



The Asia Foundation



[ OCCASIONAL PAPER NO. 4, OCTOBER 2010 ]

## FOOD SECURITY IN ASIA AND THE CHANGING ROLE OF RICE

Opening Remarks by Douglas Bereuter, *President and CEO, The Asia Foundation*

Presentation by Peter Timmer, *Thomas D. Cabot Professor of Development Studies, emeritus, Harvard University*  
& *Adjunct Professor, Crawford School of Economics and Government, Australian National University*



**The Asia Foundation**

[ OCCASIONAL PAPER, NO. 4, OCTOBER 2010 ]

## **FOOD SECURITY IN ASIA AND THE CHANGING ROLE OF RICE**

Opening Remarks by Douglas Bereuter, President and CEO, *The Asia Foundation*  
Presentation by Peter Timmer, *Thomas D. Cabot Professor of Development Studies*, emeritus, *Harvard University*  
& *Adjunct Professor, Crawford School of Economics and Government, Australian National University*

The Asia Foundation's series of Occasional Papers presents a range of ideas and analysis on political, economic, and security challenges facing the Asia-Pacific Region. These are working papers—truly works in progress—meant to spark discussion and debate within the international development community about strategies and approaches that can deliver positive impact on the ground. They are part of the conversation going on daily at the Foundation, and meant to be shared widely in the hope of advancing knowledge and best practices in the field. The views expressed in this series are those of the authors.



## **The Asia Foundation**

The Asia Foundation is a non-profit, non-governmental organization committed to the development of a peaceful, prosperous, just, and open Asia-Pacific region. The Foundation supports Asian initiatives to improve governance, law, and civil society; women's empowerment; economic reform and development; sustainable development and the environment; and international relations. Drawing on nearly 60 years of experience in Asia, the Foundation collaborates with private and public partners to support leadership and institutional development, exchanges, and policy research.

**[www.asiafoundation.org](http://www.asiafoundation.org)**

## **TABLE OF CONTENTS**

<b>FOREWORD</b> .....	i
<b>OPENING REMARKS</b> .....	ii
<b>FOOD SECURITY IN ASIA AND THE CHANGING ROLE OF RICE: INTRODUCTION</b> .....	1
<b>A FRAMEWORK FOR UNDERSTANDING FOOD SECURITY</b> .....	3
<b>THE CHANGING ROLE OF RICE IN ASIA</b> .....	6
<b>REFERENCES</b> .....	24

## **FOREWORD**

To examine the critical issues surrounding the global challenge of food security, The Asia Foundation joined with the Asian Development Bank (ADB), the UN Food and Agriculture Organization (FAO), the International Fund for Agricultural Development (IFAD), and the U.S. Agency for International Development (USAID) for a major conference, “Food for All: Investment Forum for Food Security in Asia and the Pacific,” at the ADB headquarters in Manila from July 7-9, 2010. The forum brought together key decision-makers in agriculture and food security to discuss ways and means toward shared food security and agriculture sector prosperity.

Douglas Bereuter, president of The Asia Foundation, moderated a key plenary session on “Fostering Food Security Through Regional Cooperation and Integration.” The session, sponsored by The Asia Foundation, focused on the coordinating and facilitation roles of the key regional associations—namely the Association of Southeast Asian Nations (ASEAN), South Asian Association for Regional Cooperation (SAARC), and the Pacific Islands Forum Secretariat (PIFS).

Eminent food security economist Peter Timmer laid out the challenges, opportunities, and likely action points for achieving shared food security. We are pleased to reproduce his remarks in this, the fourth in our continuing series of Occasional Papers.

## **OPENING REMARKS**

By Douglas Bereuter, President, The Asia Foundation

The Asia Foundation is pleased to be sponsoring this session on regional integration and cooperation for food security. This is a very important topic, since strong and positive trade, and close relations and harmony in the economic management of food stocks, are crucial to the achievement of food security—not just within specific countries, but across regions and the world as a whole.

I believe it is fair to conclude that the recent food price crisis primarily emerged out of relatively minor downturns in production and supply in a few countries—nothing too much out of the ordinary. Bad decisions, unnecessary actions, knee-jerk administrative controls on food stocks and trade imposed by fearful governments, combined with careless international procurement by panicky parastatals—these were the major factors triggering the full-blown food crisis in 2007 and 2008.

Eventually, after much damage, the food price bubble was broken in mid-2008, in major part by the expectation that Japan, if necessary, would release stocks of non-domestic rice into the world market. In retrospect it is clear that there was no actual food shortage in the world or the region. But it is also clear that cooperation among countries, beginning with the open and timely sharing of knowledge and information on food stocks and production, is crucial to maintain stability and predictability in food prices and supplies.

That stability is vital for national planning and management by countries in order to provide their citizens with food security. Such food security relies in significant part, of course, on rational, international trade in food stocks, but also, perhaps, on trade backstopped by emergency buffer stocks held by regional bodies and subject to joint management.

This afternoon we are indeed fortunate to have Dr. Peter Timmer as a primary resource person for this session. He certainly deserves his worldwide renown as a highly respected researcher and analyst who has dealt with the issue of food security in Asia in as much depth and breadth as anyone over the past quarter century. Importantly, Peter Timmer has followed and analyzed food security issues not only as an academic economist, but also as a wise and distinguished adviser to governments as well as international bodies on food security and agricultural development. I also understand there have been times when Peter has had impact as a direct actor, helping shape and influence market movements.

Please join with me now in welcoming to the lectern Dr. Peter Timmer

### *Concluding Comments*

Stability in food supplies and prices is crucial for credible and effective governance across all countries—in meeting their fundamental responsibility to assure that their citizens have reasonable access to adequate affordable food for themselves and their families.

