6 °C over high latitudes (other scenarios show lower increases, however). Increases in precipitation extremes related to the monsoon are very likely in East, South and Southeast Asia. Although precipitation may increase in some areas of China, the country is expected to be lacking water for agriculture in the 2020s and 2040s due to increases in water demand for non-agricultural uses. Future rates of sea-level rise are expected to exceed those of recent decades, thus increasing flooding, erosion, saltwater intrusion and land inundation in coastal delta areas. People in low-elevation coastal zones are particularly at risk from climate change hazards, including floods, droughts, sea-level rise, storm surges and typhoons.

Implications for rice cultivation

The impacts of climate change will be complex, locally specific and, depending on the context, negative or positive or both. Temperature rise within 1–2 °C and CO2 fertilization may benefit plant growth, but higher temperature may also make rice flowers sterile. Rice cropping periods and zones may expand in higher latitude areas. Crop water requirements may increase, but water availability may decrease in the dry season. An increased frequency and intensity of extreme weather events and changed patterns of pests, diseases and weeds may induce crop failure and losses. Land inundation and salinization in coastal areas may reduce rice cultivation area. Infrastructure systems and rice processing and marketing facilities may also be affected by increased extreme weather events. These will directly affect rice cultivation, rice systems and rice value chains, and ultimately the livelihoods of human populations in rice cultivation areas. Smallholders and

poorer farmers will be more affected because of a lack of capacity to adapt.

Although it is difficult to predict exactly how the combination of these potential impacts will affect future rice yields and production, there is a general consensus that positive impacts will be limited and the overall impact on rice cultivation and rice systems in the region is likely to be negative. The International Food Policy Research Institute (IFPRI) forecasts that, without CO2 fertilization, climate change may cause a reduction in rice production in East Asia and the Pacific of about 10 percent in 2050 compared with a scenario of no climate change (the impact with CO2 fertilization would be smaller, although the report does not cite this number).

Contribution of rice cultivation to GHG emissions

Rice is often grown in flooded fields under anaerobic soil conditions that release methane, a GHG about 20 times more potent than carbon dioxide. In addition, application of nitrogen fertilizer in rice cultivation may result in emissions of nitrous oxide, another type of GHG that is about 300 times more potent than carbon dioxide. Currently, rice straw and husk residues are burned or incorporated back into the soil after harvest. When returned into the soil, methane is produced as decomposition occurs under waterlogged conditions; when burned, soot develops and contributes to GHG emissions. According to the IPCC 5th Assessment Report and FAO (IPCC, 2014; FAO, 2014), annual total non-CO2 GHG emissions from agriculture contributed 10–12 percent of global anthropogenic emissions in 2010, and paddy rice cultivation contributed about 10 percent of annual total non-CO2 GHG emissions from agriculture. During 2000–2010, 94 percent of GHG emissions from paddy rice came from developing countries, with Asia being responsible for almost 90 percent of the total.

Options for adaptation and mitigation

There are various strategies and options for adaptation to climate change in the rice sector, as illustrated by the following experiences in China and Viet Nam.

In Northeast China, from 1970 to 2009, changes in climate moved the suitable rice cultivation zone 120 km to the north, extended the suitable rice-growing period by 8–11 days, reduced precipitation in the cropping season by 14.5 mm/decade and increased the occurrence of extreme weather events, pests and diseases (Zhang *et al.*, 2012). The region adopted a combination of measures to take advantage of the positive impacts and mitigate the negative ones, including: (1) adjusting cropping patterns to expand rice cultivation; (2) breeding new rice varieties with longer growing periods that are tolerant of a wider range of temperatures; (3) improving irrigation and drainage systems, especially promoting alternate wetting-and-drying (AWD) irrigation; and (4) improving pest and disease control, fertilizer application and mechanization. By 2011, the actual rice cropping zone in this area had extended by 110 km to the north, the cultivation area had expanded by 4.5 times compared to 1971, the average growing period had extended by 5.3 days and average yield had reached 7.5 tons/ha. Northeast China is now producing 16 percent of the total national rice production, compared with less than 2 percent in the 1950s.

The Mekong River Delta (MKD) in Viet Nam produces 52 percent of the national rice production and nearly all rice exports. Because of the impacts of climate change, it is expected that floods will intensify in the wet season, as will droughts in the dry season. These impacts will be accompanied by increased salinity intrusion, inundation and incidence of pests and disease, and the Vietnamese government and donor agencies have been working jointly to address these concerns. A typical approach adopted was community-based adaptation, which comprised measures such as (1) participatory community planning and decision-making on adaptation strategies and action plans; (2) development of adaptive livelihoods for smallholder rice farmers in the coastal areas, such as combined rice-fish, rice-duck farming and alternative rice-vegetable farming; (3) breeding and

adoption of early-maturing and salt-tolerant rice varieties; (4) implementation of integrated disaster risk management projects; (5) implementation of irrigation modernization projects; and (6) relevant capacity development.

Mitigation of climate change in the rice sector could be realized through improved water, nutrient and residue management. Water-saving technologies, such as AWD, reduce the time rice fields are flooded, and can reduce methane emissions. Proper application of nitrogen fertilizer, combined with water-saving technologies and good nutrient management, can reduce field nitrogen losses, and therefore nitrous oxide emissions. Charring – or partly burning – rice residues and adding the obtained black carbon or "biochar" to paddy fields could also reduce field methane emissions.

Policy in the context of uncertainty

A major issue that hampered climate change mainstreaming in rice farming in some countries is the lack of overall guidance and coordinated support at the sector level. It is necessary to formulate and implement sector or regional strategies and policies, which identify proper objectives and targets suitable for local conditions, prioritize measures and options, establish mechanisms and procedures, and mobilize resources and efforts to improve the climate-resilience of rice systems. Lessons and experiences learned from within and outside the region indicate that the following issues need to be properly addressed in policy making for climate change mainstreaming in the rice sector.

Dealing with uncertainty of climate change impacts

One difficulty faced in policy-making is the uncertainty of climate change trends and impacts. Although efforts should be made to improve overall capacity in climate change monitoring, modeling and projection, it may be helpful to adopt a "no-regrets" approach, that is, adopt policies and technologies that will be beneficial even if future climate change threats do not occur exactly as anticipated. Good practices and options identified following the approaches of climate-smart agriculture and sustainable rice systems could be considered, such as disaster risk management, water-

saving techniques, integrated landscape planning and social safety nets.

Addressing local specificities of climate change

Climate change is global, but its impacts are local. Different areas and systems may receive different impacts. Policy settings should adopt typological classifications, avoid uniformity and ensure suitability to local conditions. Local impact assessment will help to better understand the specific needs in different areas. Policy-making should follow a participatory approach and allow flexibility to adapt to local realities, while paying special attention to indigenous knowledge and vulnerable groups, especially smallholder, poor and female rice farmers.

Tackling the multiple effects of climate change policies and sector spillovers

Options for productivity enhancement, climate change adaptation and mitigation in the rice sector may interact with each other. Furthermore, rice cultivation interacts with other sectors, such as natural resource management, fishery development and ecosystem conservation. Thus, strategies and policies should promote multidisciplinary and cross-sector cooperation to capture the synergies and manage the trade-offs. An integrated planning approach at the landscape level may help to better engage all stakeholders and adopt balanced, coordinated actions to maximize the positive benefits and minimize the negative impacts.

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Production

Does Protecting "Rice Land" for National Food Security Harm Farmer Prosperity?

Steven Jaffee and Nguyen Do Anh Tuan

In the context of urbanization and industrialization processes, governments in many East Asian countries are concerned about the pace and manner of the conversion of arable land for alternative uses. Historically, region-wide and currently in some countries, the primary concern has been possible threats to national food security. But other considerations have also played an important role in policy discussions on this issue, including concerns about environmental degradation, the loss of rural livelihoods and conflicts related to non-transparent land acquisition.

Monitoring and restricting the conversion of agricultural land

There have been significant conversions of arable land for urban, industrial or transport infrastructure purposes in low- and middle-income East and Southeast Asia, although the extent of this varies widely between and within countries. By far the largest scale of conversion of farmland to non-farm use has occurred in China. Between 2000 and 2008, some 1.24 million hectares were converted in this way, although 0.66 million hectares of new farmland were created by the conversion of former grassland or forest land.[1] Very significant arable land–to–urban land conversions also occurred during this period in Indonesia, Thailand and Viet Nam, with estimates for the latter averaging about 70,000 hectares per year.[2] In most countries, the most rapid pace of such land conversions has been occurring near the capital and other mega-cities. This, together with controversies over unfair land acquisition processes and compensation rates, has given high visibility to this issue.

1 In China, the area of agricultural land actually increased substantially during the 1990–2000 period. While 3.06 million hectares were converted from farmland to non-farm use, some 5.7 million hectares were converted from grassland or forest land to agricultural use.

2 General Department of Land Administration (2009) National Strategy for Food Security and Paddy Land Planning to 2020 with a Vision to 2030.

Many countries, through zoning laws, land-use plans and other means, have long sought to limit, restrict or otherwise manage the pace and location of agricultural lands being converted for other uses. For example, China has set a national target for maintenance of aggregate agricultural lands, linked to estimates of current and future demand for cereals. Some countries have sought to zone different uses of agricultural land as between annual crops, perennial crops, aquaculture, etc., based on food security, environmental and other considerations.

Yet, some countries have gone further. For many years, Indonesia, Myanmar and Lao People's Democratic Republic designated a large share of the irrigated agricultural area as being strictly for rice cultivation in order to ensure national food security. These restrictions are being relaxed, although local-level implementation of reforms seems to vary and public services (especially water management and agricultural extension) generally remain tailored for rice. Viet Nam has had the longest standing and most extensive policy of designating and controlling the use of "rice land."[3]

Viet Nam's experience: the achievement and burden of success

Viet Nam was a net rice and overall food importer in the late 1970s and early 1980s. A series of land reform and wider agricultural market reform measures, twinned with increased investment in irrigation infrastructure and higher-yielding varieties, paved the way for a steady and long-term improvement in the productivity and expansion of rice production. By the early 1990s, Viet Nam had become a net rice exporter. Between 1990 and 2010, national paddy production more than doubled, even though the land dedicated to rice cultivation was virtually the same at the end of this period as at the beginning. Domestic rice consumption also increased, yet at a much slower pace. The net result of this has been a steadily growing surplus – from about 3 million tonnes in 1995 to 8.5 million tonnes in 2010 (Nguyen *et al.*, 2012). This was largely channeled into exports, with Viet Nam coming to dominate the lower quality and price segment of the international rice market and ranking second or third among exporters in volume of trade. This essentially involved a massive "over-shooting" of the country's food security targets, rather than being the outcome of any concerted market development or trade strategy.

3 On which a farmer is not permitted to shift to perennial crops and is mandated to grow one or more seasonal rice crops.

In Viet Nam, land ownership rests with the state and not with individuals. Yet, Viet Nam's land laws of 1987 and 1993 and their subsequent revisions have granted farmers long-term land-use rights and the rights of land transfer, exchange, lease, inheritance and mortgage. However, strict limitations have been applied on land-holding sizes and the government has retained the right to determine land-use purposes through land-use planning at central and local levels. Land-use restrictions have primarily been applied to rice cultivation – with the designation of "rice land" appearing in many farmers' land rights "Red Books."

Although the 2003 Land Law did not explicitly restrict the growing of other annual crops on "rice lands", local-level planning and efforts to meet rice production targets resulted in many practical restrictions. A series of recent (2009 and 2011) decrees went further, requiring plans to clearly identify areas for wet rice cultivation and making provincial officials responsible for enforcing the protection of these rice lands. Thus, any alternative agricultural uses by farmers would require permission from provincial and local officials. The Government's Resolution on National Food Security (2009) stipulates that, by 2020, 3.8 million hectares must be reserved for rice cultivation. This represents about 90 percent of the currently cultivated paddy land and 35 percent of all land used for agricultural production. In recent years, actual rice cultivation has taken place on 4.0 to 4.2 million hectares, with a majority of this being double (or triple) cropped.

The stated purpose of this designated rice land was and remains food security, with a particular emphasis on national self-sufficiency in rice production.[4] This goal has been achieved, in a rather spectacular fashion. And, this achievement is sustainable, especially as urban and middle-income households are diversifying their diets and food expenditure patterns. One study explored various production, productivity and demand scenarios to 2030 and found that, even under some worst-case circumstances, Viet Nam would maintain a comfortable (exportable) surplus even if the core rice-growing area declined by 20 percent from the present level (Nguyen *et al.*, 2012). Thus, Viet Nam's long-standing success in raising rice productivity and production, together with changing demographic and food consumption patterns, would

4 Gains in rice productivity and progressive reforms in the marketing of paddy also played an important role in Viet Nam's achievements in poverty reduction in the period between the late 1980s and early 2000s.

seem to provide the country with an opportunity for a more flexible approach to land-use planning in order to achieve a wider set of objectives.

Although policymakers in other East and Southeast Asian countries are less sanguine about their countries' long-term ability to balance domestic rice production and demand, they can relate directly to an area of growing concern in Viet Nam – farmer livelihoods. Protecting rice land has not protected rice farmers. More than 80 percent of Viet Nam's nine million rice farmers cultivate less than 0.5 hectare of land. Fewer and fewer of these households can sustain a livelihood based on rice. Even in the Mekong Delta (MKD), where the average planted area is 1.25 hectares, the vast majority of growers must rely primarily on income from livestock or off-farm employment (Table 1). For farmers growing 1 hectare or less, the income from rice sales was less than half the (per capita) poverty line of Viet Nam. Only for farmers with more than 2 hectares, which comprise about 20 percent of the growers in the MKD, was there a possibility to earn an income from rice above the national poverty line. And, as Viet Nam progresses further to upper-middle-income status, simply being above the poverty line will not satisfy the aspirations of farmers.

Table 1: Farmer annual incomes from different sources, MDI 2009 survey results based on sample of 117 farmers in the Mekong River Delta region (in US$/month/person)

Farm size		Total income per capita	Rice income per capita	Other crop income per capita	Animal and aquatic income per capita	Off-/non-farm income per capita
<1 ha	Mean	46	8	5	4	29
	%	100	18	10	10	63
1–2 ha	Mean	63	15	4	19	25
	%	100	24	6	31	39
2.01–3 ha	Mean	103	35	1	40	27
	%	100	35	1	38	26
>3 ha	Mean	104	70	1	4	29
	%	100	68	1	4	27
All farmers	Mean	71	29	3	11	28
	%	100	41	4	16	39

Source: Le *et al.* (2010).
*In 2009, the official poverty line for rural areas was VND 400,000 (equivalent to US$21.62) per month per capita.

When set in the context of evolving broader national economic development objectives, the maintenance of the current land policy can be seen as increasingly inefficient, ineffective and inequitable (Jaffee *et al.*, 2012; Maerten and Nguyet, 2012). It is inefficient because it locks in land and other resources in a relatively low-value use and deters farmer investment. Some of this designated rice land is suitable for higher-value legumes or horticultural crops, or to help substitute for burgeoning national imports of maize, soybean and other animal feed ingredients.[5] Viet Nam's future national food security challenge is likely to relate more to reliance on feed imports than have anything to do with rice. Rice land restrictions are no longer effective in terms of food security as the remaining pockets of household food insecurity are mainly due to poverty, remote locations and limited livelihood opportunities, not the size of the country's rice surplus. Viet Nam's food security challenges now need to be addressed from an integrated perspective of nutrition, food affordability, crop diversification and livelihood support, rather than increments in national (rice) production.

Finally, the policy is inequitable as it forces a large number of farmers to continue to grow (or completely specialize in) a crop that keeps them significantly poorer than they would be if they could make more diversified use of their land and other resources. Farmers have largely borne the cost of Viet Nam's rice surplus "success": low-value exports and the maintenance of restrictive land-use policies. For many individual households, the restrictions on land use present an untenable choice between assured poverty and exiting agriculture altogether.

Policy options

What policy options exist for Viet Nam and other countries to achieve a better balance between national food security objectives and the welfare and livelihood prospects of rice-growing households? There appear to be several and these are not mutually exclusive. One approach would be for governments to continue to closely monitor and restrict the conversion of rice lands to

5 The impacts of lifting the rice land-use restrictions were estimated using the MONASH-VN CGE model (Giesecke *et al.*, 2013). The major results were (i) an 11 percent decline in rice plantings, yet little impact on the overall national rice balance; (ii) significant positive impacts on agricultural growth and per capita expenditures of nearly all income groups; and (iii) significantly accelerated growth in certain regions, especially the Mekong Delta.

non-agricultural uses, but allow more flexibility in alternative agricultural land uses – so as to better meet more diversified food demand. As diets further change, definitions of national food (and nutritional) security will evolve. Allowing flexibility in agricultural land uses will help meet these evolving goals. At the same time, it would allow for shifts back to rice cultivation if economic or national food security conditions warrant this.

Another approach is for governments to continue to protect rice lands, yet involve fewer rice growers. Under this policy, efforts would be made to spur land consolidation and mechanization in which farmers would sell, lease or pool their rice land, creating larger specialized rice farms. Such land consolidation initiatives have had a checkered history in terms of protecting farmers' rights. Thus, considerable care would need to be exercised in implementing such a policy. In addition, complementary measures would need to be taken to strengthen the broader rural economy and increase local employment opportunities as well as facilitate the successful migration of exiting rice farmers.[6]

In order to maintain a high smallholder farmer participation in rice production, efforts can be made to help farmers to introduce rotation crops or a rice-aquaculture farming system and, in so doing, raise household annual income, break pest and disease cycles and potentially reduce adverse environmental impacts. Smallholder farmers with diversified income sources can remain viable (seasonal) rice producers. To support this, adjustments may be needed in water management and drainage services.[7] Also, these other activities may involve other production and/or market risks and governments may need to assist farmers in their efforts to mitigate these risks.

6 Viet Nam is currently implementing reforms to facilitate a more vibrant land market, albeit with limits placed on lease holdings of arable crop land. It is also seeking to extend the application of a "large field, small farmer" model, in which households maintain their land-use certificates, yet dozens or hundreds of neighboring farmers operate a (rice) farm block, involving increasing coordination in varietal choice, agronomic and water management functions, and, in some cases, post-harvest management and paddy sales. Myanmar is beginning to experiment with a similar approach.

7 Improving irrigation and drainage services may also facilitate increased cropping intensity, allowing two or three crops per year (see next Policy Note, pag 39). This has occurred in much of Viet Nam's Mekong Delta region, although farmer profitability is much lower for one of the seasonal rice crops due to climatic and other factors. Combining one rice crop with one or more other seasonal activities could help realize both food security and farmer livelihood objectives.

Varied agro-ecological conditions should give rise to differential strategies. In locations with the highest suitability for rice cultivation, the continued rice specialization by larger smallholder farmers (i.e. those with 2 to 5 hectares) will not be achieved by decree, but rather by the provision of the necessary public goods to relieve existing constraints on farm productivity and improve the competitiveness of domestic and export supply chains. In less favorable rice-growing areas, efforts may need to focus on increased participation in the formal labor market, perhaps complemented by targeted safety net interventions. In these locations, rice-related interventions will have limited, if any, capacity to provide household food security and a means to escape poverty and join the emerging middle class.