Our discussions during this session highlighted and emphasized the necessity for significantly deeper regional and international collaboration and cooperation in order to achieve and sustain shared stability in food prices and supplies.

The regional associations can and surely should play a major role in facilitating the sharing of information and data crucial to rational food security planning and management, as well as helping to establish communication lines and collaborative mechanisms among the principle actors in food stocks and trade.

## FOOD SECURITY IN ASIA AND THE CHANGING ROLE OF RICE<sup>1</sup>

Presentation by C. Peter Timmer<sup>2</sup>

### INTRODUCTION

The food crisis of 2007/08 caught most of the countries in Asia unprepared for a sudden spike in food prices, especially the price of rice. The panicked response of both rice importing and exporting countries is testimony to the continued political importance of rice, but also to how little long-run strategic planning has gone into the formation of rice policy in Asia, and its relationship to food security.

The relatively minor impact of the food crisis on the welfare of poor consumers in Asia, as far as the data indicate, suggests that rice might not be as critical to food security as political economists who analyze Asian policy are used to thinking. Part of this result stems directly from the overall success in keeping rice prices stable in most of the large Asian countries, mostly by using trade policies that had a devastating impact on prices in the world market for rice (Dawe, 2010). But part of the lack of impact may result from the fact that rice prices were already high in many Asian countries, and the poor had already been affected. Finally, rice may simply not be as important in the food baskets of most Asian consumers as it used to be.

Food security in Asia has traditionally been defined as having stable prices for rice in the major urban markets of a country. The world market was used as an instrument to defend this goal, with imports and exports controlled by government authorities tasked to defend stable prices (Timmer, 1996). That approach to food security made sense when a third of the economy was dependent on rice production, marketing, and consumption, and well over half of daily caloric intake in some countries came from rice. Except for a few important exceptions—Bangladesh and Vietnam still get more than half their calories from rice, for example—that world no longer exists. But the mindset still exists, and most discussions about food security in Asia even in 2010 still focus on rice (Timmer, 2010a). It is time to update that mindset.

Part of the updating requires a clearer recognition of who consumes rice. Increasingly, rice is consumed by the poor, who usually must buy most of their rice in rural and urban markets. Almost by definition, having a surplus of rice to sell to the market raises a family above the poverty line in most Asian countries. This reality, of course, makes rice more, not less, important to food security in Asia, but it also

---

<sup>1</sup> This Working Paper is a slightly revised version of a paper that was presented at the ADB/FAO/IFAD Investment Forum for Food Security in Asia and the Pacific, “Food for All,” held at ADB Headquarters in Manila, Philippines, July 7-9, 2010, and that was supported by The Asia Foundation. It draws directly on presentations to the ASEAN Food Security Conference 2010 held in Singapore, 16-18 June, 2010, and an earlier food security investment forum held in Dhaka, Bangladesh, 25-27 May, 2010. Neither of the conference organizers is responsible for the views expressed here. Special thanks go to Tom Slayton and Tom Reardon for very helpful comments on an early draft of this paper.

<sup>2</sup> The author is Thomas D. Cabot Professor of Development Studies, *emeritus*, Harvard University, Cambridge, MA, and Adjunct Professor, Crawford School of Economics and Government, Australian National University, Canberra, Australia. Contact at [ptimmer63@gmail.com](mailto:ptimmer63@gmail.com).

makes a mockery of the strategy of most Asian countries of keeping rice prices stable by keeping them high, well above long-run levels in world markets.

When *food security* is equated with *food self-sufficiency*, this strategy may make sense, because it is easier to stabilize domestic food prices using domestic production—stimulated by high prices—than to follow and depend on the world market for rice, with its great price volatility. But this strategy forces poor consumers to pay high prices for rice, and it increases considerably the degree of poverty in a country. Self-sufficiency in rice is a political strategy, not a poverty strategy. If countries were more open to rice trade, they would be richer, not poorer. The big question is how to make such openness possible when policy makers and the general public distrust the world rice market, for reasons that are easy to understand (Timmer, 2010e).

## A FRAMEWORK FOR UNDERSTANDING FOOD SECURITY

Especially when a long-run perspective is needed, it is useful to have an organizing framework for understanding how the essential components of food security relate to each other. In what is otherwise an extremely complicated food system, this framework should be as simple as possible (but no simpler, to quote Albert Einstein). The framework used here divides the world into issues facing policy makers in the short run (e.g. 1-2 years) versus the long run (5-10 years or longer), and at the macro, economy-wide level versus the household, or individual level (see Figure 1).

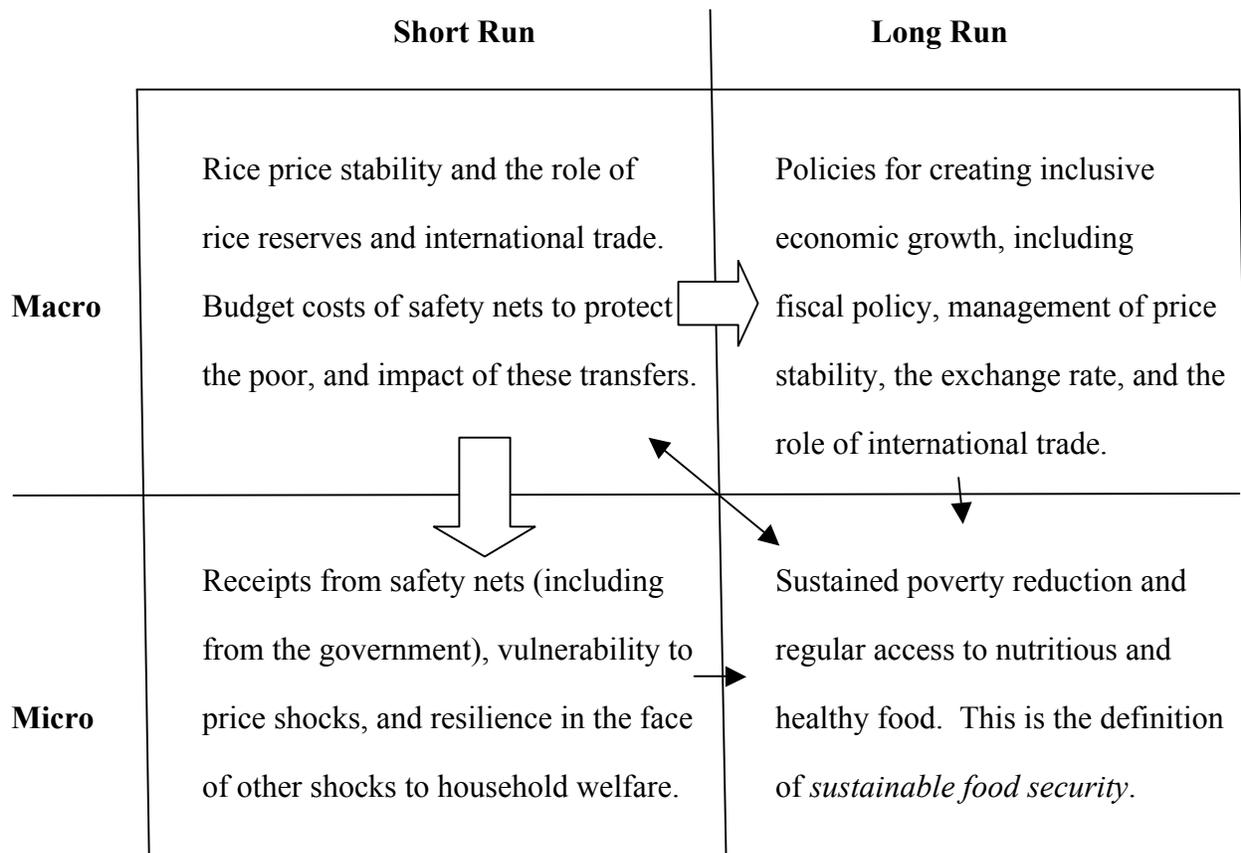
The policy objective in this simple framework is for all households to have reliable and sustainable access to nutritious and healthy food. Thus “food security” is achieved by ending up in the bottom right box of the matrix. The starting point, however, is the upper left box of the matrix, where policy makers deal primarily with macro-level issues in the short run. To the extent they are concerned about the welfare of poor households, in the short run the best they can do is stabilize food prices and send transfer payments—via safety net mechanisms—to those households most affected during a food crisis when prices rise sharply.

In an ideal world, policy makers could use economic mechanisms under their control to shift households directly to the long-run objective, the lower right box where sustainable food security is achieved. In return, policy makers would receive political support for this achievement, hence the two-way diagonal arrow connecting the upper left and lower right boxes. The diagonal arrow reflects a technocratic view of the world where policy makers take informed actions on behalf of public objectives and are rewarded when they succeed.

In fact, market economies, and politics, do not work that way. Policy makers at the macro level must implement long-run measures to stimulate inclusive, pro-poor economic growth, and sustain that growth for decades in order to have a measurable impact on poverty, via the small vertical arrow connecting the upper right box to the lower right box. These long-run measures are reflected in the broad arrow from the upper left to the upper right, but it is hard to concentrate the political and financial resources needed to make this arrow an effective mechanism to stimulate economic growth if most policy attention, and fiscal resources, are being devoted to short-run crises.

Simultaneously, and creating tensions for the policies favoring long-run growth, policy makers must also find enough resources, and efficient transfer mechanisms, to ensure that the poor do not fall into irreversible poverty traps during times of economic crisis, including food crises. These transfers can impose substantial fiscal costs and hence challenge the necessary investments for long-run growth. Design and implementation of these transfers involve human and political capital that also has real opportunity costs to the growth process. Thus a focus on the broad downward arrow is necessary to ensure the continued viability and participation of poor households, but these activities have opportunity costs in terms of economic growth.

**Figure 1. Basic Framework for Understanding Food Security Issues in Asia**



When the global economy is reasonably stable, and when food prices are well behaved, policy makers can concentrate their political and financial capital on the process of long-run, inclusive growth. Keeping the poor from falling into irreversible poverty traps is easier and less costly in a world of stable food prices, and the poor are able to use their own resources and entrepreneurial abilities to connect (via the small horizontal arrow) to long-run, sustainable food security for themselves. With success in achieving the objectives in the upper right and lower left boxes, market forces gradually—over decades—bring the poor above a threshold of vulnerability and into sustained food security (connecting macro to micro and short-run to long run). The country has then managed the “escape from hunger” that Fogel documented for Europe and America in the late 18<sup>th</sup> and early 19<sup>th</sup> centuries, and which a number of Asian countries have managed in the 20<sup>th</sup> century (Fogel, 1991, 1994; Timmer, 2004, 2005a).

By contrast, a world of heightened instability—in global finance and the world food economy—forces policy makers to concentrate their resources in the upper left box, where they are trying to stabilize domestic food prices and keep the poor from slipping deeper, irreversibly, into poverty. Important as this effort is, it clearly comes at the expense of significant progress out of the short-run box on the upper left, both to the right and from top to bottom. From this perspective, instability is a serious impediment to achieving long-run food security. In a world of greater instability, induced by climate change, by new financial arrangements, even by the pressures from new political voices, food security is likely to suffer.