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Modernizing Irrigation and Drainage Service Provision

Jacob Burke and Paul van Hofwegen

For the world as a whole, irrigated areas account for an estimated 75 percent of total paddy production, and the percentage is likely even higher in East and Southeast Asia. And, in most of the region, paddy production is the central focus for more than three-fourths of all harvested irrigated area (Table 1). But, although irrigation (for rice) continues to dominate water withdrawals in East Asia, allocations are declining progressively as competition for land and water intensifies. This compression is driven by processes of agricultural diversification, rapid urbanization and industrialization. Sustainable intensification of irrigated rice production – on the remaining land – is now the central challenge for all irrigated sub-sectors in the region.

Table 1: Rice irrigated area in Southeast Asia

	Full-control equipped area all crops (ha)	Harvested area of irrigated rice under full control (ha)
Cambodia*	317 225	373 331
China*	54 218 976	31 347 000
DPR Korea	1 460 000	465,000
Indonesia	6 722 299	10 733 600
Lao PDR*	270 742	310 676
Malaysia	340 717	363 000
Myanmar	2 083 000	1 861 000
Philippines	1 879 084	2 421 900
Republic of Korea	880 400	760 000
Thailand*	5 059 914	6 268 080
Viet Nam	4 585 500	6 842 127
TOTAL	**73 232 357**	**61 745 714**

*Equipped area actually irrigated. Source: FAO (2012).

Why is this so critical? First, a politically acceptable level of food security is fundamental when international trade in rice is small. Second, rural economies need a measure of stability if they are to provide pathways out of poverty. And, third, in order to service rice market segments demanding higher-quality rice, more precision agronomy needs more reliable water control to generate a predictable yield response.

Beyond this, a future of decreased water availability (economic competition and hydrology), limited labour and more expensive energy will begin to impose another set of imperatives. Irrigated rice is also a source of the greenhouse gas methane (CH^4), due to extended flooding periods that result in anaerobic decay of organic material. On a global scale, the production of lowland rice contributes only 1.5 percent of the anthropogenic greenhouse effect (FAO, 2011) given that irrigated rice occupies only 10 percent of global wetland area. Using IPCC methodologies, Yan *et al.* (2009) estimated that "draining the continuously flooded rice paddies once or more during the rice-growing season would also reduce global emissions by 4.1 Tg CH^4 per annum." At the same time, rice production will be affected by the acceleration of hydrological cycles. Irregular rainfall and drier spells in the wet season and prolonged droughts and floods are all having an effect on yield. These factors have already caused or contributed to outbreaks of pests and diseases, resulting in large losses of crops and declines in yield. More reliable water services are therefore an essential tool to mitigate these production risks and take advantage of higher temperatures.

Approaches that rely on supply-driven allocation and management of water and irrigation infrastructure are no longer adequate to address the scope of this challenge. Farmers want reliable and flexible water service suited to new styles of rice cultivation and to give them options for crop diversification. Many are making their own local adaptation with pumps and off-line storage to extend their current canal service. But, a wholesale review of irrigation scheme operations and service delivery is warranted in many cases. This avoids opting for cycles of rehabilitation and deferred maintenance that simply push up the economic costs without generating any benefits from improved service to farmers. The focus on upgraded, service-oriented water control is at the heart of irrigation modernization (Box 1).

Box 1: The process of irrigation modernization

The process of modernization needs to adhere to a strict phasing of scheme analysis and design choice:

— Institutional commitment to change operations and management – and adoption of a capacity-building process.

— Diagnosis of current performance through standard rapid appraisal or canal optimization tools (e.g. Irrigation Training Research Center/FAO Rapid Appraisal Procedure, FAO Mapping System and Services for Canal Operation Techniques (MASSCOTE) operational audits).

— Specification of the level of service (rotation, pre-arranged demand, including duration, flow and intervals, etc.) to meet crop water requirements requested by farmers.

— Choice of canal configuration model (distributed, centralized, automated control).

— Determination of the mode of operation of the main canals (basic upstream versus downstream control and combination of, or nearly simultaneous operation of, regulators).

— Selection of water level and flow control equipment (including measurement).

— Infrastructure adjustment and installation of flow control/measurement equipment at each unit of management.

"Modernization" involves adapting institutions, financing and management processes, and infrastructure operation to generate a higher-performing rice economy. It is a process that needs to be carefully phased to avoid otherwise expensive hardware "redundancy" or unnecessary staff deployment. Investments in "soft" elements, including institutional adjustment, scheme diagnosis, operational design and hardware planning, can result in significant operational cost savings and can identify priority infrastructure upgrades. Crucially, a marginal investment in software (professionalization and management of system operation) can offset expensive rehabilitation (e.g. replacement of flood-damaged embankments and canals) and reduce the costs of routine maintenance (e.g. de-silting of canals that have not been operated at target flows). Methods for rapid appraisal of scheme operations and optimization of canal operations (e.g. FAO, 2007) are now well established and their cost is

minimal compared to annual operation and maintenance (O&M) budgets for large irrigation schemes.

Across many existing large-scale rice schemes in East Asia, the prerequisite is a change in management approach towards a greater service orientation. Incentives to irrigation agency staff to professionalize and adopt new management practices have to be carefully measured and applied.

How can this be achieved in practice?

— First, by sharpening the planning and design process for upgrading rice irrigation schemes. Re-setting objectives for public irrigation service, re-evaluating water balances and producing a valid design concept for improved water service delivery are critical at the outset.

— Second, by defining irrigation and drainage service levels for improved rice production under higher-level flow control, mechanization and professionalization. These need to be agreed upon between agency operators, farmers and any other users in order for upgraded scheme operations to be accepted.

— Third, by specifying an implementation plan, which matches infrastructure adjustments with training in construction, operation and maintenance (O&M). Clear standards are used for water measurement, data transfers and processing to service different users. Water accounts and operational budgets are published.

— Fourth, by using upgraded service *reliability to promote operational* flexibility with an eye to the future – leaving open options to diversify away from rice.

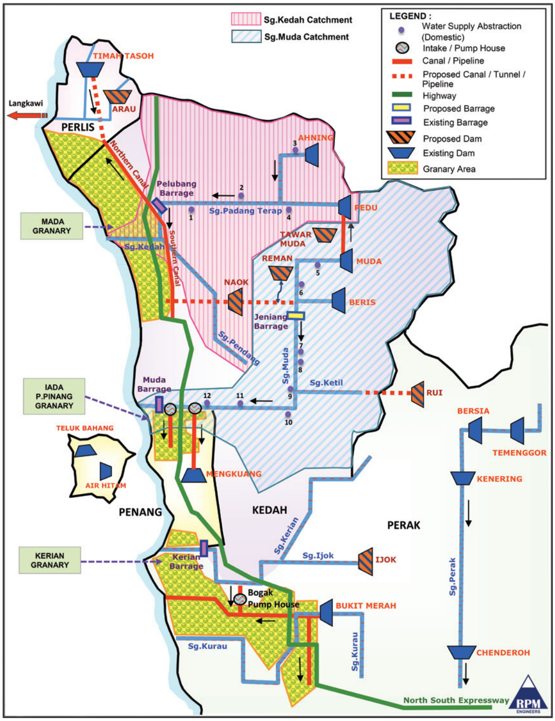
Policy responses in the region are already apparent. In countries where rice-growing environments are very diverse (e.g. Indonesia, Viet Nam), the approach has involved incremental, scheme-by-scheme adjustments. In China, adjustments have demonstrated that large schemes can respond to water scarcity and water quality constraints through improved administration of consumptive water use and by meeting the demand for alternative, non-agricultural uses of the water under scheme control. Malaysia has chosen another model, putting emphasis on large “granary” schemes involving a package of services (Box 2).

If irrigation reform is to be successful in facilitating higher productivity and flexibility in rice-based production systems, then irrigation management needs to show that it can respond and develop a service-oriented approach. Measures to improve accountability and transparency can be expected to stimulate the development of management information systems, water-use rights, service agreements and asset management systems. With these measures in hand, a continuous process of service and infrastructure improvement for boosting rice productivity can be anticipated – while still giving rice farmers options for the future. The shifting roles of government agencies and private-sector service providers present another important opportunity. As the demand for more precise rice agronomy becomes apparent and rice value chains mature, determining just where the public interest in providing and maintaining an irrigation and drainage service ends and where private services begin is critical.

Box 2: Malaysia's Granary Policy

One wholesale application of irrigation modernization principles has been Malaysia, where demographic changes and food security policies evolved and adapted over decades. In the 1960s, Malaysia introduced double cropping of paddy. **This was supported by developing water resource facilities (dams, pump stations, barrages) and canal and drainage networks.** By the 1980s, Malaysia had 936 irrigation schemes, of which eight are the "granaries" (212 764 ha) and 928 non-granary irrigation schemes (132 736 ha). Malaysia's Granary Policy was introduced in the mid-1980s in response to a shift of farm labour away from rural areas. Many of the small irrigation schemes were then abandoned. The larger contiguous irrigation areas survived mainly due to economies of scale. The new policy stated that large contiguous schemes (of not less than 4 000 ha) would serve as the main source of paddy production and be given special attention in terms of technical, administrative and financial support. In 2013, the government activated four new additional granaries. This concentration of rice production has prompted a re-think of who was going to benefit from an improved irrigation service and a re-design of the upstream water control systems to match the level of demand for reliable water service in the granaries.

Figure 1: The Water Resources Network in the Northern Region of Peninsular Malaysia



Source: RPM Engineers SDN BHD

Climate change mitigation and adaptation measures can be expected to affect on-farm water management and, consequently, the way irrigation and drainage services are provided (see Policy Note "Rice, Climate Change and Adaptation Options"). To reduce GHG emissions and develop paddy fields as carbon sinks will have an important impact on farm water management practices. The introduction of modifications to water management practices, such as mid-season drainage and AWD, reduces the amount of time rice fields need to be flooded. As a result, AWD is reported to reduce the production of methane by up to 50 percent (IRRI, 2013), although this reduction can be offset by accelerated release of nitrous oxide (another potent greenhouse gas).

Other recent initiatives in Indonesia and Viet Nam have promoted switching from traditional transplanted rice cultivation to an improved method of direct-seeded rice. When used in combination with AWD, the period for which rice fields need to be submerged is further reduced, leading to corresponding reductions in methane emissions. The introduction of such practices requires higher levels of water management independence and hence an intensification of water management infrastructure, especially in those areas where traditional field-to-field water supply and drainage systems are practiced. The experience of "informal" land consolidation and rice value chain development in the core rice-growing areas of the Mekong Delta is instructive in all these respects (Box 3) and illustrates how even a complex range of drivers and constraints can result in relatively simple adjustments in rice agronomy underpinned by water control.

Box 3: Mekong Delta, Vietnam. Alternate wet-dry irrigation regimes in practice

The Agricultural Competitiveness Project in Vietnam has been promoting alternate wet-dry regimes of rice irrigation procedure along with the application of GAP seed (one "must do") and five "reductions" (water, seed, fertilizer, herbicide, labour) in addition to measuring methane emissions. By allowing irrigation applications to drain to an unsaturated soil depth of 15 cm, growth is maintained and comparable to fully saturated regimes. The aggregate impact of such adoption will be important to monitor in order to fine-tune rice irrigation. The changed timing of water applications (fewer but more frequent) may need long-term adjustment of canal storage regimes in lowland deltas serviced by low-lift pumping and more frequent adjustment of flow regimes in upstream control systems regulated by reservoir releases. The overall impact of reduced water demand and lower fertilizer and herbicide applications is expected to benefit downstream users and their specific use patterns but will require a degree of monitoring and adjustment.

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Reducing the Environmental Footprint of Rice Production

Humnath Bhandari and Samarendu Mohanty

Introduction

Rice production affects the environment by changing the quantity and quality of air, water, land, biodiversity and landscapes. The major environmental footprint of rice involves a substantial amount of water use, groundwater depletion, reduced stream flows, waterlogging and salinization, biodiversity erosion, soil health deterioration (soil erosion, nutrient depletion and soil acidification), agrochemical pollution (of water and landscapes), agrochemical damage (to soil microorganisms, beneficial insects and human health), air pollution from straw burning, greenhouse gas emissions and associated social problems. These consequences could degrade natural resources, reduce ecosystem services, accelerate climate change, threaten rice production, jeopardize long-term food security and impose heavy costs on human health. The growing concern about climate change has increased the pressure on rice farming to adopt sustainable practices that lessen its environmental footprint.

A burning question is how to reduce the environmental footprint of rice without jeopardizing production. The solution lies in using technological, management, policy and institutional mechanisms to mitigate environmental risks and bring about a more efficient use of resources. Although the environmental footprint of rice has many aspects, the discussion in this paper is limited to three key issues for which the impacts are expected to be significant. These relate to water, fertilizer use and pesticides (reduction of greenhouse gas emissions is covered in Policy Note "Extension Service for Rice Farmers: What's Next?").

Evidence/findings

The footprint of water

Rice accounts for significant water withdrawal. About 45 percent of the total water withdrawn in East and Southeast Asia is used in rice. Of the total water withdrawal for rice, 55 percent is consumed by evaporation and transpiration (ET), while 45 percent goes to runoff, seepage and percolation (RSP). Rice's water productivity in terms of ET is similar to that of other major cereals, but its water withdrawal has been two to three times greater because of high RSP. In East and Southeast Asia, irrigated rice area rose by almost 40 percent from 39 million hectares in the 1970s to 54 million hectares today. This increased rice water demand (from 370 billion m^3 to 510 billion m^3) has involved a massive exploitation of surface water and groundwater. By 2025, some five million hectares of irrigated rice are projected to suffer some degree of water scarcity within the region due to factors such as depletion of groundwater tables, silting of reservoirs, chemical pollution, salinization, malfunction of irrigation systems and increased competition for water from urban and industrial uses.

The way out is to improve water-use efficiency and productivity. This should be done in a sustainable way to make sure that multiple functions, especially ecosystem services of paddy-field water systems, are properly considered and maintained. For thousands of years, paddy-field water systems have been functioning for multiple purposes, including rice cultivation; fisheries and livestock raising; domestic, cultural and religious water uses; groundwater recharge; and maintenance of paddy-field ecosystems and biodiversity.

One controversy surrounds the notion of real water savings. Although RSP are considered as losses at the field level, part of them may be needed for other purposes or are reused by downstream users; hence, they are not real losses at the system or basin level. By contrast, a reduction in ET constitutes real water savings at both the field and system levels. This observation suggests that the current focus of many water-saving investments on canal lining for improving conveyance efficiency should shift to water-saving options that reduce ET. But excess RSP also result in evaporation, water pollution, water management costs and energy costs if the water needs to be pumped further downstream. Integrated planning at the river basin/ecosystem level, when feasible, can help to avoid these costs of excess RSP.

Water use in rice can be saved throughout the crop cycle, from the time of land preparation to the later stages of crop growth. Potential water-saving options during land preparation are reducing water outflows through proper land leveling, water delivery using field channels, proper tillage and bund maintenance. Water input during crop establishment can be reduced by adopting conservation tillage and dry direct-seeded rice (DDSR), and during the crop growing stage by adopting technologies such as saturated soil culture (SSC), shallow flooding, midseason drainage, intermittent irrigation, AWD, aerobic rice and efficient irrigation methods such as center-pivot sprinkler irrigation systems.

If adopted in 50 percent of the irrigated rice areas of East and Southeast Asia, the water-saving potential would be about 50 billion m^3 for DDSR, 160 billion m^3 for SSC, 70 billion m^3 for AWD and 180 billion m^3 for aerobic rice. As these methods are mutually exclusive, the potential water saved from adopting them is not additive. Moreover, of the total water saved by these methods, 80 percent would be due to savings in RSP and 20 percent would be due to savings in evaporation. So, while water savings in rice at the field level could be substantial, actual savings in consumptive use of water in rice at the system level would be much smaller[1]. Other water-saving strategies include diversification of rice-based cropping systems; integrated approaches that allow water reuse; the consumptive use of rain water, surface water, and groundwater; and efficiency gains targeted towards consumptive use (ET) of water in rice.

The footprint of fertilizer

In East and Southeast Asia, rice accounts for 22 percent of total fertilizer NPK[2] use. NPK use per hectare of rice in the region has tripled from 60 kg in the 1970s to 180 kg today. In most countries, fertilizer use on rice is unbalanced, with the NPK use ratio ranging from 1.1:1.3:1.0 in Japan to 17.7:3.0:1.0 in the Philippines. Overuse, misuse or unbalanced use of fertilizer on rice results in extra financial costs to farmers and environmental costs to society. The environmental footprint of fertilizer is water pollution, soil acidification, harm to soil microorganisms, GHG emissions and unintended nutrient inputs to natural

1 Although the adoption of DDSR saves water, it also increases weed problems and thereby increases herbicide use.

2 NPK refers to nitrogen (N), phosphorus (P) and potassium (K), the three major macronutrients in plant nutrition.

ecosystems. The challenge is to improve fertilizer-use efficiency so that the environmental footprint will be minimized without jeopardizing production.

One option to improve fertilizer-use efficiency is site-specific nutrient management (SSNM). By tailoring fertilizer rates and timings to field-, season-, variety- and growth stage-specific needs of the crop, SSNM lessens wasteful fertilizer application, N loss from rice fields, production costs and even pesticide use. SSNM is implemented using a leaf color chart (LCC) and *Nutrient Manager for Rice (NMR),* a decision support tool that includes computer- and mobile phone-based applications that provide advice on farming condition-specific fertilizer use for rice farmers, extension workers and crop advisors. Other mechanisms that can enhance fertilizer-use efficiency are soil testing and precise fertilizer application, the use of modified application methods such as deep placement of urea supergranules and the use of new-generation environmentally safe fertilizer products that use polymer coatings to control nutrient release. Appropriate water management in rice can reduce fertilizer rates by improving the indigenous N supply and soil organic matter. A nutrient cycling approach – the use of organic manure and green manure – can increase the indigenous supply of nutrients and reduce chemical fertilizer use. Rice varieties that can uptake nutrients from soil more efficiently can also reduce fertilizer use.

The footprint of pesticides

Pesticide use in rice is significant and still growing, although slowly. In East and Southeast Asia, total pesticide use grew fivefold from 0.43 million tonnes of active ingredients in the 1970s to 2.16 million tonnes today. Rice share in total pesticide use ranges from 13 percent in the Republic of Korea to 66 percent in Viet Nam. Overuse and misuse of pesticides in rice are serious problems. The indiscriminate use of pesticides can affect the health of farmers who spray the pesticides, cause water and landscape pollution, increase pesticide residue accumulation in consumers and lead to the development of pesticide resistance in harmful insects and the destruction of the natural predators of pests and populations of microorganisms. Research has shown that a minimum of pesticide use can conserve natural predators and parasitoids of pests and successfully keep insect pests in check.On the other hand, the judicious use of pesticides can lessen pest populations, increase profits, improve biodiversity

and reduce the environmental footprint. Integrated pest management (IPM) is an ecologically sound approach that controls pests by using a combination of biological, cultural and mechanical methods, plus a judicious use of chemicals and pest-resistant varieties. A natural biological pest control method – or an ecological engineering approach – controls pests by enhancing their natural enemies through minimizing pesticide use and planting beneficial plants on the bunds of rice fields. Other useful and environmentally sound methods are cultural practices such as crop rotation and mixed planting of rice varieties, mechanical pest control methods (erecting sticks for birds, pheromone traps and tillage practices) and the adoption of rice varieties resistant to insects, diseases and weeds.