How can we fix this? The first step is to understand how the world of food security has changed in the past several decades. The starting point—where we've come from—reflects a broad political mandate in Asia to feed both urban and rural populations, the contributions of a technological revolution in rice (and wheat) that made this possible, and the role of rapid, inclusive economic growth in giving Asian households access to the food in their fields and markets (Timmer, 2005b). What's changed is the structural transformation driven by these processes and the role of rice in the economy—Asia is now richer, more urban, better connected and much better fed (Timmer, 2009a). Asia's food marketing system is also being transformed before our eyes, as modern supply chains and supermarkets change the nature of farm-market-consumer interactions (Reardon, 2010). Finally, climate change really does seem upon us, with greatly increased uncertainty about weather patterns, and corresponding increases in instability of production. As noted above, instability is a real problem for food security.

The following section highlights several of these trends, especially the changing role of rice in Asian agricultural production and household food consumption. A possible path forward, to make the world market for rice more reliable and hence trusted by Asian policy makers, concludes the paper. If successful, the Asian rice economy could become much better integrated and more stable.

## THE CHANGING ROLE OF RICE IN ASIA

### *Rice in Production*<sup>3</sup>

It is hard to imagine a more compelling picture of the changing role of rice in the global and Asian economies than the simple black-and-white data presented in Table 1 (pages 18-19). The objective of the table is simple, to show how structural transformation has altered the role of rice in the agricultural and overall economies of Asia and the rest of the world. The calculations, however, turn out to be complex. It is no wonder that these results will strike most readers as “new” and, perhaps, surprising.

Still, the approach is straightforward. The first step is to determine the share of cereal production in total agricultural production, something that is now possible with the new FAO production index that reports these values in 1991 International Dollars, by country and for regional aggregates (see Table 1, page 18, sections 1-3). At a global level, the share of cereals has not changed much from 1961 to 2007, rising slightly from 1961 (21.4%) to 1980 (24.4%), reflecting the productivity impact of the new technologies for rice and wheat. By 2007, however, the share of cereals had declined to 21.3% of total agricultural production, virtually unchanged from the 1961 value.

There is substantial regional variation in this pattern. The share of cereals in East Asia’s total agricultural production rose from 33.7% in 1961 to 37.9% in 1980, before falling sharply to 19.4% in 2007. A rapid agricultural transformation was going on in East Asia after 1980, both cause and effect of the rapid economic growth in the region and its accompanying structural transformation. South Asia saw similar but more modest changes, as did Southeast Asia from a higher base. Africa, of course, relies much less heavily on cereals in its agricultural production, and there is little change in that pattern from 1961 to 2007.

The next step is to determine the role of rice in cereal production, something not possible directly from the FAO production index. An alternative approach is straightforward, however. Sections 4-7 in Table 1 (pages 18-19) use physical production of total cereals and of rice to calculate the share of rice in the total. In these calculations, the amount of paddy rice is used in the comparison, despite the milling losses needed to produce an edible product. Although this approach tends to overstate the role of rice, an offsetting factor is that rice tends to be more valuable as a foodstuff per unit of weight, so the end result is about right. Further, whatever biases are introduced by this approach will not change much over time, and it is primarily the temporal patterns that are of interest.

Again, at a global level, the share of rice in total cereal production does not change a lot between 1961 and 2007, starting at 24.6% and rising gradually to 28.1%. But the regional patterns of change are quite dramatic. First, it is obvious that Asia relies far more heavily on rice than the rest of the world, as East Asia’s share of rice fell steadily from 56.2% in 1961 to 43.0% in 2007. A similar, but slower decline from a higher base is seen in South Asia. Southeast Asia is very heavily dependent on rice—it accounted for 90.6% of cereal production in 1961 and rice still accounted for 85.9% of cereal production in 2007.

Perhaps surprisingly, Africa has steadily increased its production of rice over the past half century (by 3.5% per year since 1961), and the role of rice in overall cereal production. In 1961, rice was 9.3% of to-

---

<sup>3</sup> This section draws on Timmer, 2010c.

tal cereal production in Africa, and this share has risen steadily to become 15.2% in 2007. Rice has become a significant cereal crop in Africa.

The final three sections of Table 1 (pages 18-19) show the calculations needed to understand the changing role of rice in overall agricultural production and for the entire economy. In Section 7, rice as a share of total agriculture is calculated by multiplying the values in Section 3 times the values in Section 6. The results are just arithmetic, but are interesting nonetheless. Rice has been about 5-6% of agricultural production since 1961, but the share varies enormously by region. In East Asia, rice's share has dropped from about a fifth of agricultural output to less than a tenth. Rice remains more significant in South Asia, contributing 15.2% in 2007. In Southeast Asia, rice contributed 40.2% of agricultural output in 1961, a figure that has dropped steadily, but slowly, since then. In 2007, rice still contributed 32.0% of agricultural output in Southeast Asia.

The share of rice in Africa's agriculture is small, just 1.48% in 1961. But unlike the patterns in Asia, the share of rice in Africa is rising; it was 2.34% in 2007. Although still a small factor in Africa's overall agricultural production, it is clearly a commodity with a promising future.

Section 8 of the table reports the share of agricultural value added in overall Gross Domestic Product (GDP), a value reported regularly in all countries' national income accounts and available from the World Development Indicators (WDI) published by the World Bank. In its crudest form, this is the structural transformation. For the entire world, agriculture contributed a bit over 10% of economic output in 1961 and a bit less than 3% in 2007. These low numbers are the result of the economic dominance of rich countries in global GDP, and the very small contribution of agriculture in these economies.

Asia is much more dependent on agriculture, reflecting its historical structural dependence on smallholder farmers and the need to keep them profitably employed in agriculture even as the industrial sector is expanding rapidly. The World Bank reports these data for East and Southeast Asia combined, and the share of agricultural value added in overall GDP declined from 36% in 1961 to 12% in 2007.<sup>4</sup> The share of agriculture in South Asia's economy is higher, starting at 42% in 1961 and declining to 18% in 2007. The share of agriculture in Africa's economy is surprisingly low, but it has declined little, from 22% in 1961 to 15% in 2007.

The contrast between Asia and the rest of the world is sharp: in 1961 agriculture was 3.7 times as important to Asian economies as to the world as a whole (taking the simple average of East Asia and South Asia). This ratio had climbed to 5.2 times as important in 2007. Despite the rapid transformation of Asian economies, agriculture remains very important. This is mostly because Asian economies remain, on average, very poor, but it is also because the huge number of small farmers in Asia cannot be moved to urban industrial and service jobs in just a few decades, even with rapid economic growth. The structural transformation takes generations, and the stress on agricultural families to adjust is greater the faster the economy grows.

---

<sup>4</sup> If the major agricultural producers of Southeast Asia (Indonesia, Thailand, Philippines, Vietnam and Malaysia) are examined as a regional aggregate separately, the share of agricultural value added to GDP was 40.9% in 1961, 38.6% in 1970, 26.9% in 1980, 21.9% in 1990, 16.4% in 2000, and 14.5% in 2007). Most of the remainder of the World Bank regional aggregate of "East Asia and the Pacific" is then composed of China. The share of agriculture in China's GDP was 36%, 35%, 30%, 27%, 15%, and 11%, from 1961 to 2007, by decades.

Finally, Section 9 provides the “bottom line” to our question: how has the role of rice changed? At a world level, rice accounted for just over one half of one percent of GDP in 1961. Over the next half century, the share of rice in GDP for the entire world fell to just 0.174% of GDP. In terms of overall economic output on a global scale, rice is a very small factor.<sup>5</sup>

In Asia, rice is far more important, although its share in national economies is not as large as many observers think. Even in 1961, rice accounted for just 6.8% of GDP in East Asia, 8.4% in South Asia, and 14.5% in Southeast Asia. Naturally, because of the structural transformation and the declining role of agriculture in successfully growing economies, and the agricultural transformation, where farmers diversify out of low-valued rice production, the share of rice in Asian economies (share of GDP) has declined very rapidly. In 2007, it was just 1.0% in East Asia, 2.7% in South Asia, and 3.8% in Southeast Asia. So, even in Asia, rice is less important *economically* than livestock, construction, transportation, or even banking. Total employment in the rice economy may still rival these other sectors, but that is because the economic returns to working in the rice sector are so low—a failure of the structural transformation to absorb rural workers fast enough.