Box 1. Impact of pesticide policies in the Philippines

In the Philippines, the use of pesticides in rice production expanded rapidly during the 1970s and 1980s. Research in the Philippines in the late 1980s found that the health costs and environmental effects of pesticides applied to rice were substantially larger than their economic benefits (Pingali and Roger, 1995). Other studies provided evidence that the indiscriminate use of pesticides could cause ecological imbalances that exacerbate, rather than alleviate, pest problems. In response, the Philippine government in the early to mid-1990s passed a suite of pesticide regulatory policies and implementing guidelines that restricted the import and sale of hazardous pesticides commonly used in rice and encouraged safer pesticide use. The use of hazardous (all WHO-classified Category I and some Category II) pesticides was banned in 1994. In cases in which banning was not feasible, a selective pricing policy was adopted wherein the more toxic pesticides were taxed at higher rates than the less toxic alternatives. The import, sale and use of banned pesticides are declining gradually, and the use of pesticides (especially insecticides) on rice is now much lower in the Philippines than in many other Asian countries (Moya *et al.*, 2004). Farmer education probably also played an important role: over time, farmers have adopted safer pesticide management practices and the incidence of acute pesticide poisoning fell (Templeton and Jamora, 2010).

Implications for policy

The promising pathways to reduce the environmental footprint of rice are water-saving technologies to save water and reduce GHG emissions, SSNM and other technologies to improve nutrient-use efficiency, IPM approaches to reduce pesticide use, technologies that increase yield without jeopardizing natural resources and crafting suitable policies to promote these technologies. Yet, farmers adopt a new technology only if it works well and promises higher profits without excessive risk. This warrants an integrated approach of research, development and policy support to develop and promote technologies that reduce the environmental footprint of rice without compromising economic benefits.

In considering policy and technical options, we have constructed a typology that presents the various techniques according to their (i) potential impact from an environmental viewpoint and (ii) their ease of implementation from a cost, technical and/or political economy viewpoint. Techniques with high impact and less difficulty in implementation (those in the upper right corner of the figure below) are good candidates for extension. These includes options such as water-saving irrigation techniques and methods, precise nutrient management, pest-resistant rice varieties, smart subsidies on biopesticides and innovative extension methods to educate farmers. Those that may have high impact but will be more difficult to implement require long-term funding for research and/or subsidy. These include options such as the development and promotion of input-efficient rice varieties such as green super rice, promotion of environmentally safe fertilizer products and biological pest control, removal of subsidies on synthetic pesticides and fertilizers, and regulation of hazardous pesticides. Those that involve low impact and little difficulty can be adopted without policy/ program interventions, while those that involve low impact and high difficulty should be considered for active promotion only in very special cases.

Figure 1: Potential impact and ease of implementation of various technologies/agronomic practices

Potential impact	Ease of implementation: More difficult	Ease of implementation: Less difficult
High	— Develop input-efficient rice varieties such as green super rice — Promote environmentally safe fertilizer products — Biological pest control — Remove subsidy for synthetic pesticides and fertilizers — Enforce ban or higher taxes on hazardous pesticides — Volumetric pricing of water	— For water savings: aerobic rice, midseason drainage, SSC, AWD, DSR, efficient irrigation methods, consumptive use of water, conservation agriculture, diversified cropping — SSNM (LCC and NMR) and urea supergranules — Develop pest-resistant rice varieties — Register pesticides and license pesticide dealers — Provide temporary subsidy for biopesticides and IPM — Train farmers, input dealers and extension workers on safe pesticide use — Innovative extension and communication
Low	— Water delivery using channels or pipes	— Proper land management: tilling, leveling and bund maintenance — Nutrient cycling: organic and green manures — Cultural method of pest control: crop rotation and mixed planting of rice varieties — Mechanical pest control: sticks for birds, pheromone traps and tillage practices

Source: Author's own calculation.

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Breakthroughs in Rice Varietal Development: Yesterday, Today and Tomorrow

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Introduction

Rice is grown under a variety of climates and variable hydrological conditions, from dryland conditions in the uplands to flooded soils in the irrigated and rainfed lowlands, and to temporarily or long-duration deeply inundated conditions in flood-prone areas. The enormous flexibility in rice to adapt to these variable environments led to the development of a considerable number of rice varieties with diverse adaptive and grain characteristics. This diversity made rice one of the most widely grown crops over an extreme range of habitats and a model for genetic studies and manipulation to improve its adaptation to various weather conditions, soil problems and pests and diseases and to enhance its attainable yield and grain quality. The Genetic Resources Center of the International Rice Research Institute (IRRI) hosts more than 115,000 rice cultivars collected worldwide.

About 75 percent of global rice production comes from irrigated areas, which constitute the most favourable growing environment and where the Green Revolution (GR) had its greatest impacts. Rainfed areas where the remaining 25 percent of rice is produced are often prone to submergence, soil problems and drought and have seen much slower yield growth. However, rapid changes are anticipated in these areas in the future due to some recent breakthroughs discussed below.

Technological interventions

Several technologies developed in the past revolutionized rice production and helped meet the increasing demands of local consumers and trade. The most prominent of these technologies are the elements of the GR in the 1960s and 1970s (high-yielding seeds, fertilizer and irrigation); the introduction

of hybrid rice in the 1970s in China; short-maturing, high-yielding varieties that enabled multiple cropping seasons; and, more recently, the development of stress-tolerant varieties in South and Southeast Asia and sub-Saharan Africa, which show promise in transforming rice production in less favourable areas. The contribution of these technological innovations was aided by the development of effective management strategies, including post-harvest technologies, that further helped improve and sustain yield, reduce losses and enhance the efficiency of production systems. These successes were largely contingent upon strong partnerships between international and national research institutions during technology development, validation, commercialization and adoption. More recently, the role of the private sector in these processes also became evident, especially in the production and dissemination of high-quality seed.

In favourable areas, the most significant progress certainly came from the development of new varieties that led to the GR of Asian rice. This process involved a long-term development progression starting in the 1960s, with a span of varietal improvements, steady adoption and productivity gains. The increase in rice production before the GR came largely from area expansion and, to a lesser extent, from investments in irrigation facilities in some countries. The GR started as an initiative to combat expected food shortages and famine in Asian rice-based economies because, by then, land available for rice cultivation in the region was becoming increasingly scarce, and the best remaining option was to increase yield. The first generation of modern varieties such as IR8 doubled the yield potential of rice. Their semidwarf stature and stiff stems allowed farmers to use more fertilizers and their photoperiod insensitivity and shorter duration (130 days versus 160–170 days for older varieties) allowed more efficient use of resources and greater annual yield from multiple cropping. As a consequence, farmers in favourable areas quickly adopted these varieties, though their yield fluctuated because of their susceptibility to pests and diseases.

Since then, these varieties have been systematically replaced with others (IR36, IR62) that have better resistance to existing pests and diseases, and later with ones (IR64, IR72) that have better grain quality and shorter growth duration. With this later generation, productivity growth was enhanced and sustained. More recently, no further improvements

in yield have been evident and breeding activities mostly led to further improvements in adaptation to specific environments and preventing reductions in yield as a result of the evolution of new strains of pests and diseases or changes in climate, a process commonly referred to as "maintenance breeding."

With the availability of these high-yielding varieties, public investments in irrigation and fertilizers also increased and favourable institutional policies contributed considerably to their adoption. Cropping intensity was also enhanced in several countries with the development of shorter-maturing varieties that are photoperiod-insensitive, resulting in a substantial increase in annual productivity. Two examples are the double and triple rice cropping systems developed for southern Viet Nam that transformed rice production and trade and converted the country from a net importer to one of the largest exporters of rice in the world. Another example is the shorter-duration boro (winter-dry-season) rice in Bangladesh and parts of India, which played a major role in reducing dependence on imports. In Bangladesh, boro rice production now exceeds that in the traditional aman (wet) season.

The second significant improvement in rice productivity in favourable areas came from the introduction of three-line hybrids in the 1970s and two-line hybrids in the mid-1980s. Generally, these hybrid varieties increased yield by about 20 percent over the conventionally bred varieties, yet hybrid rice has so far been successful only in a few regions, as in the favourable areas of China. Several improvements need to be made if hybrid rice is to be adopted more widely: more efficient seed production technology to lower seed production costs, better resistance to pests and diseases and tolerance of adverse weather conditions, and better grain quality to meet consumers' preferences.

With the introduction of these high-yielding, shorter-duration varieties, parallel progress was made in developing knowledge-intensive crop and natural resource management strategies. Some of these interventions focused on improving input-use efficiency to reduce the environmental footprint, cut production costs and reduce harvest and post-harvest losses. New production systems subsequently evolved with more use of machinery and need-based nutrient and water management strategies, more investments in irrigation facilities and

better post-harvest, processing and other value-added activities. Yields of more than 8 tons per hectare are now attainable in the most favourable climates with a combination of high-yielding varieties and proper management, as in China, Australia, the United States of America and Egypt.

In spite of these successes, yields in many irrigated areas of the tropics remain stagnant, more or less at levels comparable with those of the early-generation GR varieties. Breaking this yield plateau in these areas is challenging and will require considerable research and development efforts. The productivity of current varieties needs to be improved through a restructuring of the rice plant to enhance its yield potential, now becoming possible with new scientific developments and a greater understanding of essential processes. For example, scientists are introducing the more efficient C^4 photosynthetic carbon fixation system into rice to replace the current, less efficient C^3 metabolic pathway – this is expected to increase yield potential by 30–50 percent. Proper management strategies also need to be in place to narrow the current and future gaps between attainable yield and what farmers are actually achieving in their fields.

More interest is recently being devoted to developing nutritious rice enriched with essential micronutrients such as vitamin A, iron and zinc that are associated with major health problems or "hidden hunger." This is effectively useful for rice farmers and consumers who cannot afford a balanced diet for nutritional security as in most developing countries. For example, low amounts of natural provitamin A or carotene in the diet manifest themselves in high susceptibility to diseases, blindness and premature death in young children. This is a particular problem in countries where rice, which lacks provitamin A or βcarotene in the grain, is a dominant part of the diet. Rice varieties rich in provitamin A, commonly known as "Golden Rice," have recently been developed using transgenic approaches, yet these varieties have not been commercialized because of social and political hurdles associated with the acceptance of genetically modified crops. Shortages of iron (Fe) and zinc (Zn) in the diet are among the most prevalent micronutrient deficiencies in humans, and increasing the content of these elements in polished rice grains could considerably benefit human health. Recently, high-Zn rice varieties were developed jointly by the International Rice Research Institute (IRRI) and national programs in India and Bangladesh, and one variety was released by the Bangladesh Rice Research Institute (BRRI).

Varieties rich in Zn (Brazil) and Fe (China) were released recently as well.

Despite the considerable variation in rice grain quality standards among consumers in different regions of the world, grain quality traits of any variety largely determine its chances of adoption and market value. Enhancing the quality of rice grains will therefore provide better revenue for farmers and help meet the increasing demand for high-quality rice in global markets. Recent developments in analytical and biotechnological tools are improving our understanding of the traits that determine specific grain qualities, such as texture, appearance and aroma, and eating qualities, although this understanding is still far from being complete. This slow progress (despite substantial research effort) led to a handful of varieties dominating rice markets over several decades, such as Khao Dawk Mali selected in 1920, Basmati 370 selected in 1958 and IR64 released in 1985. Understanding the factors that determine these quality aspects will facilitate developing varieties that combine higher grain quality, better tolerance of weather extremes, resistance to pests and diseases and higher yield.

In less favourable areas, rice production is affected by too much or too little water, excess salt and nutritional deficiencies and toxicities in the soil. Yields are low and unstable, usually in the range of 0.5 to 1.5 tonnes per hectare in South and Southeast Asia. About 23 million hectares are affected by drought, 22 million hectares by submergence and 16 million hectares by soil salinity each year. Crop losses due to abiotic stresses in these areas are enormous and have a human dimension usually not captured by measurements of financial losses, because most of these areas are populated by the poorest members of society, who often have few alternative livelihood options. Farmers in these areas may be forced to liquidate their belongings, such as farm equipment, livestock and even their land, simply to survive, thus seriously limiting their future options.

Recent advances in genetics and breeding have now made it possible to develop rice varieties tolerant of most abiotic stresses encountered in the less favourable areas. Cultivation of these varieties can substantially enhance productivity, contributing to poverty alleviation and securing food supply for millions of impoverished farm households in Asia. Using modern plant breeding technologies made it possible to locate and transfer adaptive traits and tolerance mechanisms from old landraces into modern high-yielding varieties, making

them suitable for cultivation on unfavourable lands. As a result, tolerance for submergence, salinity and drought has been successfully incorporated into some of these modern high-yielding varieties. Because popular rice varieties such as Swarna, IR64 and BR11 (all high-yielding and with good grain quality) are being used to deliver these tolerance genes, the new varieties have reached close to 5 million farmers since 2009, with the submergence-tolerant varieties (that can withstand more than 2 weeks of complete submergence) being the most widely adopted to date. In general, these new varieties reduce risk, which encourages farmers to invest in complementary crop management practices that result in higher and more stable production (yields of 1 to 3 tonnes per hectare more than previous farmers' varieties when subjected to stress).

Progress to date on the spread of the new stress-tolerant varieties has been substantial, thanks to the significant support of donors and national institutions in Asia. However, realizing the full potential of these varieties will require additional investments and policy support. Strengthening the capacity of national programs to take part in modern breeding will ensure that stress-tolerant varieties well adapted to local conditions will be developed. National and regional enabling policies and guidelines need to be in place that permit germplasm exchange and ensure faster evaluation, commercial release and alignment of relevant partners in the seed chain. More investments into effective seed systems will ensure availability and timely delivery of high-quality seeds, which is currently the major holdup for wider adoption of these varieties. Aligning proper public- and private-sector partners is necessary to ensure a far-reaching network along the research-to-adoption continuum, coupled with effective awareness and monitoring programs.

Rice research for development clearly shows promise for increasing productivity and profits in both favourable and less favourable rice ecosystems, particularly the latter. Nevertheless, it will be a great challenge to keep rice affordable for the poor while conserving our natural resources. More rice needs to be produced from shrinking natural resources and under deteriorating weather conditions.

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Extension Service for Rice Farmers: What's Next?

Benjamin O'Brien and Nuno Santos

Increasing demand, slower yield growth, pressure on available land, climate change and shifting demographics will continue to put pressure on rice farmers to increase their farm productivity to meet these challenges. More investment to raise potential yield in a range of different environments is certainly needed (see Policy Note "Improving the Quality of Agricultural Public Expenditures in Asia, pag. 73), but there is also a considerable gap between farmers' yield and potential yield that should be further exploited. Modeling of selected key regions of East and Southeast Asia suggests that this gap ranges from 55 to 100 percent (Fischer *et al.*, 2011). These yield differences can exist for many reasons (culture, risk and profitability, literacy), but one key reason in many circumstances is the poor connection between farmers and extension services.

The sustained strong economic growth in many regional economies has translated into major advances in the availability of basic market infrastructure in rural areas, improved access to financial and input markets, and improved capacity of both the public and private sector to invest in extension. Given this, which technologies will be most critical and which delivery mechanisms for these will be appropriate? It is important for policymakers to understand some of the likely trends in future extension systems.

The modalities for agricultural extension have shifted over time. During the colonial period, the main sources of agricultural advice were large plantations and farms established by colonial powers. From the 1960s to 1980s, most extension systems were based upon "top-down" methods, with advice linked to production targets set under central government development planning cycles. This approach evolved into the training and visit system (T&V), featuring a hierarchical organizational structure overseeing a large cadre of village-level workers that were conducting rigid bi-weekly visits to a fixed list of farmers.

The T&V approach proved to be unsustainable due to the "incompatibility of its high recurrent costs with the limited budget availability" (World Bank, 2006). In many locations, extension delivery shifted to more "bottom-up," participatory approaches. Good examples of this are a variety of farmer field school and (IPM) programs. There has also been a trend toward decentralization of extension in Southeast Asia (e.g. Cambodia, Indonesia, the Philippines). Although the expectation was that these systems would become more responsive to local needs, effectiveness has been compromised to some extent by inadequate funding and extension staff maintaining traditional top-down approaches (Feder *et al.*, 2010).

What is the future of rice extension systems?

In many ways, the future is already here, with "market-led extension service provision" becoming more common in rice production systems in many countries across Southeast Asia. Private-sector operators (mainly input suppliers and increasingly rice millers and exporters) provide extension services in order to sell product and to ensure that their supplies comply with specific product characteristics in destination markets. This has also taken place in South Asia as demonstrated by the expansion of basmati rice in India, primarily led by the private sector, with the public sector mostly focused on the provision of improved varieties. A second important development is the evolution in rice extension models towards site-specific and farming systems technology packages. Finally, information and communication technology (ICT) is expected to continue to gain in importance as a needs assessment, extension delivery and monitoring tool. We will look at these three main expected developments in turn.

Moving towards "market-friendly" extension systems

A policy option for public extension service providers is to consider shifting their focus from "retailing" to "wholesaling" extension. In such a system, a range of service providers is contemplated for final delivery of extension packages (public and private sector, Non-Governmental Organizations (NGOs), input suppliers, etc.), while the public extension system mainly focuses on the development and packaging of technologies, as well as input pricing policies and regulation (i.e. to reduce the incentives to use pesticides or fertilizers in

cases where they may not be needed). In many extension systems, a transition has begun in which existing informal farmer-to-farmer information exchange is leveraged by public extension services. The evolution of such informal mechanisms to a market-led system takes place when the farmer (or in certain cases the public extension worker) starts to attach other services (such as the provision of inputs) to this information, effectively becoming a private extension service provider. A second option includes the public system contracting/outsourcing extension service providers for specific activities (this can include forms of public-private partnerships). In addition, "wholesale" extension can also take the form of capacity building of existing service providers such as input suppliers so that they improve the quality of their service delivery (e.g. up-to-date fertilizer recommendations).

Cambodia provides a good example of such options being implemented: the government is partnering with the private sector to expand a network of private "Farm Business Advisers." The Australian government is also assisting the Cambodian Provincial Directorates of Agriculture to link with and provide direct training to retailers (CAVAC, 2012). China has been actively encouraging extension staff to become involved in business enterprises, with the goal that they become competent in advising farmers on operating farms as businesses. Viet Nam is drawing upon private service providers, NGOs and university units to promote sustainable production practices for rice and expects a growing number of milling/trading companies to include advisory support as part of contract farming arrangements.

Fostering and financing pluralistic extension systems should allow public extension to reach a wider audience. However, a shift in public-sector extension service provision towards a more "market-friendly" system faces significant challenges. First, all farmers have a business (some are just less commercial than others), while public field extension workers, who typically come from a technical or research background, often lack experience or training in business management. But, such skills are fundamental to understanding farming as a business, and, if extension agents had a better understanding of the economic implications of the technologies they are promoting, they would be able to provide more convincing extension messages. Second, there is likely to be resistance to change from public extension workers and local officials because

of entrenched interests. This is further complicated by the institutional setup of many ministries of agriculture in East and Southeast Asia that separate different functions in different line departments and thus do not provide a unified service. For example, many farmers have multiple enterprises covering a mix of rice, other crops, livestock, aquaculture and agro-forestry. But, extension for these subsectors is generally delivered through separate line departments that have different modalities of delivery and varying levels of extension resources and don't always have a good appreciation for the interactions between different subsectors at the farm level.