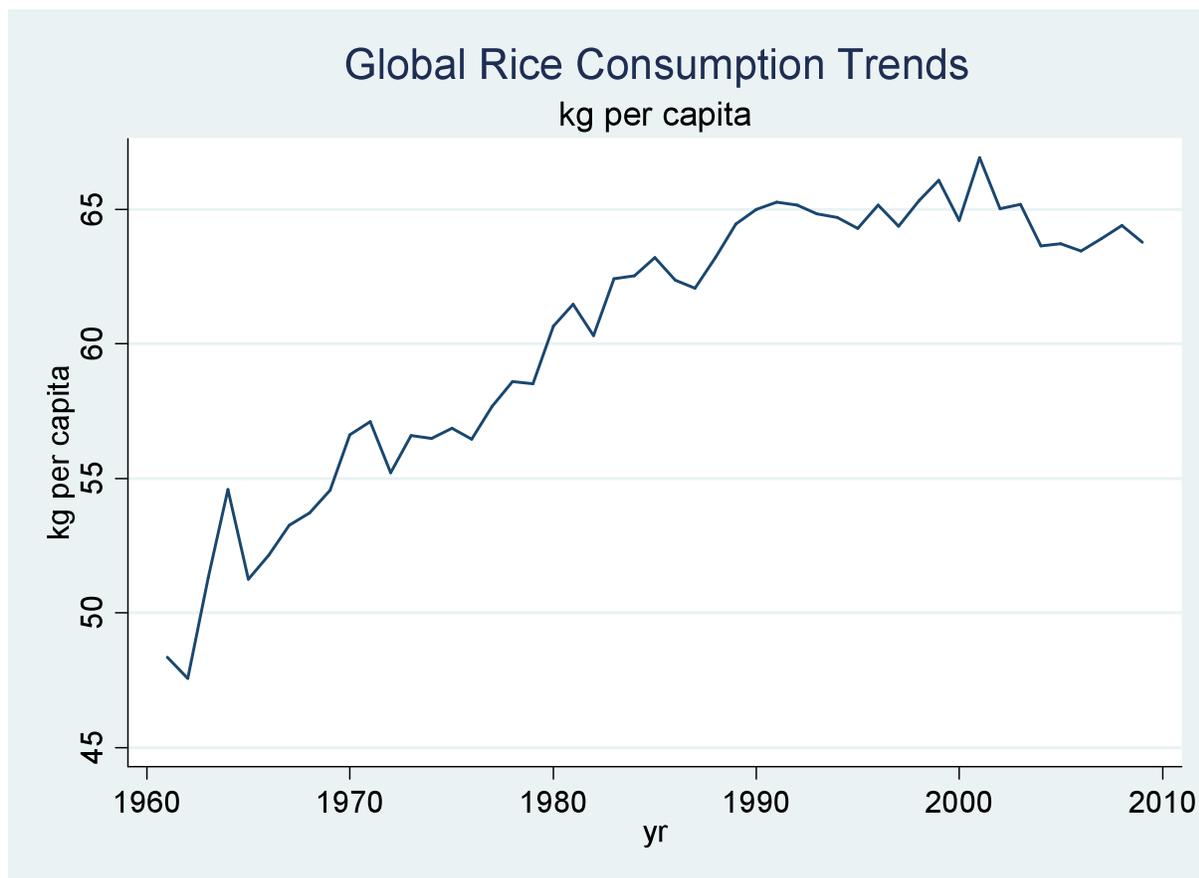
### *Rice in Consumption*

Momentous changes are also underway in rice consumption, especially in Asia (see Figures 2 and 3). New data, extensive econometric analysis, and a historical perspective help us understand the underlying dynamics of these changes (Timmer, Block and Dawe, 2010). The result will surprise many readers, as the projections suggest a significant decline in global rice consumption in the next four decades, starting in just 10 to 20 years. The main drivers of this decline will be rapid income growth in Asia, accompanied by a massive shift of labor from rural to urban areas. The impact of these two drivers is especially vivid in Figure 3, which shows the annualized change over at least a two-decade period in the quantity of rice consumed per capita per week, by rural and urban households separately, according to which income quintile they fall into, for Bangladesh, Indonesia and India. The sharp negative trend with respect to incomes, and between rural and urban households, is striking.

---

<sup>5</sup> It should be emphasized that these are production shares of rice to value added and do not include the value of processing and marketing. The share of rice at the level of consumption is probably about half again as large. See the following discussion of rice in consumption.

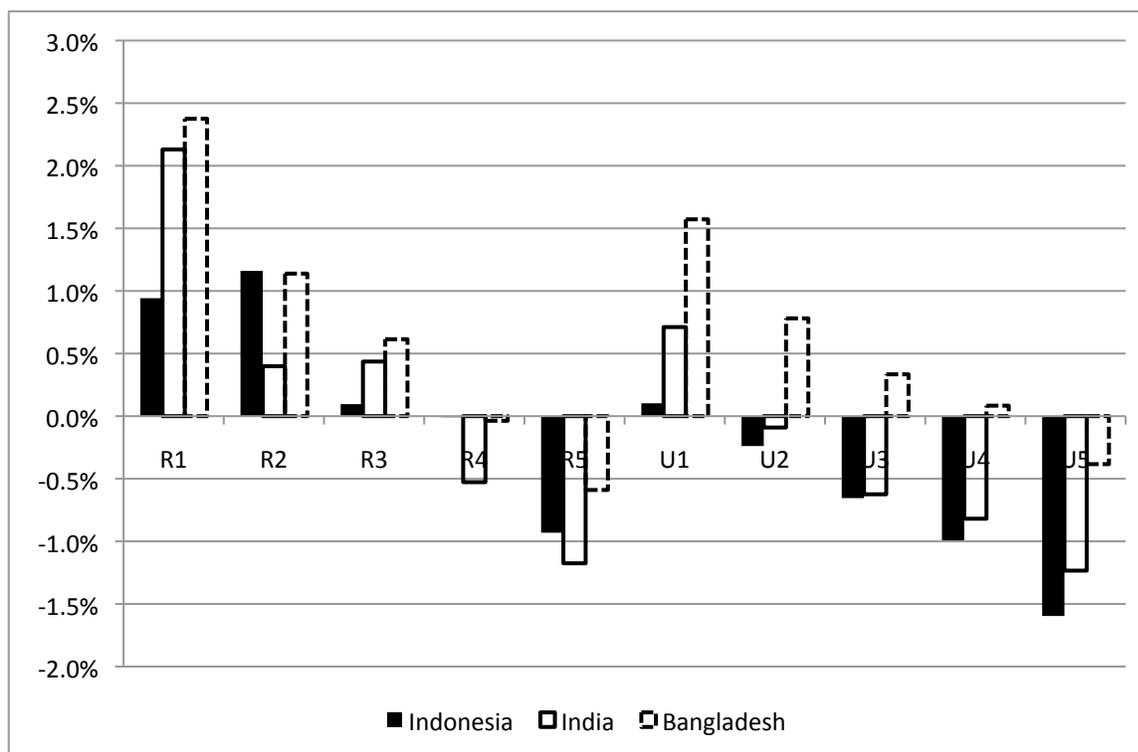
**Figure 2.** Trend in Global Rice Consumption per capita, 1961 – 2008.



Source: Timmer, Block and Dawe, 2010.

With more open trade and the globalization of tastes, a shift to more balanced diets in Asia—less rice and more wheat, animal products, fats and oils, and vegetables and fruits—means a decline in rice consumption. The foundations of this decline have been apparent in the global data since the early 1990s, when the aggregate income elasticity of demand for rice turned negative. Per capita consumption of rice peaked about the same time (see Figure 2). Projecting forward, global rice consumption is expected to rise from the 441 million metric tons (mmt) consumed in 2010 to about 450 mmt in 2020, before declining to just 360 million metric tons in 2050.

**Figure 3.** Annualized percentage change in rice consumption by quintile and location, Indonesia, India, and Bangladesh.



Notes: R refers to rural quintiles, U to urban quintiles. Period over which changes are calculated are 1967-2006 for Indonesia, 1983-2005 for India and 1983-2005 for Bangladesh.

Source: Timmer, Block and Dawe, 2010.