Developing site-specific and farming systems-based rice extension

Standard rice extension models of the 1970s often had fixed recommendations for input management (e.g. calendar spraying). As it became evident that a "one size fits all package" was not suitable for all situations, alternatives such as IPM emerged, particularly in Indonesia, as a viable extension model. Other strategies for managing rice crops in a more holistic manner include the system of rice intensification (developed in Madagascar) and the Australian *Ricecheck* system (NSW Department of Primary Industries, 2012), an integrated crop management approach. Its subsequent adaptation and use by a number of countries in the region (Indonesia, the Philippines, Viet Nam and others) has arguably been a contributor to improved yield growth over the past 10 years.

The next frontier is likely to be increased site-specificity of rice extension. For example, the Cambodian Rice Crop Department is considering "fine tuning" its rice farming extension packages for localized climatic and agro-ecological conditions and is initially discussing having 8 to 10 variations (Ngin Chhay, director, Rice Crop Department, and Christian Roth, Australian Centre for Agricultural Research (ACIAR) project leader, personal communication, May 2014) using recommendations from climate change adaptation research (ACIAR, 2010). A key part of the package will be decision trees to help farmers better manage risk. In the future, more attention will also likely be given to extension that looks beyond rice production to farming as a business (see above), post-harvest management, crop rotations, livestock/fish-rice farming systems and risk management. Delivery of this wider smorgasbord of services by the public sector will be difficult without adopting some of the approaches described above in relation to wholesaling extension and those below on ICT.

An increasingly important role for ICT

It is estimated that, within three years, up to one-third of the rural population in East and Southeast Asia will have access to a smartphone and already a large portion of the population is served by basic Internet connectivity. This provides an opportunity for public extension systems to leverage both private-sector initiatives and ICT platforms. Governments can promote such developments through different policies such as (i) creating an enabling environment for ICT in agricultural extension services (infrastructure, regulation, etc.) and (ii) providing start-up financing and/or establishing public-private partnerships with successful ventures already operating in other countries/agricultural subsectors. Already this is happening to some extent: partnerships between government agencies and private companies such as Nokia, Reuters Market Light (RML) and Syngenta are delivering technical content to rice farmers. For example, through RML, farmers receive crop advice, specific weather forecasts, local market price information and other information directly to their mobile phones. A study by Gesellschaft für Internationale Zusammenarbeit, (GIZ) of RML in 2011 indicated that 90 percent of the farmers believed they benefited from the mobile phone-based service and 80 percent were willing to pay for it.

ICT is also being used for service monitoring, the provision of decision support systems (IRRI Rice Nutrient Manager), needs-based extension advice (eExtension Service, Philippines) and knowledge sharing through social media (Digital Green). These services are proving to be effective and in some cases financially sustainable. Public institutions are also attempting to develop ICT extension systems, yet they may be constrained by a lack of in-house ICT expertise and funds. Experience so far indicates that partnering with private-sector companies seems to yield better results than exclusively public-led ICT initiatives. An example of the latter is Cambodia's public-led attempt at developing a market information system for prices of certain agricultural commodities (including rice) with donor support: after a promising start, the system collapsed mainly because of a lack of maintenance funding. This contrasts with the positive private-sector-led experiences such as Reuters Market Light mentioned above.

One area not well explored is the opportunity to make use of ICT for more responsive management of public extension. The opportunities lie in using ICT tools for rapid assessments of farmer demand, monitoring of program inputs and outputs, and the use of these assessments for understanding key issues such as the return on investment to various extension activities.

Conclusions

Public extension systems in most countries in East and Southeast Asia are sufficiently financially constrained so that outreach is limited. Under such circumstances, policymakers may benefit from thinking of public extension delivery in terms of wholesaling rather than retailing. At the same time, introducing a more business-oriented culture is likely to help extension service providers better connect with farmers as clients. If public extension systems can become more responsive to demand by better understanding localized climatic and agro-ecological conditions, more farmers will probably see the new technologies as relevant. Finally, ICT offers many cross-cutting opportunities that could allow public extension systems to respond better to local demand, to manage interventions on a day-to-day basis and to better quantify the impacts and returns on investments in extension.

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Measures for Reducing Post-production Losses in Rice

Alfred Schmidley

Reducing post-production losses is a key part of meeting future food demand, improving incomes of farmers and lowering prices paid by consumers. Losses occur at each point in the post-production chain. These losses can be divided into two types: physical losses and quality losses. The International Rice Research Institute (IRRI) estimates that physical losses (measured in weight) of rice in many parts of Southeast Asia range from 15 to 25 percent. Furthermore, quality losses (measured in lost value) range from 10 to 30 percent due to suboptimal management that contributes to farmers receiving lower prices. Reducing losses, even by a few percentage points, can have a significant impact on national food security and benefit smallholder farmers, rice consumers (including the poor who depend on rice for much of their daily caloric intake) and other participants in the value chain. Moreover, remediation options and best management practices exist, yet preventable losses remain high. This begs the question: "Why has public policy not more effectively addressed post-harvest (PH)[1] losses?" Some critical questions come to mind:

— Is there an awareness or knowledge gap among policymakers and practitioners in this field? Are policymakers aware of the significant impact of losses on farmers, the rural poor and other actors, and that losses are preventable with known technology and best practices?

— Are post-harvest (PH) losses deemed an exclusive domain of the private sector with a limited rationale for public intervention?

— Has a mixed track record of past interventions inhibited further public action?

— Does the economics (costs and benefits) of improved technologies present a compelling case for increased adoption?

1 In this Note, the terms post-production and post-harvest are used interchangeably. Thus, post-harvest should be understood to include harvesting.

There is a need for a more dynamic approach to understanding losses in local and rapidly changing environments. Such an approach must go beyond data collection under assumed static and generalized conditions that do not provide policymakers and other stakeholders with any practical insight into steps for local loss prevention. Policymakers and other stakeholders often do not have access to information on PH losses in an understandable and actionable way.

For example, the media may report on PH losses in rice that are combined with other cereal crops or even incorporate losses of unrelated horticultural crops. This provides only a superficial understanding of "numbers" without any deeper insight into critical issues about what can be done. Methodologies used to gather loss data may also be confusing or misleading. For example, social scientists may use lower-cost farmer surveys for understanding PH losses. However, surveys themselves do not actually measure losses – only the interviewee's awareness of them. Many smallholders tend to underestimate losses simply because they are not aware of them or consider them inevitable because they lack knowledge about how to prevent them. In addition, experts may understand losses in particular operations in isolation, yet fail to understand how practices upstream (e.g. suboptimal field drying) affect losses in operations downstream (e.g. milling quality). Lastly, losses in value (quality losses) vary according to what quality factors consumers value, which can differ significantly for different markets.

History provides many lessons regarding PH technologies and their sustainable adoption that still remain unheeded. One well-known example of great historical success is the axial-flow threshing technology that IRRI developed in the early 1970s. What is perhaps not so well understood is that success was linked to a convergence of factors: (i) significant resources dedicated to industrial extension; (ii) local adaptations to suit local actor needs and environments; (iii) effective engagement of the private sector through provision of technical assistance to fabricators beyond the original design process; and (iv) a long time frame (10 years) working with multiple stakeholders. Today, this technology continues to be adopted in rice-growing regions in East and Southeast Asia and, more recently, Africa (as stationary and mobile threshers). It is even incorporated in today's larger modern combine harvesters.

Although there are other success stories in the mechanization of other post-harvest operations, such as the adoption of flatbed drying technology in Viet Nam in the 1990s, attempts to widely apply this technology in other countries, such as Cambodia, Lao PDR, Myanmar and the Philippines, indicate that the policies used for technology transfer can play either a positive or negative role in advancing sustainable adoption.

More broadly, some of the key reasons why technology adoption and spread have failed even though technology and country environments seemed appropriately matched follow:

Public-sector programs that manufacture and/or distribute free equipment to farmers or other actors. This undermines sustainability and displaces private-sector activity and entrepreneurship. Despite the many and repeated failures of this approach, it remains surprisingly popular with policymakers, donors and implementing agents. As an illustration, Douthwaite (2002) shows how a free distribution program for stripper harvesters in Myanmar to groups of smallholder rice farmers resulted in zero adoption.

Technology not adapted to suit local actors and environments. This often stems from a "one size fits all" approach and an assumed static environment in which actor needs don't differ. For example, Schmidley (2009) describes how the promotion of a local mini-combine design in China failed to sustain adoption until proper account was taken of the needs of farmers and other actors downstream.

Group ownership of equipment by farmers. Schemes for cooperatively owned equipment generally haven't been sustainable for a number of reasons. Bottlenecks have typically included the care and maintenance of machinery (and knowledge to do so), along with the costs associated with breakdown (and who pays). Also, the resolution of disputes during seasonal high demand periods over whose needs for machinery come first often leaves less empowered and the least well-off farmers at a disadvantage.

Interventions that focus exclusively on marginal farmers. Successfully addressing the needs of poor farmers requires understanding of mechanization

processes, value chains and clearly defined impact pathways. For example, the poorest farmers may not be in a position, nor may it be in their interest, to own certain technologies, especially if they keep much or all of their harvest for their own consumption and thus lack a revenue stream to finance investment. Other relatively better-off smallholders or larger farmers are more likely to become successful first adopters. Such early adopters often become providers of contract services to smaller and more marginal farmers. Thus, marginal farmers may still receive the benefits of technologies without incurring high investment costs or having to bear risk, while still retaining choices of technical options and service providers.

Implications for policy

The implications of the observations above for policy are significant and point to the need for longer-term strategies to achieve sustainability in approaches to reducing post-harvest losses. Policymakers should consider the following:

Making use of market-driven mechanisms and a "bottom-up" approach to build a sustainable supply chain (without subsidies or free giveaways of equipment); such an approach includes the piloting of locally unknown technologies from other countries, plus responding to needs assessments before scaling out.

The provision of sustainable technical assistance, built upon actor knowledge and capacities, to a significant number of manufacturers – this creates more competition to improve quality and services to farmers, while minimizing the risk fabricators will fail because of technical reasons.

The availability of business support services in the form of credit/ financing, business plans and marketing assistance to end-users along with facilitating linkages between chain actors for more robust and sustainable business models.

Support for local adaptations and innovations that suit local conditions and needs of actors. Studies by Douthwaite and Gummert (2010) suggest that there is a need for agricultural researchers to stay engaged with fabricators/

manufacturers to support local end-users in a process of local adaptation, rather than treating R&D products as finished public goods for stakeholders to simply pick up.

Support for field demos with business cases for technology adoption. This helps promote products and services throughout the supply chain and create end-user awareness of technical benefits as well as economic benefits that improved options provide.

Develop and support technology champions that come from a project team, local farmers or other stakeholders, including policymakers.

Facilitate the development of multi-stakeholder platforms that include project partners, the private sector, extension agents, NGOs and others to facilitate capturing of lessons, integration of actor learning and awareness of options. This helps connect research and existing knowledge about improved PH technologies and best management practices to multiple stakeholders. Good examples of this can be found in Cambodia and the Philippines (Meas and Sorn, 2012; Quilloy *et al.*, 2012; Schmidley, 2013).

Allow for a sufficiently long time frame: normally at least a 10-year horizon should be contemplated. Examples of sustainable longer-term success include laser leveling in India and flatbed dryers in Viet Nam (Gummert *et al.*, 2012).

In relation to the last point, it is important to highlight that policymakers, development partners and practitioners should be careful in using typical 3–5-year project cycles given that these are relatively short and may not be sufficient to support sustainable long-term outcomes for technology adoption and spread. In addition, without a means to measure and assess sustainable outcomes in the longer term, policymakers remain uncertain about what really has worked and what hasn't. In conclusion, while technical considerations on matching PH technologies to different country environments are extremely important, so too are the enabling conditions for technology suppliers and other supportive public policies.

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Improving the Quality of Agricultural Public Expenditures in Asia

Sergiy Zorya and Nuno Santos

In the wake of the food price crisis of 2007–2008, many Asian governments renewed their efforts to become self-sufficient in rice, as the world market is perceived to be an unreliable source of supplies. They have increased public spending on rice and other agricultural programmes. Yet, an increase in agricultural spending alone does not guarantee higher growth, lower poverty and even self-sufficiency. A large body of research shows that these outcomes will be determined as much by the *quality* of the expenditures as by the *quantity.* An important consideration is the fiscal sustainability of agricultural spending, because larger budget deficits can negate any positive impact the higher agricultural public expenditures can have in the short run.

As presented below, international experience has conclusively established that expenditures on public goods such as agricultural research, extension services, education and rural infrastructure are indispensable for agricultural growth, competitiveness and poverty reduction. These types of expenditures have consistently been associated with high economic and social returns. In contrast, subsidies to farmers or inefficiently organized delivery of public goods have been found to have limited impacts on triggering long-term agricultural growth.

Using data from 10 Latin American and Caribbean countries for 1985–2000, López and Galinato (2007) found that a reallocation of 10 percentage points of agricultural public expenditures from input and output subsidies to public goods increased per capita agricultural income by an average of 2.3 percent. This benefit, which was realized without increasing total expenditures, resulted from the increase in the provision of public goods and the reduction in the distortions caused by subsidies, which negatively affect the quantity and quality of private investments. In contrast, increasing public expenditures without changing their

composition was much less effective in raising per capita agricultural income: a 10 percent expansion of government outlays was found to increase agricultural income by only 0.6 percent on average.

A similar empirical result about the importance of expenditure mix for agricultural growth was found in Indonesia. During 2001–2009, spending on public goods drove agricultural growth in the country (World Bank, 2010). At the same time, public expenditures on fertilizer subsidies reduced per capita agricultural growth. Although the increased use of fertilizer helped increase rice production in the short run, the overall impact of fertilizer was offset by the crowding out of public goods and by poor targeting of the input subsidy programme.

The bias in the mix for private vs public goods has both efficiency implications and important equity implications. Studies by the International Food Policy Research Institute in India (Fan *et al., 2000)* and China (Fan *et al., 2001)* showed that, in India, the most effective rural poverty reduction investments were roads, followed by agricultural research. In China, the most important contributors to poverty reduction were education, followed by agricultural research and then roads. Significantly, these studies showed very clearly that public investments that have the highest effects on growth are also likely to be the most pro-poor.

Pro-poor agricultural growth is unlikely to occur in the absence of a sustainable macroeconomic environment. Public expenditure policy is a form of direct economic intervention. Like other interventions, public spending on agriculture should be part of a market-friendly approach to economic policy, and supportive of development and adjustment goals. Excessive agricultural public spending can lead to high or rising budget deficits that can result in different types of macroeconomic imbalances (e.g. high inflation, misaligned exchange rate), causing lower economic growth and weaker demand for farm products. Based on an analysis of 85 developing countries, Gardner (2005) found macroeconomic stability and real income growth in the non-agriculture economy among the most important factors explaining agricultural growth performance over a 40-year period. His findings reinforce the notion that public spending on agriculture should remain consistent with aggregate fiscal discipline.

Recent increases in agricultural spending in many Asian countries are not yet large enough to undermine long-term macroeconomic stability but further increases could do this. Public spending for agriculture in general has been on the increase around Asia since the 2008 global food price spike. In Cambodia, for example, public spending on agriculture increased from US$116 million in 2007 to US$155 million in 2009, expanding the share of agricultural budget in GDP from 1.3 percent to 1.5 percent, respectively (World Bank and AusAid, 2010). The increases in Indonesia and the Philippines were even larger (World Bank, 2010; DBM, 2013). The nominal agricultural budget in Indonesia grew threefold, from US$1.8 billion in 2004 (0.7 percent of GDP) to US$5.9 billion in 2009 (1.5 percent of GDP). In the Philippines, the agricultural budget grew from US$754 million in 2006 (0.6 percent of GDP) to US$2.5 billion in 2013 (0.9 percent of GDP).

Increases in overall agricultural spending have been fueled by increases in spending on rice programmes. Non-rice spending has lagged behind, leading to slower agricultural diversification and agricultural growth. Higher spending on rice has been justified in the name of increasing self-sufficiency (Indonesia and the Philippines) or generating foreign exchange earnings from exports (Cambodia). In Cambodia, about 62 percent of the budget increase observed between 2007 and 2009 was due to the higher expenditures on irrigation. The agricultural budget increase observed in the Philippines was driven in large part by higher irrigation expenditures, even as rice and corn input subsides were phased out. The share of irrigation expenditures in the total agricultural budget increased from 35 percent in 2007 to 50 percent in 2012–2013. In Indonesia, on the other hand, the major contributors to the higher public expenditures were fertilizer and seed subsidies, combined with a rice consumer subsidy (Raskin). From 2006 to 2009, these subsidies accounted for about 85 percent of the total agricultural budget increase.

Box 1. Improving the quality of public expenditures – the case of Lao PDR

Analysis of 2010/11 public expenditures in the agricultural sector in Lao People's Democratic Republic (WB, FAO and IRRI 2012) indicates that some 70 percent is associated with irrigation (i.e. development, O&M; and electricity subsidies) and that this directly benefits only 10 percent of the country's rice farmers. In contrast, agricultural extension services have little funding (averaging US$1.60 per farmer, excluding donor programs). To achieve greater efficiency and equity of rice-related public expenditure, there is an evident need to:

— Achieve a better balance between irrigation and support for agricultural innovation services (e.g. varietal development, seed quality improvement, agricultural extension, etc.). In Lao PDR, the evidence suggests that the highest incremental benefits (e.g. productivity and income gains) come from extension activities that induce agronomic and technological changes by farmers.

— Develop clearer geographic targeting, with rice-related expenditures focused heavily on the irrigated and non-irrigated areas that are most suitable for rice and a different set of programs to improve farm productivity and livelihood diversification in the more marginal rice-growing areas.

In parallel with further improvements in irrigation services, major gains can be achieved in Lao PDR by devoting more resources to the development, testing and adoption of high-yielding and high-quality rice varieties for the country's major rice ecosystems – based on the more than 13,000 accessions deposited in the Lao PDR gene bank and in the International Rice Gene Bank. There is also a need to continue to produce and make widely available new and better rice seeds, which the study suggests would require the involvement of private-sector investments to supplement existing public-sector production.

Improving extension services is also very important as the national system currently has inadequate technical staff numbers and capacity, poor incentives for staff and a generally low amount of contact with farmers. The study points to opportunities to increase the involvement of the private sector and other non-government organizations in farm advisory services and to undertake schemes involving public-private partnerships in this area. Lao PDR can benefit by learning from the experiences of other countries, including the IDE Farm Business Advisor extension model being implemented in Cambodia.

Despite a history of disappointing results, input subsidies still attract high attention in Asia. Without nutrient replenishment, many farmers risk taking their soil resource base beyond a point of no return. Mainly for this reason, there is widespread agreement that the improvement in soil fertility needed to boost agricultural productivity growth, improve food security and raise rural income will require increases in the use of P and K fertilizers, in combination with accelerated adoption of improved land husbandry practices and modern seed varieties. There can be little doubt that fertilizer use must increase in some places in Asia[1] if the region is to meet its agricultural growth targets, poverty reduction goals and environmental sustainability objectives. If implemented well, input subsidies can help achieve that objective.

At the same time, it is important to recognize that fertilizer is not a panacea for all of the problems that afflict Asian agriculture and that promoting inputs in isolation from other needed actions can have little lasting impact. Many input promotion schemes have succeeded in temporarily increasing the use of inputs, but only in ways that have encouraged their inefficient use, imposed heavy administrative and fiscal burdens on governments and undermined the development of private-sector-led fertilizer markets (Morris *et al., 2007).*

In designing interventions to promote increased input use, policymakers should bear in mind a number of guiding principles if they wish to achieve lasting impacts. Interventions designed to promote the use of inputs should be developed as part of a comprehensive strategy that includes actions designed to reduce input costs along supply chains, foster competition, strengthen output markets, promote input-use efficiency and empower farmers. It needs to be recognized that reducing the cost of inputs through subsidies alone is likely to stimulate production gains only in the short term; once the subsidies are removed, production will decline. Subsidy programmes, therefore, should be designed to support market development, including a reduction in public-good-related costs along input production and distribution chains, and not undermine the incentives for private-sector investments.

1 It is also true that in many places farmers significantly overuse fertilizers, for example, in China. Christiaensen (2013) estimates that a 30 percent reduction in the use of fertilizers would leave the agricultural output of Chinese farmers unchanged, providing significant cost-saving potential.

Effective demand for inputs, shaped by the current and potential profitability of input use, should be the ultimate driving force behind input supply policy reforms. The promotion of input use should be farmer targeted and ideally have pro-poor growth objectives. In countries with a history of input use and in which private markets exist, universal input subsidies have proven to be expensive and not very effective in significantly improving access to inputs, as the subsidies are often captured by farmers who already use inputs. The highest payoffs have been achieved when input subsidy programmes have focused on farmers who were not already using inputs and who were located in areas in which commercial input distribution systems were less developed. Targeting regions with underdeveloped input markets is administratively easier in most cases than targeting producers who fall into a particular social stratum or income class nationwide. E-vouchers, currently being piloted in a number of countries worldwide, promise to allow more effective targeting of subsidies and can also provide flexibility with respect to the input mix preferred by individual farmers.

Efficient input use is a precondition for the economic survival of farmers and their ability to converge with non-farm income. Public investments in agricultural research, farm advisory services, water management and soil management practices are necessary to design location-specific input packages and technical advice and improve farmers' knowledge on how to use inputs appropriately. Although selective use of targeted input subsidies may be justified in some instances as a way to help farmers climb the learning curve and build effective demand for inputs that can sustain a profitable private input distribution industry, subsidies should be time limited. Several years of support may be necessary for input promotion programmes to achieve their objectives, but beyond that subsidies should be phased out to prevent the fiscal costs from becoming unsustainable.

As governments in Asia continue to scale up support for agriculture, these and other principles should be kept in mind. Public expenditure could help solve problems and build a strong foundation for long-term agricultural growth. Yet, spending too much or spending on the wrong things could undermine the benefits of investments. Financing of public goods available for both the rice and non-rice sector offers the highest returns to economic growth and poverty reduction and thus should be prioritized over farm subsidies in spite of their popular support and short-term gains.

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Markets, Trade and Welfare

Targeted Social Safety Nets to Ensure Food Security

Saswati Bora and Sergiy Zorya

Introduction

In many Asian countries, rice remains closely tied to food security objectives, particularly as an important element of a food-based social safety net programme. Food-based safety nets are designed to ensure livelihood (for example, through providing employment in a public works programme paid in food), increase purchasing power (through providing food stamps, coupons or vouchers) and relieve deprivation (through the direct provision of food to households or individuals). They differ from cash-based programmes – public employment or cash transfers – in that they are tied to food as a resource (Rogers and Coates, 2002).

In most cases, targeted cash transfers are often preferable to food-based transfers as they involve less distortion to production and consumption choices, and have relatively lower administrative costs, leakage and pilferage. However, in-kind food transfers are sometimes preferred as they have the potential to be self-targeting, are not subject to inflation to the same extent as cash transfers and can realize specific policy goals (such as increased nutritional security for mothers and children through supplementary feeding programmes) (Subbarao *et al.*, 1997).

Most food-based safety nets in place in developing countries were instituted as a temporary response to a short-term crisis, yet they remained in place (Rogers and Coates, 2002). In Asia, food-related safety net programmes range from universal food subsidies to more targeted programmes, such as feeding programmes or public works programmes. The choice of instruments depends on country circumstances, with countries such as India, Indonesia and the Philippines experimenting with a large array of programmes, including food subsidies, nutrition programmes, public works programmes and cash transfer programmes. The Philippines has moved from poorly targeted and largely

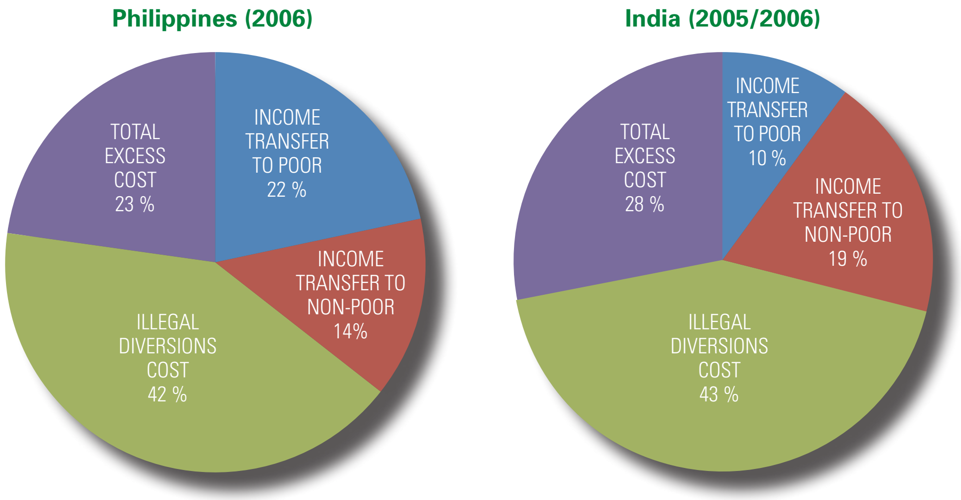
ineffective in-kind food subsidies to more targeted cash transfer programmes inspired by the success of countries such as Mexico in transitioning from these to conditional cash transfer programmes such as PROGRESA. Some other Asian countries are considering doing the same.

Evidence/findings

In Asia, the prevailing mode of food-based safety net has been largely rice subsidies. However, these programmes have proven to be fiscally expensive and economically distortionary and they have been accompanied by high targeting errors, leakages and economic inefficiencies. For example, the share of subsidy going to the poor through the Targeted Public Distribution System (TPDS) in India and the National Food Authority (NFA) rice subsidy programme in the Philippines in 2005/06 was only 11 percent and 21 percent, respectively (see Figure 1); the rest of the subsidy is spent on income transfers to the non-poor (inclusion errors), excess costs (costs incurred in purchase, transport and distribution) and illegal diversion costs (Jha and Ramaswami, 2010).

In Indonesia, the Beras untuk Rakyat Miskin (Raskin) programme is the largest permanent social assistance transfer programme, in both coverage and overall government expenditure. Roughly 50 percent of the entire population buys Raskin rice at least once a year and it is increasingly bought by both poor and non-poor households. As total rice is spread more thinly, few households enjoy full Raskin benefits. As a result, the actual transfer received by households has fallen to about 2 percent of total poor household expenditure, while the kilograms purchased represent less than 10 percent of a household's food needs. Raskin's geographic targeting is also not efficient, with food-insecure regions not receiving a greater share of benefits (World Bank, 2012).

Figure 1: Decomposition of Subsidy in the Philippines and India



Source: Author's own calculation.

In recent years, there has been a shift towards targeted cash-based transfer programmes. These have been largely driven by fiscal tightness, poor cost-effectiveness and high targeting errors. In the Philippines, the rice price crisis of 2008 increased the government's attention to the need to develop improved and more cost-effective social protection measures as an alternative to the badly targeted rice distribution. In particular, the crisis has reinforced the need to (i) improve the targeting of social safety net spending and (ii) accelerate the rollout of a cash transfer system. During 2008, the government launched a conditional cash transfer programme (Pantawid Pamilyang Pilipino Program, or 4Ps) that focuses on supplementing the income of the poorest households while also supporting their human capital development (for example, activities to improve children's health and education and preventive checkups for pregnant women) (Fernandez and Olfindo, 2011).

At the same time, the government is improving the targeting of poor households by developing a proxy means test (PMT) methodology for identifying the poor. Such a household targeting system is expected to provide

the government with a vehicle to redirect more inefficient subsidies that are not well targeted to the poor (such as the NFA rice subsidy) to more targeted, possibly cash-based programmes in the future (World Bank, 2008). The early results of this conditional cash transfer programme in terms of reaching the poor in a cost-efficient manner and of changing behaviour of the recipients have been encouraging (Velande and Fernandes, 2011).

At times of crises, cash transfers may be the fastest and least costly method of reaching poor and vulnerable households, if the delivery infrastructure exists and markets are functioning. Using cross-sectional household surveys from Indonesia carried out before and after the 1997/98 economic crisis, Skoufias *et al.* (2011) found that cash transfer programmes can play an important role in helping households protect their consumption of essential nutrients during a crisis. However, to ensure that all micronutrients are consumed, relying entirely on cash transfers may not be sufficient. Targeted micronutrient supplementation programmes may have to accompany cash transfer programmes to ensure that key micronutrients are not sacrificed during crises.

Implications for policy

Going forward, several issues need to be considered:

Clarity in the objectives of the safety net. If the sole objective of the safety net programme is simply income transfer, then providing an in-kind food subsidy is not an efficient way of delivering an income increase to a household (Rogers and Coates, 2002). As was seen in the case of the Philippines' NFA rice subsidy, it endeavours to satisfy multiple, often conflicting, food security objectives, which the government is now trying to unbundle. If there are other goals in mind, for example, related to dietary adequacy, nutrition and health, responding to emergencies and crisis, then food-based transfers (but not necessarily a food subsidy) are preferred. These can be supplementary feeding programmes, school feeding programmes, food-for-work, emergency feeding programmes, etc. Getting clarity on food security objectives can help in designing an optimal mix of efficient safety net programmes that can complement each other, with each type addressing a specific population and its needs.

Size of the programme and programme costs. If rice is being used as a safety net for emergency responses or nutritional outcomes, the size of

the programme should be small and targeted so as not to distort the market and focus on vulnerable population groups. Maintaining low programme costs ensures a programme's sustainability. Keeping transaction costs low also makes sure it does not erode the net value of the transfer (Subbarao *et al.*, 1997).

Transitioning from subsidies to individually targeted transfers. Two sets of issues need to be addressed while shifting from subsidies to targeted transfers: (i) designing an appropriate targeting mechanism and (ii) managing the political economy so as to create the space needed for a transition in which there will be new beneficiaries but also losers (Hoddinott, 2010). In this, the progress of Mexico from a poorly targeted food subsidy to the PROGRESA Conditional Cash Transfer programme can be instructive. In addition, increased use of information and communication technologies (for example, through the pilot ID program underway in India) and inculcating a culture of evaluation can also help in the transition (Hoddinott, 2010).

Targeting efficiency. Targeting can reduce inclusion (non-poor included) and exclusion (poor excluded) errors, increase a programme's cost-effectiveness and confine benefits to those who need them the most. But, this also entails costs associated with identifying, reaching and monitoring targeted populations. Grosh (1994) estimates that targeted transfers (across various programmes and countries) cost 3–8 percent more than similar universal transfers (Subbarao *et al.*, 1997). Food-based safety nets are sometimes preferred as they can be self-targeted to needy households and thus entail less targeting costs.

Economic costs and disincentives for work. It is difficult to measure incentive costs, yet it is important to be aware of behavioural changes triggered by transfer programmes that raise real economic costs. The best way is to keep the amount of transfer modest (Subbarao *et al.*, 1997).

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Rice and Nutritional Security: Some Connections and Disconnections

David Dawe and Steven Jaffee

Evolving concepts of food security

Concepts of food security have evolved over time. During the 1950s, food security was generally equated with the secure and adequate supply of food. Food aid programs during the 1960s emphasized the need to ensure people's physical access to food. The Green Revolution (GR) brought major gains in the availability of food, yet the persistence of hunger and periodic cases of famine drew attention to problems of economic access to food and the precarious vulnerability of the poor even in the face of an expanding food supply. Since the 1990s, the concept of food security has evolved beyond aspects of supply and demand to draw attention to the effective use of food – that is, its contribution to nutritional status. Thus, the current definition (FAO, 2013), adopted at the World Food Summit in 1996:

"Food security exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active, healthy life."

Within East and Southeast Asia, many countries have revised their food security objectives over time to extend beyond meeting goals in food supply or self-sufficiency to include reference to reducing (child) malnutrition and improving the nutritional status of the population. This poses challenges of institutional coordination, since ministries of agriculture tend to focus on ensuring food availability, while other entities address other dimensions. After all, malnutrition may stem from factors other than inadequate dietary intake: poor sanitary conditions (e.g. unsafe water), poor maternal health and poverty.

Uneven outcomes

Although the region's lower-middle-income countries have embraced various definitions of food security that incorporate nutrition, their food security strategies tend to remain heavily focused on rice.[1] Although rice remains the single largest source of calories in these countries, a "nutrition-sensitive" food security strategy would normally be expected to give considerable attention to ensuring the availability of and access to a variety and diversity of safe and good-quality foods and to improving the nutritional properties of prominent staples (e.g. through varietal improvements, food fortification).

Regional progress on the FAO measure of undernourishment, which focuses solely on dietary energy, has been solid – six middle-income countries (China, Cambodia, Indonesia, Malaysia, Thailand and Viet Nam) are on track or have already met the Millennium Development Goal (MDG) target "1c." Regionally, Southeast Asia has already met the target, and East Asia is on track to meet it. Despite this impressive performance, malnutrition is still an important problem in East and Southeast Asia, in terms of both levels and progress over time. Reducing the incidence of stunting is not one of the MDGs, but, if it were, only two of the six successful countries noted above would be on track to achieve a 50 percent reduction in prevalence: China and Viet Nam.[2]

Even for Viet Nam, the picture has been mixed over time and space. Between the late 1990s and 2004/05, steady progress was made in reducing the incidence of stunting among children less than five years old. Since then, however, little further progress has been made. Somewhat surprisingly, Viet Nam's major "rice bowl," the Mekong Delta region, still has a child malnutrition rate in line with the national average. Although this region accounted for more than two-thirds of the country's expansion in rice production since 2000 (and virtually all of its growing exports), it ranked seventh out of the eight regions in

1 For example, Viet Nam's most recent (2009) Food Security Resolution lays out a broad set of objectives, yet the "solutions" largely center upon rice, even as the country's diet is rapidly changing. The Resolution makes no reference to secondary food crops or protein-rich foods and says little about approaches to tackle malnutrition and nutritional imbalances.

2 The statement is based on the annualized rate of change from the first year to the last year for which there are data in each country, relative to the rate of change required to achieve a 50 percent reduction over a period of 25 years (namely, a reduction of 2.73 percent per year). This calculation uses raw data from the World Bank.

the country in terms of making further progress in reducing child malnutrition during this period. And, within the Mekong Delta, rice-dominant rural areas feature higher rates of child malnutrition than rural areas with more diverse cropping and other land-use patterns. During this period, ever-greater rice surpluses haven't translated into improved nutritional security. The problem seems to be income, not calories: malnutrition in the Mekong Delta is highly correlated with poverty. Farmers who grow fruit, vegetables and fish make more profit than rice farmers and can therefore afford more nutritious food. They also improve nutrition directly by consuming some of their own produce (Dung *et al.*, 2011).

In Lao People's Democratic Republic, emerging rice surpluses at the national and provincial levels haven't always given rise to improved nutritional outcomes. Using household survey data, Ramasawmy and Armstrong (2012) found significant imbalances in the Lao PDR diet, with average carbohydrate consumption (driven by rice) exceeding WHO international standards, protein consumption at the low end of the acceptable range and fat intake at well below the recommended minimum. This echoed an earlier (2007) study by the World Food Programme of dietary diversity among 4,000 households. That study concluded that "addressing low consumption of staples (rice) and securing overall caloric intake is less urgent than promoting a higher intake of animal protein, oil/fat and fruits." That study found dietary diversity to be lower in several provinces with significant rice surpluses than in several others that were rice-deficit. This doesn't imply that producing more rice is a bad thing, but it does suggest that in some contexts this is insufficient for achieving nutritional security goals.

People eat more diverse diets when they are able to afford them, when they have gained an understanding of the nutritional value of various foods and where and when a variety of safe and healthy foods is readily available. Rice-based strategies are generally not the most critical in bringing about these circumstances. Nevertheless, there are three main channels through which rice can affect nutritional security: changes in income, changes in prices and changes in nutritional content.

More rice production can increase the income of farmers, and thereby help to improve nutrition, under two conditions. First, rice production should be the most beneficial use of land – this depends on the risk profile of the particular farmer as well as on the biophysical characteristics of the land. Forcing farmers to grow rice instead of another crop in the interests of greater exports or self-sufficiency provincially or nationally is not consistent with improving their income, and is thus likely to increase the prevalence of malnutrition. It is also essential that increased rice production (i.e. more tonnes of rice) be accompanied by lower costs of production per tonne. If the greater revenue from larger rice sales is counterbalanced by higher production costs, then farmers do not gain.

Rice prices affect nutrition differently for net sellers and net buyers of rice. Since the bottom quintile of the income distribution buys more rice than it sells in many Asian countries, higher rice prices tend to lead to adverse consequences for nutrition. For example, a study in rural Central Java (Indonesia) found that higher rice prices reduced the purchasing power of households. The typical response was for families to maintain the rice consumption of children, although mothers did reduce their rice consumption, leading to increased maternal wasting. Furthermore, spending on more nutritious foods such as eggs and green leafy vegetables was cut, leading to an increased prevalence of anaemia for both mothers and children (Block *et al.*, 2004). Another study (Torlesse *et al.*, 2003) also found an inverse correlation between rice prices and nutritional status. The bottom line is that policies to increase rice prices through import barriers or excessively high procurement prices for farmers lead to worse nutritional outcomes.

Rice is the most important source of dietary energy for the world's poor. But it can be lacking in some crucial micronutrients that are essential for healthy diets. In order to remedy one of the most important of these deficiencies, years of research have gone into creating Golden Rice, a new variety that can supply increased quantities of beta-carotene and thereby make a substantial contribution to reducing vitamin A deficiency. Substantial research effort has also been directed to breeding rice varieties high in iron and zinc, two other common micronutrient deficiencies.

Techniques other than plant breeding offer promise as well. New extrusion technologies (WFP, 2013; Maberly, 2011) can produce "premix" high in micronutrients such as iron, zinc and several different B vitamins (including thiamine, niacin and folic acid) that is then mixed with ordinary rice to create fortified rice. Although fortifying rice kernels is technically very different from fortifying wheat and maize flour, the products are similar from regulatory and public health perspectives, and flour fortification is already mandatory in 78 countries. Thus, greater use of rice fortification seems like a sensible way forward. Estimates suggest that the costs of fortifying rice would raise retail prices by 2 percent; there are also barriers in terms of start-up capital costs. Initial adoption might take place through government distribution programs targeted to the poor.