From a food security perspective, the changing role of rice in Asian diets has three clear implications. First, the overall importance of rice to Asian consumers as a source of calories is gradually declining (see Table 2, page 20). Rice as a share of calories for all of Asia (as defined by FAO, with data from their food balance sheets), peaked in 1970 as the Green Revolution got under way, with 38.2% of the average Asian household's calories coming from rice. That share has steadily declined, falling to 29.3% in 2007. What is particularly striking about this decline is its acceleration. The share fell by 0.25% per year between 1961 and 1990, but by 1.00% per year from 1990 to 2007. If Asian policy makers are worried about where their constituents get their daily food, the answer is over 70% from the non-rice economy. And that number reflects the *calorie* dimensions of food; Asian consumers are now spending less than 5% of their food budgets on rice.

Second, however, the total size of rice demand remains important, because rice remains the largest *single* source of calories for a significant majority of Asian consumers. This point returns the discussion to the production situation, where yield growth has stagnated and many key rice-growing basins are threatened by short-run environmental degradation and long-run impacts from climate change. But precisely because rice production is facing serious challenges, and is likely to be more unstable in the future, most countries

in Asia need to increase their participation in the world rice market and trade, not seek localized self-sufficiency. A strategy for building trust in the world rice market is presented below.

Third, there is great country variance in the role of rice in Asian food consumption, and in how that role is changing (see Table 3, pages 21-23). On average, India consumed just 703 Calories of rice per capita per day in 2007, a sharp contrast with the 1629 Calories consumed in Vietnam. Still, rice consumption in Vietnam accounted for “only” 57.8% of total caloric intake, whereas the share in Bangladesh was 69.8% in 2007. Excepting only the Philippines, that share has been falling since 1970 or 1980 in all the countries shown in Table 3 (pages 21-23), and the fall has been especially rapid in South Korea—from 49.8% in 1980 to 26.8% in 2007—and in China—from 38.7% in 1970 to 26.8% in 2007. But the drop is also noticeable in Bangladesh—from 75.2% in 1990 to 69.8% in 2007—and in Indonesia—from 56.1% in 1980 to 48.8% in 2007. In all of these countries except Bangladesh (and, again, the Philippines), the drop in share of rice has also been accompanied by at least a modest fall in the total consumption of rice. Only population growth continues to drive rice consumption upward in Asia, and population growth is slowing in most countries.<sup>6</sup>

### *Current Challenges to Food Security in Asia*<sup>7</sup>

One advantage of a long-term perspective is the realization that food security challenges are never fully met, and they can change radically in a short period. Shortages give way to surpluses and back again; large rice reserves become a financial burden when surpluses are available and prices are falling, but are welcome when regular import supplies are embargoed or severe drought hits and prices rise rapidly; the efficiency of rice trade for both exporters and importers can be disrupted by political demands for self-sufficiency as the only way for a large country to ensure food security for its citizens, but the high prices required soon meet consumer resistance. Food security is all about trade-offs in both the short run and the long run (Timmer, 2010a).

These trade-offs were presented in a particularly vivid fashion by the Prime Minister of Bangladesh, Sheikh Hasina, in her opening speech to the Bangladesh Food Security Investment Forum 2010. A short excerpt provides the essential message:

The unprecedented food crisis of 2007-2008 has compelled the entire world to attach high priority to food security. Particularly it has proven the international market as an unreliable source of food at times of crisis, and reminded us of the need to exploit whatever comparative advantage we have in food production. In Bangladesh, the crisis has signaled a policy shift from self-reliance to self-sufficiency (Sheikh Hasina, 2010, p. 1)

---

<sup>6</sup> The Philippines case is interesting and hard to explain. The share of rice in the average Filipino diet declined steadily from 1961 to 1990 under the pressures of rapid population growth, slow growth in domestic rice production, and a lagging economy. The share has since increased 9 percentage points to 2007, with daily rice intake rising 1.7% per year since 1990. Substitution away from corn, sharply higher rice imports to support political campaigns, apparent success in the domestic rice production program, and increased rice consumption among the poor because of extensive subsidies may account for these trends.

<sup>7</sup> Much of this section draws on a presentation to the Bangladesh Food Security Investment Forum, Dhaka, 26-28 May, 2010. See Timmer, 2010d.

A policy shift from using export earnings to finance the import of rice, to producing more rice domestically, is perfectly understandable under the circumstances of the past several years, and has direct consequences for one of the issues here—the changing role of international markets in providing food security. We all understand that markets, as an institutional mechanism for allocating resources, are absolutely essential because of their speed in processing information. All economies, no matter how poor or simple, must handle billions of bits of data every day, and facilitate transactions that usually number in the hundreds of millions per day. No other institutional mechanism can allocate resources as efficiently as markets. We know this because societies over time have tried every other possibility.<sup>8</sup>

The widespread and persistent search for an alternative to markets as the organizing framework for a society's economic activities has a deep underlying rationale.

### Markets

—often (thinks the political left),

—sometimes (thinks the political center), or

—rarely (thinks the political right),

fail to produce an outcome that is satisfactory to groups of individuals, or even to society as a whole. In particular, we may not like the *distribution* of the outcome from a market economy (in terms of incomes and asset ownership), and we may not like the *instability* of those outcomes (in terms of food prices, in particular).

### *An Alternative to Free Markets?*

Is it possible to have an efficient market economy and still influence its distribution of income and the stability of food prices? Since the 1970s, most economists and donor agencies have said “no.” You have to have “free” markets, or they won't produce rapid economic growth. Policy advice and structural adjustment programs invariably pushed countries to liberalize markets, even if that meant worsening income distribution and greater instability in prices.<sup>9</sup>

We have now learned that “no” is the wrong answer.<sup>10</sup> Over the past decade, individual countries have demonstrated that “inclusive” economic growth is possible if investments are made in agriculture, rural infrastructure, education and health, and the macro economy is stimulated by sound fiscal policy, a competitive exchange rate, and a reasonably open (but not “free”) trade regime (2005b). That is, the distribution of benefits from economic growth can be affected by public policy without necessarily slowing the overall rate of growth. This critical lesson has still not been learned in most of the donor community.