Brown rice (rice that is milled to a lesser extent so that the bran layer is left intact) also offers nutritional benefits, mainly higher levels of dietary fibre and vitamins. Its main drawbacks are a lack of acceptance by consumers that are used to highly polished white rice, as well as shorter shelf-life (due to increased spoilage and rancidity caused by a breakdown of the oil in the bran).

Conclusions

So, is more rice production the path to improved nutritional outcomes? In some cases, the answer is yes, but in other cases the answer is no. Increased rice production that is the result of individual farmers' choices can be beneficial, but increased rice production that is due to government restrictions on imports or land use is likely to lead to increased malnutrition. On the other hand, more research to improve the nutritional qualities of rice holds much potential for improved nutritional security. Finally, in order to sustainably eradicate malnutrition, a multi-sectoral approach will be required.

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Rice Price Shocks: Impacts on the Poor

Maros Ivanic and Will Martin

Changes in rice prices can have very marked impacts on the poor. Given the high shares of rice in the food expenditures of the poor in East Asia, an increase in the price of rice can sharply reduce the spending power of the poor, perhaps pushing them into poverty or threatening their food security. On the other hand, many poor people are farmers, some of whom may benefit from the increase in the price of rice. A decline in rice prices may have the opposite effect, making some farmers worse off and benefiting poor consumers of rice. Who gains, who loses and the overall impact of a price change cannot be determined without detailed knowledge of how much individual households spend on rice and the extent to which they depend upon it for their income.

Price volatility offers some advantages: when prices are low, consumers benefit both from the lower cost of the good and by being able to increase their consumption; producers may benefit from higher prices both directly and by increasing their output in response to the higher prices (Turnovsky *et al.*, 1980). For staple foods such as rice, these advantages are likely to be outweighed by the limited ability to adjust the quantities supplied or demanded and by the large effects on the real incomes of consumers and producers. The effects of high or low prices on the poor may also be quite asymmetric – depending upon the specific situation of the country – and hence of greater concern than volatility per se. These impacts are likely to be most intense in the poorest countries, where many people depend heavily upon rice as a staple food and as a source of income. Given the recent experience of high prices for rice, and the apparently greater vulnerability of many of the poor to higher prices, we focus on the impacts of higher prices.

Data on the expenditure patterns and the income sources of the poor needed to assess the impacts of changes in food prices are available from household surveys conducted in many countries. In the short run, the impacts of food price

changes on the incomes of the poor depend primarily upon their net sales (or purchases) of the particular food. Net sellers gain when food prices rise, while net buyers lose (Deaton, 1989). This picture is complicated by the ability of consumers to adjust the quantities they consume of the staple(s) experiencing the most significant price shocks. Yet, these net food buyers would still lose from price increases. In the longer run, producers may adjust their supply of food considerably and consumers may make more significant changes in their consumption patterns. Further, other prices, including the wage rates for the unskilled labour on which many poor people depend for their incomes, are likely to change when food prices change.

Estimates of the short- and medium-run impacts of higher food prices on the poverty headcount are given for six East Asian countries in Table 1, along with such impacts for other regions where large numbers of poor people are significant rice consumers. Consistent with these findings, Reyes *et al.* (2009, p. 15) find an adverse impact of higher rice prices on poverty in the Philippines, with a 40 percent price rise increasing poverty by 2.2 percentage points. Warr (2005) finds an effect comparable to our estimate for Indonesia in the short term, but a persistently adverse impact in the longer term. The third and fourth columns of Table 1 focus on the impact of the change on the poor by looking at the change in the gap between the incomes of the poor and the poverty line. Changes in this measure reflect both changes in the headcount and changes in the depth of poverty of those below the poverty line (Foster *et al.*, 1984). To illustrate the relationship between the magnitude of the price change and the corresponding poverty implications, Table 2 highlights the poverty changes following a simulated 25 percent increase in rice price.

Table 1. Impacts of a 10 percent rise in rice prices on the poverty headcount and poverty gap (percentage points)

Country or region	Headcount		Poverty gap	
	Short run	Medium run	Short run	Mediumn
Cambodia	–1.52	–2.20	–0.12	–0.18
China	–1.01	–1.11	–0.04	–0.04
Indonesia	0.07	–0.06	0.00	0.00
Mongolia	0.27	0.27	0.01	0.01
Timor-Leste	0.53	0.09	0.13	0.09
Viet Nam	–0.38	–0.87	–0.01	–0.04
East Asia	–0.70	–0.86	0.00	0.00
South Asia	0.78	0.01	0.12	0.02
Sub-Saharan Africa	0.16	0.06	0.03	0.02
World	0.23	–0.16	0.06	0.02

Source: Author's own calculations.

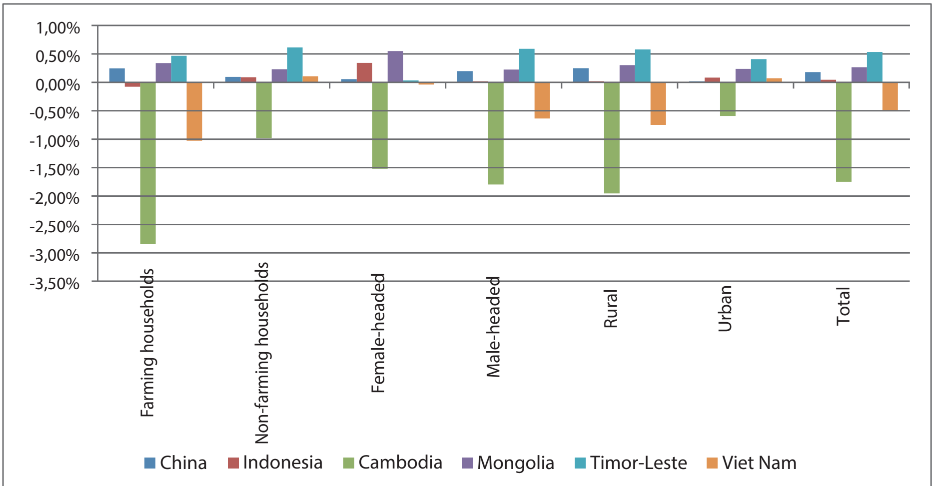
Table 2. Impacts of a 25 percent rise in rice prices on the poverty headcount and poverty gap (percentage points)

Country or region	Headcount		Poverty gap	
	Short run	Medium run	Short run	Mediumn
Cambodia	–3.58	–5.04	–0.28	–0.40
China	–2.29	–2.46	–0.09	–0.10
Indonesia	0.28	–0.06	0.01	0.00
Mongolia	0.32	0.32	0.02	0.02
Timor-Leste	1.28	3.87	0.33	0.24
Viet Nam	–0.48	–1.76	–0.01	–0.07
East Asia	–1.56	–1.87	–0.06	–0.08
South Asia	1.81	0.01	0.30	0.07
Sub-Saharan Africa	0.16	0.06	0.03	0.02
World	0.56	–0.33	0.14	0.03

Source: Author's own calculations.

The short-run impacts of rice price increases on the poverty headcount vary considerably between countries and regions. In Indonesia, Mongolia and Timor-Leste, as well as South Asia and sub-Saharan Africa and the world as a whole, the impact is to raise the poverty rate. Although some households that are net sellers of rice gain from the rise in price, and consequently rise above the poverty line, the net effect is to increase the poverty rate. This is because a large number of households, including many farming households, are net buyers of rice. Cambodia, China and Viet Nam are important exceptions to this general pattern. All of these countries have large numbers of poor farming households that are net sellers of rice and whose incomes rise above the poverty line as a consequence of the price rise. The results for East Asia as a whole indicate that the simulated increase in the price of rice would contribute to a small reduction in poverty. In South Asia, by contrast, there would be a noticeable increase in poverty in the short run.

Figure 1: Implications of higher rice prices for poverty in different socioeconomic groups often vary



Source: Author's own calculations.

Higher rice prices tend to have differential impacts on different socioeconomic groups. The economic background of households appears to be the most important factor – for example, in Cambodia and Viet Nam, a 10 percent increase in rice price benefits farming and rural households while it benefits much less – or often hurts – non-farming or urban households. However, even though urban households rarely benefit from higher rice prices, their lower initial poverty also means that they are less negatively affected. The social dimension of the household appears less important, with male- and female-headed households affected similarly.

The changes in the poverty gap resulting from a 10 percent increase in rice prices are generally small and correlated with the previously reported changes in poverty headcount. Only for South Asia do we observe a noticeable increase in the poverty rate – by 0.12 percent – in the short run following a 10 percent price increase for rice. The increase in the poverty gap for the developing world as a whole is estimated to be 0.06 percentage points. In the medium run, however, the increases in the poverty gap are much less pronounced and are generally close to zero in all regions and globally.

In the medium run, when we take into account both the ability of farmers to increase their output of rice when prices rise and the impacts of rice price increases on wage rates, the impact of an increase in the price of rice on poverty becomes more favourable in virtually all cases. In some cases, such as Indonesia, the effect changes sign. Only in Mongolia, where rice production is not observed, is there little difference between the short-run and longer-term impacts. In Cambodia and Viet Nam, the beneficial impact of higher rice prices on poverty in the short run becomes greater over time, as rice output increases and higher wages increase the non-farm earnings of poor households. This is a consequence of both these countries' comparative advantage in rice production (which makes them net exporters and hence beneficiaries at the national level of higher prices) and a reasonably equal distribution of productive assets within the rice sector.

The results in Tables 1 and 2 for 10 and 25 percent increases in the price of rice suggest that many countries have strong economic incentives to avoid short-run spikes in the price of rice. In addition, sharp increases in food prices

frequently result in strong political pressure for action. Many countries have responded to this pressure by varying the protection rates that they impose in order to insulate their domestic markets from changes in world price – for example, by lowering tariffs or imposing export restrictions during periods of high prices.

Price insulation is likely an attractive solution for individual countries. Although it generates economic costs – and perhaps high costs when domestic prices are far from international prices – these costs are likely to be less than those associated with stabilization using stockholding policies. In fact, many countries use this approach to manage fluctuations in domestic rice prices, increasing protection when world prices fall and lowering it when they rise. A fundamental problem with this type of insulation is its beggar-thy-neighbour nature. Each country's reduction in protection during a price surge reinforces the original increase in world prices, putting greater pressure on its trading partners to lower their own protective barriers. Martin and Anderson (2012) estimate that 45 percent of the increase in world rice prices in 2008 was due to countries' reduction in protection designed to reduce the increases in their domestic prices.

As shown by Martin and Anderson (2012), if all countries change their protection to the same degree, this policy is completely ineffective in stabilizing domestic prices, with each country's reduction in protection completely offset by the resulting increase in world prices. In fact, countries differ considerably in their responses to world price changes. If these differences reflect differences in the sensitivity of the poor to higher rice prices, this pattern might reduce poverty by exporting price increases from those countries where the poor are vulnerable to countries – such as the high-income countries – where high food prices can more readily be managed.

Anderson *et al.* (2013) find, however, that the combination of these policies used in the 2008 food crisis did not significantly reduce poverty, even though most countries' policy changes – taken individually – would appear to have been successful. Identifying approaches that deal with this collective action problem and successfully dealing with the vulnerability of the poor are enormously important policy challenges for the future.

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The Benefits and Costs of a Paddy Pledging Policy: The Experience of Thailand

Nipon Poapongsakorn

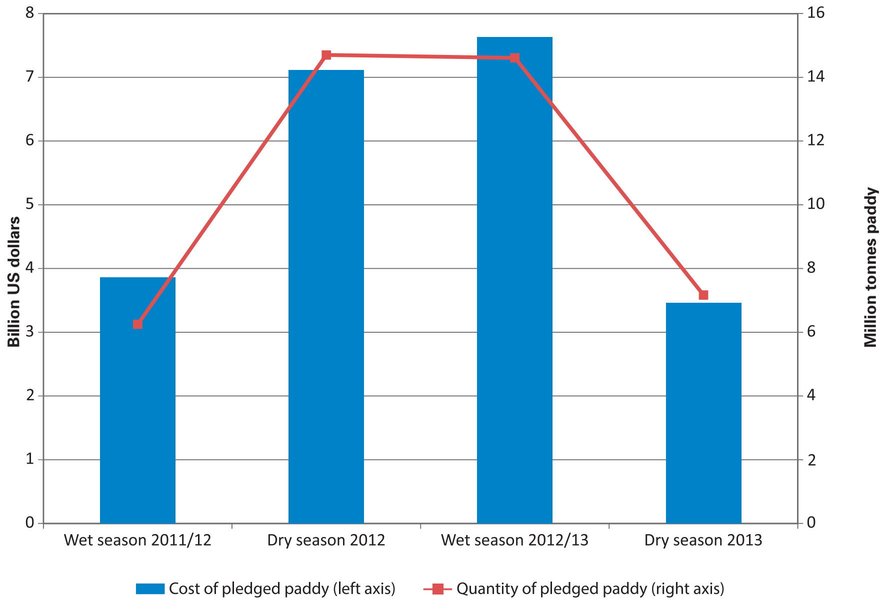
Thailand has recently experimented with two different policies to achieve various policy objectives, one key objective being to support farmer income. Supporting farmer income in the face of rapid economic growth that increases disparities between rural and urban areas is a key challenge facing many governments in the region. Therefore, it is important to understand more about the benefits and costs of various options to deal with these issues.

The paddy pledging policy, implemented in the 2011/12, 2012/13 and 2013/14 crop years, is well known and controversial. It replaced the previous government's policy of an income guarantee for farmers, which was implemented during the 2009/10 and 2010/11 cropping years. Under the farmer income guarantee policy, farmers could insure up to 20 tons per family per season of paddy. If the market price at the harvesting week was lower than the guaranteed (or insured) price, farmers received the price difference from the government when selling their paddy in the open market; if the market price was higher than the guaranteed price, they received nothing from the government (and still sold their paddy in the open market). Because the government did not intervene in the market by buying and selling rice, the income guarantee policy had minimal impact on the market.

For a guaranteed price equal to the pledging price, the financial cost of the income guarantee policy will tend to be lower because it does not incur the logistical expenses of market intervention; further, there is a per household ceiling on the quantity of insured paddy. Another advantage of the income guarantee policy is that all farmers, particularly those poor farmers who do not have any marketable surplus of paddy, can insure and benefit from the policy. Yet, the income guarantee policy has some weaknesses. If the market price declines, the financial cost could be higher because the policy does not try to

shore up the market price, meaning that a large gap could develop between the guaranteed price and the market price. In addition, some farmers who insured their crop but did not actually grow rice still received compensation from the government because of lax monitoring and enforcement procedures.

Figure 1: Quantity and cost of pledged paddy, 2011/12–2012/13



Source: BAAC
Note: Estimates for dry season 2013 are as of 30 September 2013.

With the change in government, the paddy pledging policy was launched in October 2011, and it became the largest agricultural intervention in modern Thai history. As of 30 September 2013, the government had already spent US$22 billion[1] to buy a total of 43 million tonnes of rice from farmers (Figure 1). The objectives of the pledging policy were very ambitious: increase farmers' income, stimulate the economy, regulate the supply of rice and maintain (retail) price

1 Throughout this document, THB are converted to US$ at the 2013 average exchange rate of THB 30.73 per US$1.

stability, and increase the export prices of Thai rice (NRPC, 2012). Since the government promised to buy every grain at US$488 per tonne of paddy (THB 15,000 per tonne,[2] 40 to 50 percent higher than the market price), the policy drew both widespread criticism from economists and strong support from political scientists (Eawsriwong 2012; Poapongsakorn and Siamwalla 2012).

Under the paddy pledging policy, every farmer who registered could sell paddy to the government twice a year. After delivering the output to a registered mill, farmers brought the receipt to receive their payment from the Bank of Agriculture and Agricultural Cooperatives (BAAC). Government agencies hired registered rice millers to mill the paddy and deliver rice within 7 days to granaries rented by the government. Surveyors were hired to inspect the rice delivered to the granaries. The government borrowed money to buy paddy and paid the operational cost from the fiscal budget. It claimed to release rice via five channels, using the services of private traders.

One of the main objectives of the paddy pledging policy was to increase farmers' income. Out of four million rice farmer households, about 1.2, 1.0 and 1.4 million farmers participated in the first three seasons of the policy, respectively. Most of the direct benefits went to the medium- and large-scale farmers. About 92 percent of the paddy sold to the government came from the medium and large-scale farmers in the irrigated areas who accounted for 68 percent of the participating farmers in the 2012 dry season (Table 1a). However, farmers who did not sell rice to the government also indirectly benefited from the higher market price of rice. To estimate both the direct and indirect net benefits, this note assumes that all farmers – those who sold rice to the government and those who did not – sold all of their paddy output at the price of THB 15,000 per tonne and then purchased rice for consumption since the government also had a policy to stabilize the retail rice price. As can be seen in Table 1b, poor farmers received a small share of the net benefit from the paddy pledging programme.

2 The pledging price for white rice was THB 15,000 per tonne and THB 20,000 per tonne for jasmine, with prices between those two for other types (e.g. glutinous rice, provincial jasmine).

Table 1: Distribution of benefits of paddy pledging projects by value of sale per farmer. (a) Direct benefit by value of per capita sale to projects

Value of pledged paddy (US $)		2011/12 wet season		2012 dry season	
		% farmers	% pledged value	% farmers	% pledged value
Small	Up to $ 3,254 (max. 1.54 ha)	52.3	20.4	32.0	7.8
Medium	$ 3,254–6 508 (max. 3.07 ha)	28.1	28.5	24.1	15.2
	$ 6,508–19 525 (max. 9.22 ha)	18.6	46.0	38.4	57.9
Large	Over $ 19 525 (min. 10.76 ha)	0.9	5.1	5.4	19.1
Total		**841 391 farmers**	**US$ 3.86 billion**	**614 399 farmers**	**US $ 4.61 billion**

Source: BAAC (as of 16 July 2012).

(b) Total net benefits by household income

Income decides (of farm and non-farm households)	% farm households	% net benefits
30 % poorest	39.3	18.4
40 % middle	43.7	42.3
30 % richest	17.0	39.3
Total	**100.0**	**100**

Source: Calculated by Ammar Siamwalla from National Statistical Office, 2011 Household Socio-economic Survey.

In fact, the actual benefit that farmers received from the policy was lower than the price of pledged paddy. Rather, it was the difference between the pledging price and the market price of paddy without the policy, the so-called economic rent. The policy also generated rent for some private millers and warehouse owners, the commodity surveyors and the rice traders who are fortunate enough to engage in rice transactions with the government, because the government hires them and pays a high fee for their services. The highest economic rents go to the farmers and the connected traders who bought cheap rice from the government. The farmers received US$386 per tonne of milled rice for the 2011/12 projects, and US$251 per tonne for the 2012 crop. The rent to the connected traders was US$169 and US$141 per tonne for the respective projects. The economic rents received by the millers, the warehouse owners and the surveyors amounted to US$68 per tonne in the 2011/12 project, and US$62 in the 2012 project.

Another objective of the policy was to increase the export prices of Thai rice, and thus increase the revenues from rice export. Its logic was that, by withdrawing a large enough supply of rice from the market, the government would be able to increase the export prices of Thai rice since Thailand controlled 30 percent of the world market share. Indeed, export prices for Thai and Vietnamese rice went up for a few months after implementation of the programme. After that, however, the Indian government decided to lift its rice export ban in September 2011. Because of this decision as well as a bumper harvest in India, Viet Nam quickly decided to lower its export prices to compete with Indian rice, causing a decline in world rice prices. The FAO Rice Price Index for high-quality *indica* rice dropped from 237 in 2011 to 230 in 2012. Unable to compete with the lower average world price, Thai rice exports suffered a sharp decline of 3.68 million tonnes and US$1.46 billion of lost export earnings from 2011 to 2012. As a result, Thailand has fallen from first to third place among the world's largest rice exporters. The decline in rice export business forced a few large-scale Thai exporters to diversify their business into neighboring countries (Slayton and Muniroth 2012), while most information brokers went out of business.

However, the government has successfully maintained domestic retail price stability. Domestic retail rice prices between October 2011 and December 2012

were surprisingly low, averaging US$0.79 per kg milled rice compared with US$0.80 per kg between October 2010 and September 2011 (when there was no rice pledging policy). This success was made possible by selling supplies of rice at low prices. The average selling price (across all types of pledged rice) was US$0.47 per kg for the 2011/12 wet season crop, and US$0.42 per kg for the 2012 dry season crop, much lower than the Bangkok weighted average wholesale prices of US$0.60 and US$0.58 per kg during the same periods.[3] Therefore, the government has successfully raised the paddy price for farmers, and kept rice prices low for consumers. This is a political success, but it comes with large fiscal and social costs.

Available public information makes it possible to estimate the "economic" loss of the three paddy pledging projects, taking into account both the explicit and implicit costs. Assuming that the stock is valued at market prices and sold immediately, the estimated loss is US$9.9 billion. This estimate would be less if the government stock were valued at the pledging price, but it would be even greater (US$14.2 billion) if it is assumed that the government will need five years to completely sell its stock, which seems more likely than being able to sell it all at once (the losses would be greater if sold over five years due to interest costs and quality deterioration). This latter figure is 70.8 percent of the cost of paddy. Thus, the rice pledging policy is a very expensive way of subsidizing the farmers.

As a result of the large fiscal costs, the government ran into serious liquidity constraints because the Ministry of Finance limited the ceiling of government-guaranteed loans to US$16.3 billion (and the Ministry of Commerce failed to sell enough rice). Furthermore, these high costs also mean that less money is available for government expenditures on the public goods that are essential for productivity growth and maintaining competitiveness in an increasingly globalized economy (see Policy Note "Improving the Quality of Agricultural Public Expenditures in Asia").

3 The average prices across all types of pledged paddy, weighted by their shares in each crop. The wholesale prices are the average of prices in the months that the rice was sold, i.e., April 2012 to January 2013 for the 2011/12 wet season crop, and September 2012 to January 2013 for the 2012 dry season crop.

But fiscal costs, high as they were, were not the only costs. There is some evidence that the economic rents created by the policy were dissipated on wasteful expenditures. Farmers expanded their production, resulting in increased demand for inputs and higher production costs, especially land rent, which has more than doubled. Many farmers switched from upland crops and fruit orchards to rice. This increased rice production will end up in the public stockpile. Its value will deteriorate rapidly, while storage and interest costs increase exponentially. A rush to expand milling and storage capacity has resulted in huge excess capacity.

Perhaps the most serious social cost of the policy has been its impact on Thai rice quality and the destruction of a highly efficient and competitive rice economy. The policy created a distorted incentive for farmers to expand their production at the expense of quality because the pledging price did not depend on the quality of rice. As a result, some farmers switched to low-quality short-duration varieties. Millers did not have to carefully check the quality of paddy because they were hired only to mill it; they never took ownership. The highly competitive rice market was replaced by a government-dominated system in which only a few politically connected individuals were allowed to trade with the government. After two years of market intervention, some consumers began to complain about the quality of rice, particularly the problems of chemical residues from the fumigation of rice, the smell and the yellow color (Matichon 2013).

The current policy also provides lessons in terms of the political difficulty in removing subsidies once they are enacted. Demands from rubber and cassava farmers threatened to increase government subsidies to even higher levels. And, rice farmers are upset that the subsidies may be reduced, as well as by the fact that many of them are not receiving timely payment for their output. Thus, the subsidies may end up alienating the intended beneficiaries if the government does not have the funds necessary to support these expenditures.

Many Asian governments have been seeking ways to support rice farmers. The evidence from Thailand indicates that, while there are some positive aspects, such policies can have many negative side effects. Intervening directly in the market can undermine the foundation of a competitive national rice sector (for example, quality). Setting prices too high above the domestic market (or world market in the case of exporters) can create large fiscal costs that undermine the sustainability of the policy and the ability of the government to invest in public goods. Social safety nets (see Policy Note "Rice Price Shocks: Impacts on the Poor") are one possible alternative that deserves consideration for supporting the income of the poor with fewer of the side effects discussed above.

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Rice Stocks and Trade Policy for Price Stabilization

Sergiy Zorya and David Dawe

Asian countries highly value rice price stability. Many of them employ various policy instruments, from trade policy and price regulations to government-owned stocks, to attain stable rice prices. Stable prices[1] can indeed produce a number of efficiency gains. Among others, they can help farmers improve supply response by encouraging greater use of purchased inputs and facilitating increased investments. They can also increase investment and growth at a macro level, especially in poor countries where rice represents an important share of economic output.

Yet, stable prices per se do not guarantee the realization of economic gains. Success depends on how stability is achieved and what complementary measures are taken. If prices are stabilized for long periods of time without taking into account changes in world market prices, domestic prices often end up either at high levels (above import parity) in net importing countries or at very low levels (below export parity) in net exporting countries. When this happens, stable prices may increase poverty, distort economic decisions and eventually lower the quality of growth (World Bank, 2012).

Some countries hold large government-owned stocks to stabilize prices, but this approach is costly. A multiplicity of unclear objectives often leads to failure. Fiscal costs too frequently escalate to unsustainable levels. Large stocking programs crowd out the private sector, weakening its contribution to economic growth and job creation. Some of these costs are due to political economy considerations, but some arise from difficulties

1 For some, stable prices mean fixed prices, but full price stabilization for agricultural commodities is neither achievable nor desirable. Seasonal and spatial price movements are natural for agriculture and they are essential for providing incentives to store food between harvests. Instead, policies should focus on uncertain price movements and temporary spikes, which are disruptive to economic decisions.

in efficiently managing reserves because many decisions are to be made: management structure, overlapping responsibilities among different ministries, size of reserves, composition of stocks (one commodity, several commodities and food vs cash), location of buying and selling points, financing mechanisms, price bands, replenishment and release rules, and rotation arrangements (Lynton-Evans, 1997; World Bank, 2012). The end result of this complex set of decisions is often worse than that of strategically adjusting import tariffs.

Trade policy can be a less costly and more manageable alternative. A well-implemented price stabilization policy based on trade could have very low costs, and in an economy with reasonably well-functioning markets would deliver benefits to nearly all people, in contrast to stock programs (Dawe and Timmer, 2012; Gouel and Jean, 2012). Government-owned stocks can then be refocused on protecting the poor at times of extreme events. Net importing countries can temporarily reduce their import tariffs to mitigate the impact of transitory spikes in international prices. They can also temporarily increase them, up to the WTO-bound ceiling, in the event of a sharp drop in international prices. Net exporting countries should be ready to accept higher price volatility, due to the volatile nature of the world rice market, but they could consider using a temporary, moderate export tax, implemented in a transparent and predictable manner, to mitigate external shocks. This needs to be done carefully so as not to turn an export tax into an ad hoc ban, which often has a detrimental impact on farm and private-sector incentives.

Several importing countries in Asia rely on trade to stabilize prices. They include Bangladesh, Malaysia and Sri Lanka. Bangladesh, for example, has combined commercial imports with safety nets and emergency reserves to achieve rice price stability and also to make sure its people benefit from it. In the early 1990s, the country moved from government control of rice imports and large domestic procurement for the public food-grain distribution program to the liberalization of imports and domestic trade and retaining a reduced public food-grain distribution program (Dorosh, 2009; Rashid, 2011). The strength of the distribution program is that it has focused on areas where government-owned stocks can make a difference. The role of long-run price stabilization was left to the private sector, which has successfully stabilized domestic prices around the trend of international prices (Table 1).

Table 1: Volatility of nominal wholesale rice prices in selected Asian countries (in %)

Years	Bangladesh (Dhaka)	China (Heilongjiang)	Philippines (national average)	Indonesia (national average)	Thailand (5 % brokens, FOB)	Viet Nam (5 % brokens, FOB)
2000–2005	4.6		2.9	7.2	3.4	4.1
2006–2010	5.9	1.7	4.2	5.8	8.4	9.7
2006–2012	4.4	1.3	3.6	5.4	7.4	8.7

Source: Own estimate using FAO GIEWS price data.
Note: Volatility is defined as the standard deviation of the logarithmic changes in monthly prices.

Liberalization of trade in Bangladesh has induced efficient imports of rice by hundreds of small traders, saving the government US$160–210 million per year in the 1990s from not importing and avoiding a universal food subsidy. The government instead used public funds to help victims of natural disasters, maintain a targeted safety net and meet institutional needs. It has targeted beneficiaries directly through safety nets, not ration shops. The broad set of reforms that started in the early 1990s included the reduction in public stocks from about 2 million to 1 million tonnes, and subsequently to 0.65 million tonnes in 2003. This experience shows that market development and trade liberalization provide another option for price stabilization, and are potentially less costly and more effective than large government-owned stock programs with a monopoly over imports. Such a re-orientation can also permit the government to focus on safety net programs that achieve positive food security outcomes.

But several other Asian countries continue to use government-owned stocks in combination with a monopoly over rice trade to stabilize prices. The examples are China, Indonesia and the Philippines, all net importing countries. There is no question that they have been successful in stabilizing domestic prices – their wholesale prices have been less volatile than export prices in Thailand and Viet Nam (Table 1). Yet, Bangladesh, also a net importer, has achieved similar results with private imports and much smaller stocks. Using USDA data, in 2006–2012, Bangladesh's total ending rice stocks were 3 percent of domestic use, compared with 14 percent in Indonesia and 25 percent in the Philippines.

Private imports can help stabilize domestic prices. When the Philippines opened its rice imports to the private sector in 2010, under licensing arrangements managed by the National Food Authority, it not only fully met its import requirements, but also reduced NFA's fiscal bill and lowered price volatility. In 2010–2012, the average wholesale price volatility was only 1.4 percent, achieved with a 14 percent ending stock to use ratio, compared with 4.2 percent volatility with 25 percent ending stock to use ratio in 2006–2010. Between 1999 and 2002 in Indonesia, the private sector accounted for about three-fourths of total rice imports, without any disruptions to domestic price stability.

In view of these and other examples from around the world, the countries using large government-owned reserves to stabilize rice prices would be better off by re-examining the role of stocks vs trade. Long-term prices need to be kept in line with international prices; to achieve this, a careful use of trade policy instruments, along with promotion of private-sector participation in domestic and external trade, is a necessity. Government-owned stocks would need to be re-focused on protecting consumers and producers against relatively large short-term price shocks and natural disasters. Meeting these objectives would require a smaller size of reserves, which would save money and wouldn't necessarily compromise the price stability objective.

For the stocks that are held, costs and distortions of stocking agencies can be minimized by behaving like the private sector, that is, buy low, sell high and store short. Savings can be made by contracting the private sector to store the reserves, and buying and selling stocks through open tenders at market prices. The results of these tenders should be published to maintain transparency and accountability in the tendering process. Finally, a rotation strategy needs to be carefully designed to protect stocks from aging and to minimize price distortions during rotations, while taking into account needs for safety nets.

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Regional Cooperation in Emergency Food Reserves: The Case of ASEAN Plus Three[1]

Roehlano M. Briones

Overview

Emergency food reserves are a common response to food crises, whether nationally or internationally. In response to the world food crisis of 1972–1974, the UN General Assembly established the International Emergency Food Reserve or IEFR (Shaw, 2007). Regionally, the ASEAN Emergency Rice Reserve (AERR) was established in 1979 under the Agreement on ASEAN Food Security Reserve (AFSR). This was later expanded, on a pilot basis, to include the Plus Three countries (China, Japan and Republic of Korea) in the East Asia Emergency Rice Reserve (EAERR) project. Following the 2007–2008 food price crisis, the ASEAN agreed to establish an ASEAN Plus Three Emergency Rice Reserve (APTERR) as a permanent mechanism based on the experience of the AERR project, which ended in 2010. The intergovernmental Agreement on APTERR was signed in 2011 and entered into force in 2012; the formal launch of APTERR was held in March 2013 with its Secretariat office hosted by the Thai government in Bangkok.

Emergency reserves in theory

The basic idea for emergency reserves is to accumulate food stores in normal times, to be withdrawn during abnormal times when food becomes scarce and prices rise. Traders can anticipate these price movements and undertake their own storage to realize gains from intertemporal arbitrage.

There is, however, no guarantee that what is efficient for private traders is optimal from the viewpoint of society. The possibility of stock-out given an extreme negative shock (or run of negative shocks) forces demand to

1 This note is based on the author's contribution to a study "ASEAN Dynamism – Agricultural Transformation and Food Security 2040" commissioned in 2012 by the Japan International Cooperation Agency (JICA) and prepared by Centennial Group International.

equilibrate short-term supply with drastic price increases. Increases that are sufficiently large can endanger the health and even survival of the poorest. This suggests the need for precautionary reserves with a humanitarian purpose – clearly outside the commercial motivations of traders.

Some research has shown that a "strategic reserve" deployed in cases of extreme price spikes can reduce domestic price volatility and prevent extreme price spikes more than 99 percent of the time (Larson *et al.*, 2011). Targeting the release of reserves to a needy group (at pre-crisis prices) dramatically reduces costs without any sacrifice in benefits to the poor.

Emergency reserves in practice

Under the AFSR Agreement of 1979, an emergency is defined as the state or condition in which an ASEAN Member Country, having suffered extreme and unexpected natural or man-induced calamity, is unable to cope with such state or condition through its national reserve and is unable to procure the needed supply through normal trade. The definition is carefully crafted to assign the domestic emergency reserve as the frontline defense against emergencies, as well as to prevent displacement of normal imports/exports of rice. However, the amount of AERR's reserves (total of 87,000 tonnes) is just 0.4 day of consumption of ASEAN countries (Pacific Consultants International, 2002). In fact, until 2000 no release was made from the AERR to meet an emergency requirement. This prompted a review of the mechanism in 2001, and the initiation of an EAERR pilot project in 2003, funded by the government of Japan, with in-kind contributions from other member countries.

The APTERR, which was formalized by intergovernmental agreement among ASEAN Plus Three countries in 2011, incorporates additional earmarks from the Plus Three countries, expanding the regional reserves to 787,000 tonnes (see breakdown in Table 1). The APTERR adopts the same definition of emergency as AERR; conditions for release depend on which method or tier is being applied. There are two tiers for the release of earmarked stocks, both of which are invoked in cases of emergency: Tier 1 – release under a pre-arranged scheme, and Tier 2 – release under an ad hoc scheme.

Table 1: Earmarked emergency rice reserves of the APTERR (tonnes)

Country	Amount		
ASEAN	**87,000**	**Plus Three**	**700,000**
Brunei	3,000	People's Republic of China	300,000
Cambodia	3,000	Japan	250,000
Indonesia	12,000	Republic of Korea	150,000
Lao PDR	3,000		
Malaysia	6,000		
Myanmar	14,000		
Philippines	12,000		
Singapore	5,000		
Thailand	15,000		
Viet Nam	14,000		

Source: ASEAN Plus Three Emergency Rice Reserve leaflet '20 Frequently Asked Questions about APTEER

A voluntary Tier 1 forward contract is made between a supplying country and a demanding country, in preparation for a possible emergency occurring in the latter within a given period (say, three years). The supplying country is obligated to deliver a specific quantity of rice, of a specific grade, in event of an emergency in the demanding country. Pricing shall be determined based on the prevailing price of the comparable rice grade in the international rice market. The contract is designed to ensure minimum negotiation and delays in delivery in the event of an emergency. Upon delivery, the demanding country takes responsibility for the use of stocks, say, for direct distribution to calamity victims or for storage as part of domestic emergency reserves. Tier 1 is patterned after the release of earmarked stocks under Tier 1 during the EAERR project, in which a total of 10,000 tonnes of emergency rice stocks were released by Viet Nam to the Philippines in response to Typhoon Ketsana.

Tier 2 involves the release of earmarked stocks not involving a pre-arranged forward contract. Terms and conditions are more flexible, allowing release under terms of loans or grants. There has been no precedent of release under Tier 2. Under APTERR since 2011, there has been no release of earmarked stocks as the management structure is still being organized.

Assessment of APTERR

Strengths.

One advantage of the earmarking system of APTERR is cost-effectiveness: it imposes no additional financial burden for procuring and storing stocks. The savings is obtained by leveraging existing national rice reserves, making them available to meet emergencies outside the country. Assuming low covariance of food emergencies across countries, the pooling of reserves effectively increases the size of standby stocks available to meet an emergency in any member country.

Moreover, during emergencies, releases from APTERR may be quicker and more reliable than normal commercial imports. Tier 1 dispenses with the time-consuming grind of normal commercial imports (initial contact, canvassing or tendering, negotiation, purchase order, delivery). Moreover, during emergencies, stocks held by commercial importers may be prone to hoarding, unlike a release from APTERR, which is backed by government commitment.

Weaknesses.

Somewhat paradoxically, the strength of APTERR (cost-effectiveness) hints of its basic weakness: under earmarking, the scheme becomes completely dependent on each member country's follow-through on its earmarking commitment. Another weakness is related to the official definition of "emergency," which is based on calamity; this rules out inherent instability in the market unrelated to calamity, which was apparently the case in the rice market in 2007–2008. A sizable release (or threat of release) from existing stocks was able to calm market panic and ended the rice market crisis (Timmer, 2010). Unfortunately, under current rules, APTERR cannot make such a release. Finally, the need for consensus of the Council members (from all 13 countries) prior to securing release poses a risk of undue delay in making a timely response to food emergencies.

Conclusions

In sum, APTERR can be a relevant scheme for overcoming shocks to food security. To realize its potential, member countries should first of all ensure proper food security monitoring, and governance of the reserve, to ensure a rapid response in case of emergency. Second, members need to back up their commitments with action in an emergency situation, despite domestic resistance. Third, some flexibility in its definition of an emergency should be adopted to enable it to respond to inherent instability in food markets.

Finally, it should be clear that APTERR is no panacea for regional food security. Rather, APTERR is a stop-gap measure that can provide valuable but incomplete protection against market instability. A more direct approach would be to address the underlying gaps in the food distribution system that make it vulnerable to shocks. APTERR may in fact be supportive of efforts to deepen specialization and interdependency in the food marketing system, if it can be seen as a credible device in (rare) cases of market failure.

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Re-entering the Game: Policy Options for Emerging Rice Exporters

Paavo Eliste and Steven Jaffee

From incumbent to aspiring exporters

East Asia's rice exports are dominated by two large incumbents that have been major players in the world market for decades. One is Thailand, which in 2011 was the largest rice exporter in the world (at 10.6 million tonnes or 29 percent of world trade in rice). Because of policies that adversely affected competitiveness, Thailand's rice exports fell to 7 million tonnes (or 17 percent of world trade) in 2013 (see Policy Note "The Benefits and Costs of a Paddy Pledging Policy: The Experience of Thailand", pag. 101). Thailand's rice export trade is based primarily upon higher-value products or varieties. In 2013, parboiled and other higher-value rice products accounted for 41 percent of total exports, while aromatic varieties accounted for an additional 27 percent. Almost half of the latter were destined to markets in high-income countries. The other large incumbent is Viet Nam, whose 2013 exports were 8.2 million tonnes (or 21 percent of world trade). Viet Nam's expanding rice trade has long been based primarily upon lower-quality, lower-price white rice, primarily serving East Asian and West African countries. Yet, this has begun to change. During the past three years, exports of higher-quality rice, including aromatic varieties, averaged 2.85 million tonnes, equivalent to 37 percent of Viet Nam's exports.

In recent years, however, several countries in the region – including Cambodia, Myanmar and Lao People's Democratic Republic – have sought to enter or re-enter the international rice trade, as exporters. These aspiring exporters are beginning to develop an overall vision for rice trade development and how this relates to broader goals of economic development. At this incipient stage, important strategic and policy questions arise. One set of questions relates to how the countries will balance or achieve synergies between their domestic food security concerns and their commercial trade

objectives. Another set of questions relates to how the industry should seek to position its trade, in terms of products and markets, and against whom it will likely compete. Yet another set of questions relates to the types of investments and players that will best achieve the government's objectives in the sector. Will this be led by government or by the private sector? Will investment promotion focus on domestic and/or international enterprises?

Both Cambodia and Myanmar were once major global rice exporters, yet two decades of civil war in Cambodia and economic mismanagement in Myanmar resulted in declining rice production and the loss of international competitiveness. After Cambodia regained rice self-sufficiency in the mid-1990s, farmers and traders began making informal sales of paddy to neighboring countries. Between 2001 and 2012, Cambodia's paddy rice production more than doubled, from 4.2 to 8.7 million tonnes, with its estimated surplus reaching nearly 4 million tonnes of paddy. Statistical problems prevent a clear understanding of trends in Myanmar's paddy production, although one widely referenced source (USDA) estimates that production in 2013 was little more than that of a decade earlier. Nevertheless, the country currently has an estimated (exportable) surplus of between 1.5 and 3 million tonnes of paddy rice. Lao PDR has seen a steady increase in paddy production from 2.3 million tonnes in 2001 to 3.3 million tonnes in 2012. This and declining per capita consumption have resulted in an estimated surplus of 650,000 tonnes of paddy. However, it should be noted that some 90 percent of rice produced in Lao PDR is glutinous, which has only a small and specialized trade niche in the region.

Both Cambodia and Myanmar have seen significant increases in their rice exports. Cambodia's growing paddy surplus has translated into a large cross-border trade in paddy, estimated at some 2 million tonnes in recent years. The country's formal exports of milled rice have also begun to take off. These averaged less than 6,000 tonnes per year during the 2000s, yet grew to nearly 380,000 tonnes in 2013. An important contributing factor has been Cambodia's duty- and quota-free access to the markets of the European Union since 2009. For Myanmar, rice export volumes experienced wide year-to-year fluctuations during the 2000s. Yet, during the 2012/13 fiscal year, exports reached 1.4 million tonnes of milled rice, nearly 60 percent

of which involved cross-border trade with China. Lao PDR's formal exports have remained low, averaging 60,000 tonnes of milled rice. It is understood that a significant amount of paddy is being exported informally to Thailand, some of which is re-imported back to Lao PDR as milled rice.

Varied results stem from varied policy stances

In recent years, Cambodia has developed an increasingly clear policy framework to support rice exports. Although Cambodia's rice export surge started by "accident" after the signing of an "Everything but Arms (EBA)" trade agreement with the EU, the government subsequently took a more strategic approach to supporting rice exports, combining various regulatory, legal and trade facilitation reforms. The goals of the policy are twofold: (1) to shift informal paddy exports into formal rice exports (without banning paddy exports) and (2) to enhance the competitiveness of rice value chains (Royal Government of Cambodia, 2010). The aim is to achieve 1 million tonnes of formal milled rice exports by 2015. The Cambodian industry has identified its strategic market segment as the higher-value aromatic varieties, for which it anticipates competing with both Thailand and Viet Nam. In Cambodia, there are no state interventions in trade, prices or farmers' production decisions. Increasing domestic surpluses and confidence in government rice policies have led to the policy environment putting more emphasis on commercial trade objectives than on food security concerns. A modern rice milling sector is now emerging, part of which involves direct foreign investment.

In contrast, Myanmar's overall rice policies and those specifically related to rice trade are in a state of transition. In 2003, the government ended the state monopoly on rice trade, allowing private-sector companies to operate, albeit with restrictions and with the application of an export tax. The civilian government, which came to power in 2011, has made further reforms. Still, the lack of reliable data on production volumes, consumption and rice in storage has constrained the willingness of the government to pursue more liberal trade policies. At the same time, political considerations for farmer welfare have led the government to propose measures to ensure minimum prices (or income) for farmers and to maintain domestic rice stocks. If adopted, these measures could adversely affect the rice trade in a setting in which industry players are already

struggling to cope with high milling, transport and trade facilitation costs.[1] A new investment law (2012) precludes joint ventures in rice milling and trading without special approval by the government. Although Myanmar aspires to return to its former (1920s to 1950s) position as a major rice exporter – with ambitious targets of 2 and 4 million tonnes (milled rice) in 2014/15 and 2019/20, respectively – the policy environment still needs to improve to attract the necessary level of investment in the value chain to realize these goals. Strategic choices will also need to be made regarding where this trade will be positioned. The heavy recent reliance on the cross-border trade with China has been associated with high market and price risk, although certainly China is a potentially very large market. Much of Myanmar's overseas trade involves the low-quality market segment in West Africa, a region where several countries are investing heavily in import-substituting production.

Lao PDR has been a "reluctant" exporter with primary attention still focused on domestic food security. For years, the government has used administratively set minimum prices for paddy, although this measure has generally had little impact on actual market prices. Periodic controls have also been placed on inter-provincial rice movements, limiting the ability of millers and traders to operate profitably (increasing their risks and costs) and ultimately having a negative impact on farm-gate prices. The government has set an export target of 600,000 tonnes of high-quality, non-glutinous rice by 2015 – mostly to countries in the ASEAN region but also to the international market. However, it should be noted that the current production of non-glutinous rice in Lao PDR is only about 200,000 tons and the country is a net importer of this rice type. The government's vision is silent on the topic of glutinous rice exports, the main staple of Lao PDR. There has been, however, some limited success in targeting international niche markets for exports of traditional glutinous varieties.

1 Draft Law on Enhancing the Economic Welfare of Farmers – originally called the Farmer Protection Law – which calls for setting Parliament-controlled minimum prices to ensure desired farmer income. The government is also planning to establish a rice stock management program, which it hopes will help to manage domestic price stability.

Looking ahead

There is a significant opportunity for both Myanmar and Cambodia to increase their exports. Yet, both will need to be strategic in how they position their respective trade. For Cambodia, the most attractive near-term target appears to be improving quality and price competitiveness for trade in aromatic rice. In the longer term, it can also improve its competitiveness for non-aromatic rice and aim to penetrate the large regional markets of Indonesia and the Philippines. Cambodia will require diversification away from exporting only via containers (99 percent of current exports) towards non-containerized (break bulk) exports, the form of trade required by major regional importers. Cambodia will also need to diversify its exports gradually away from EU markets (two-thirds of all exports during recent years), where it faces an uncertain future due to increasing pressure from European rice producers to limit duty free imports into that market. High-income Asian markets, such as Malaysia, Singapore, China and Hong Kong Special Administrative Region, could offer excellent longer-term growth prospects for aromatic rice if Thai prices become unattractive to buyers and the quality and brand recognition of Cambodian rice improves.[2]

If Myanmar wants to achieve its export policy goals, it would need to diversify its products and markets. In recent years, 92 percent of Myanmar's overseas rice exports have been of low-quality white rice, a segment that is accounting for a declining share of world trade. It would also need to diversify to new markets (Africa accounts for about 75 percent of all its shipments). As of July 2013, the EU extended duty-free imports to Myanmar under the EBA policy, which at current tariffs gives it an advantage of US$228/tonne over most competitors. This would offer access to new high-value rice markets if Myanmar can improve the quality of its milled rice by shifting to varieties with high grain quality and upgrading its milling sector. Potential exists for Myanmar to become a seller of high quality white and parboiled rice. Myanmar's cross-border rice trade with China could also provide long-term opportunities, although the transparency of this trade needs to be improved to reduce the (policy and counterparty) risks faced by Myanmar exporters. Addressing behind-the-border issues is critical to the future competitiveness of

2 Higher-value aromatic rice already accounts for nearly half of Cambodian exports. Cambodia's aromatic rice has won the World Best Rice awards in 2012 and 2013 and this has increased interest from international buyers.

these aspiring exporters. Although their paddy production costs are competitive with those in Thailand or Viet Nam, Cambodia and Myanmar have high milling and logistical costs. The root causes are similar, including unreliable or expensive energy; underdeveloped infrastructure; high freight, handling and port costs; and still underdeveloped supply chains. Access to credit has improved in Cambodia in recent years, but it is one of the major constraints to the expansion of rice production and exports in Myanmar. Both countries will need to invest heavily in infrastructure to increase the competitiveness of their rice trade. This could include competition from private-sector investors in port infrastructure as a way to reduce port charges and improve the cost and reliability of electricity.

Promoting additional investment in the rice value chain is also critical. Although there have been increasing investments in milling capacity in Cambodia and Myanmar in recent years, the vast majority of commercial mills are still small by international standards and they operate with obsolete equipment. Cambodia already has an improved policy environment to attract such investments. Myanmar's milling sector has been starved of capital and know-how by years of sanctions. Policymakers will need to decide whether to rely on well-connected incumbent companies to modernize the industry or to open up the rice sector to foreign competition and independent investments. At present, the private sector is cautious, perceiving the possibility (or likelihood) that the government would re-introduce ad hoc restrictions on exports when domestic prices reach levels considered politically unacceptable. The emergent exporters will need to combine the development of longer-term business relations with key buyers and an ability to take advantage of near-term, opportunistic trading opportunities created by production shortfalls or other market developments in targeted countries. Export strategies will need to be periodically revised in light of structural changes in certain markets and in the policies and business trends in Thailand, Viet Nam and India.

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Rice Policy and WTO Rules

Ramesh Sharma

Introduction

The WTO rules on agriculture, mainly spelled out in the Agreement on Agriculture (AoA), discipline policies that are considered to distort trade, rather than fully prohibiting policy instruments, with some exceptions (e.g. import bans). In most cases, policies are disciplined by setting upper limits, such as for tariff rates or subsidies. The long-standing Doha Round negotiations have sought to further reduce these limits.

Rice has historically been subject to relatively heavy policy interventions. Since the 2007–2008 rice price crisis, interventions in the form of export restrictions, subsidies and domestic market interventions seem to have further intensified. The WTO Committee on Agriculture (CoA), which meets four times a year, undertakes formal reviews of the WTO-compliance of national policies based on notifications of these policies. Countries are supposed to provide prompt notifications, but, in practice, a large number of members fail to do so. From Asia, for example, India's latest notification was for 2003/04 (submitted in June 2011), Thailand's was for 2007 (submitted in October 2010) and China's was for 2008 (submitted in October 2011). Other members can raise issues and point to the possibility of the non-reporting member breaching its WTO commitment, but this will not result in a concrete outcome due to lack of an "official" notification, unless the matter is taken all the way to a WTO dispute process.

Summary of issues on WTO rules and rice policy

Domestic support measures

There are usually more questions raised at the CoA on domestic support measures than on market access and export subsidies. Within the area of

domestic support, questions are raised mostly on four types of measures: (i) public stockholding for food security purposes, (ii) Article 6.2 subsidies, (iii) decoupled income support, and (iv) trade-distorting subsidies (Aggregate Measure of Support, or AMS). On the *first*, although a Green Box measure and so exempt from any limit, it has attracted considerable attention, presumably because reported outlays have recently increased exponentially (e.g. India, Indonesia and the Philippines – with rice being the main product). One question asked was whether the gap between the stock acquisition price (administered price) and the fixed reference price[1] was accounted for under trade-distorting subsidies in the AMS. Based on notifications and responses, the picture is not clear. Another common question was whether the volumes of stocks accumulated corresponded to predetermined targets related solely to food security. Again, there has been a lack of clarity.

Article 6.2 outlays, called development programs (typically input subsidies) and exempted from any limit, have also attracted considerable attention for the same reason as above, namely, outlays have increased rapidly. One issue raised was the definition of low-income, resource-poor (LIRP) farmers that are meant to be the beneficiaries of this exemption. WTO does not define an LIRP and members define it differently, often without a convincing explanation. India was subject to several questions because it claimed that 99 percent of its farmers are LIRP, which would then imply that most of its farm subsidies fall under this exempt category. Indonesia was also asked to explain an LIRP farmer (Indonesia's Article 6.2 outlays increased from Indonesian Rupee (IDR) 2.2 thousand billion in 2002 to IDR 19 thousand billion in 2008).

On direct income payment to farmers, only China in developing Asia has notified this measure. This is another exempt measure (Green Box), but subject to stringent criteria. It requires that the payment has to be fully decoupled from production and prices. China claimed its program to be decoupled but apparently members were not convinced and so several questions were raised for further clarification. In China's latest notification, this outlay doubled to CNY 23.6 billion in 2008 (equivalent to US$3.4 billion at that time).

1 The fixed reference price was decided by the AoA to be the average import or export price for the years 1986 to 1988, and has been fixed or frozen at that level for all years during AoA implementation, even until now.

On trade-distorting support or AMS, this measure has received more attention in recent years as support to agriculture and rice has increased rapidly. Thailand is among a handful of developing countries with an AMS commitment (limit of THB 19 billion since 2004; equivalent to US$620 million in 2013). Thailand's latest notifications, for 2005–2007, showed total AMS to be in the range of THB 12.4 billion in 2005 to THB 15.1 billion in 2007, almost all on rice. Several questions were asked by members recently, presumably due to the high paddy pledging price and Thailand's already narrow space for raising AMS further. Thailand has yet to submit figures for 2008 or later. For other countries in Asia, notified rice AMS levels are low: for example, for the Philippines they are less than 0.5 percent of the value of rice output until 2007 and 3–4 percent thereafter, while the WTO limit is 10 percent of rice output. Likewise, China's rice AMS was negative for 2005 and 2006 and marginally positive for 2007 and 2008 (less than 2 percent of rice output). Of some relevance here is Costa Rica's experience with rice AMS, which breached the 10 percent limit for some years, raising many questions. Eventually, Costa Rica indicated that it is completely abandoning its rice price support policy in favour of Green Box measures.

Export subsidies and export restrictions

Export subsidy disciplines concern all countries with regular or occasional surpluses when world prices are lower than domestic prices and exports entail losses (or subsidies). All Asian countries have committed not to grant export subsidies for rice. An exception to this rule (AoA Article 9.4 d and e) allows developing countries to grant a subsidy to defray the costs of internal transport and ocean freight on products exported, with no limit placed.

At recent CoA meetings, some questions were asked of Thailand and India concerning rice (and also wheat and sugar) export subsidies. For Thailand, the question was how it would export rice from its accumulated stocks given the large gap between the world price and the stock acquisition prices. Thailand responded that it does not see this as an issue and that government to government (G2G) sales were one channel for exports. This prompted further requests for details on the G2G sales, especially sales prices, so as to ensure that no subsidy is involved. Thailand responded that several Memoranda of Understanding (MoUs) have been signed for G2G sales, amounting to 7–8 million tonnes, but detailed information on G2G sales is confidential as this has

implications for the importing country's food security. Asked whether Thailand tracks destinations of all its stock sales, it said that it does not (which would make it difficult to discover whether subsidized stocks were being exported).

Questions were also asked on the use of the AoA's Article 9.4 (d and e) provision that allows developing countries to grant subsidies to defray the costs of internal transport and ocean freight on export products. Many countries use this provision, including for rice. Although no limits are set, questions get asked at the CoA typically when subsidized outlays are large. In the past, India has used this provision to export rice.

Food export restrictions were headline topics during 2007–2011, with this practice largely blamed for the price spikes in the case of rice. This period saw the use of various forms of restrictions besides a simple tax (*ad valorem* or specific): variable tax, minimum export price, quotas and outright bans. These responses sparked debates within countries as well as at the WTO CoA regarding their impact on price volatility and food insecurity. One concern expressed was that such policies undermine trust in the global rice market among importers, prompting many of them to resort to policies such as higher self-sufficiency goals, increased market interventions and even G2G sales agreements.

In the WTO, the AoA's Article 12 together with General Agreement on Tariffs and Trade (GATT) Article XI provide rules on food export restrictions. These rules are considered soft and weak. Any member wishing to implement a restrictive policy is required to follow some procedures, but compliance has been poor. For example, as of November 2012, only 16 notifications had been made on export restrictions although many more restrictions are known to have been placed by WTO members. There are rules for applying restrictions, such as demonstrating a critical shortage of food and giving due consideration to importers' food security. But, these rules remain vague and are mostly ignored. WTO members may revisit this issue with a view to strengthening the rules on export restrictions.

Market access

Import policies – tariffs, quotas and safeguards – typically attract attention when world market prices are depressed, as in the early 2000s. The market situation has been very different in recent years and so this issue has not been as prominent at recent CoA sessions (perhaps with the exception of tariff quotas).

In Asia, considerable amounts of rice imports are still subject to quantitative restrictions, the primary instrument for managing supply and price stabilization. Both the Philippines and the Republic of Korea continue to regulate rice imports under the AoA's Annex 5 special treatment clause (Japan gave up this option after tariffying rice imports in 2000). This provision allows countries to apply quantitative restrictions subject to a minimum import commitment (MIC). The Philippines re-negotiated in 2006 the continuation of this regime until 30 June 2012, raising its MIC to 350,000 tonnes from 238,940 tonnes before, and requiring it to allocate import quotas to various WTO members. Negotiations are currently ongoing for a further extension of this regime to 2015. The Philippines is known to control rice imports tightly, with import volumes (estimated domestic shortfalls) approved at the highest level of government.

Indonesia also tightly controls rice imports, which are subject to quantitative restrictions (as are imports of sugar, salt and several other products). Import volumes are determined annually at the ministerial level based on estimated shortfalls. At the WTO, some concerns have been raised regarding the complexity and trade-impairing effects of Indonesia's import licensing requirements.

Implications for policy

Rice attracts considerable attention at the WTO CoA. Historical reasons include the importance of rice as a staple, and the range and depth of interventions in rice markets throughout the world, notably in Asia. It seems that interventions further intensified following the 2007–2008 rice price crisis, as evidenced by higher self-sufficiency goals, increased production outlays, larger stocks and price interventions, and more export restrictions. These are divisive policy issues that involve real resource costs and thus deserve to be debated and analyzed. Although the WTO rules leave large policy space in most cases, it is extremely important that policy instruments and outlays be

transparent so that all members feel that the global trading system is fair and dependable. The concerns raised at the CoA, as reviewed here, show that there is considerable room for improving the transparency of policies through prompt notifications. This will contribute to restoring full trust in the global rice market, benefit exporters through a secure rice import market and benefit importers by avoiding resource costs incurred through costly economic policies. At the same time, there is considerable scope for improving the current WTO agricultural agreement by revising *inter alia* concepts and definitions.

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