---

<sup>8</sup> Winston Churchill once noted that Americans can always be counted on to do the right thing, after they have tried everything else.

<sup>9</sup> Of course, the market environment in a great many countries was improved by liberalization, and economic growth did accelerate. The point is that the side effects were dismissed as unimportant, or even unlikely to occur, so no policy planning was instituted to cope with them.

<sup>10</sup> Not for the first time, of course. The lesson also seemed to have been learned during the Great Depression.

At the same time, food prices within a country *can* be kept reasonably stable with respect to world prices, especially for rice in Asia (Timmer and Dawe, 2007). There are often spillovers from the actions undertaken by countries to stabilize their domestic prices, and these spillovers increase price instability in world markets. A little-researched topic is how to *minimize* the impact of these spillovers, or *cope* with them on a country-by-country basis, rather than to follow the standard policy advice, which is to *avoid* the actions altogether, and thus avoid the spillovers in the first place. *The standard policy advice turns out to be politically impossible in times of turbulent markets.* Is there a better alternative?

The mainstream economic development profession has long questioned whether stabilizing domestic food prices was

(a) desirable,<sup>11</sup> or

(b) feasible.<sup>12</sup>

After the world food crisis of 2007-08, it is time to rethink that analytical position and the policy advice that stems from it. Three things would move the agenda forward:

**First, we need a serious new research program** on the benefits and costs of stabilizing food prices *within domestic economies*, including a focus on implementation of policy, management of food logistics agencies, and instruments to control corruption in these agencies. We would know a lot more about these topics if we had spent the same resources answering these questions as we have spent over the past three decades in estimating the gains from free trade in agriculture.

**Second, we need serious new confidence-building measures** to renew trust in the world rice market. Very severe damage to this trust was inflicted during the 2007-08 food crisis, mostly because of the Indian ban on exports, the on-again, off-again ban on Vietnamese rice exports, and open talk in Thailand of withholding stocks from the market and creating an “OREC,” or Organization of Rice Exporting Countries, to boost prices in the world market. Still, there is plenty of blame to go around in explaining the growing political distrust of the world market for rice. Important importing countries, such as Indonesia and the Philippines, speak publically of their desire to end “dependence” on supplies from the world market. Such rhetoric does not make them a market that exporting countries can trust (although this rhetoric also has little impact on rice traders, who tend to judge market impact from actions rather than political statements).

---

<sup>11</sup> The desirability of stabilizing food prices is questioned by standard models of international trade and of intertemporal storage, where greater price variance generates greater opportunities for trade, with commensurate gains in producers and/or consumers surplus. See Timmer, 2010b for a review of this approach and an incorporation of insights from behavioral economics into the food security debate.

<sup>12</sup> For a good review of this thinking, see the World Bank (2005) compendium of papers presented at a conference on managing agricultural price risk in an environment of market liberalization. At that conference, Kym Anderson of the University of Adelaide, lead author of the massive World Bank research program on “distortions of agricultural incentives,” argued that “price instability is your friend,” because it stimulates appropriate responses from producers and consumers to cope with the inevitable instability in food supplies that is caused by weather, pests and diseases. In a more recent paper, Brian Wright of University of California, Berkeley, has argued that stabilizing food prices is simply not feasible. See World Bank (2005), Anderson (2009), Anderson and Martin (2009), and Wright (2009). The basic analysis in this debate is Newbery and Stiglitz (1981), although they concentrate almost entirely on international mechanisms to stabilize commodity prices, not domestic actions.

This retreat into autarky comes at a very high price to economic efficiency and the welfare of poor consumers. It makes the world market even more unstable and less reliable. Is there anything we can do to rebuild confidence and trust in international trade in general and in the world rice market in particular? Any confidence-building measures will need to involve both exporting and importing countries, *acting in their own self-interest*. One possibility is a country-by-country investment in greater rice reserves to cope with *shocks* to rice supplies, while gradually increasing the use of trade to *lower costs* of rice consumption. A higher level of stocks does not alter the requisite flow of rice from producers to consumers, but it does create a buffer against interruptions to that flow. Thus:

**Third, we need larger rice reserves** at four different levels of the global rice economy—those held by the private sector, in small importing countries by the public sector, in large rice producing and consuming countries held publicly, and internationally.

Most of the rice stocks in the global economy are held by the private sector—farmers, traders, processors, retailers, and consumers—to even out seasonal production patterns and to keep trade pipelines flowing smoothly. Few private stocks are held to even out inter-annual price fluctuations, but the pipeline stocks carried across crop-years are probably equal to a month or two of consumption, a considerable quantity. With greater price instability expected in the future, and greater uncertainty about the reliability of supplies in world markets, optimal (profit-maximizing) levels of privately held rice stocks will increase (Williams and Wright, 1991). Although we know little about the actual levels of these stocks, or the behavioral parameters that affect them, even the most basic models of supply of storage suggest there will be a significant increase in privately held rice stocks going forward. Of course, if publicly held stocks succeed in stabilizing world rice prices, privately held stocks will then gradually be drawn down.

A completely overlooked potential for the private sector to provide greater stability of rice prices through stock management comes from the “supermarket revolution” in Asia (Timmer, 2009c; Reardon, 2010). Before the turn of the Millennium, supermarkets in the region were niche players catering mostly to the urban middle and upper classes. Now they provide—via modern supply chains—perhaps a third to as much as half of the rice consumed in East and Southeast Asia, with the share growing rapidly (although even the rough numbers are not really known).

The potential of modern supermarkets to stabilize rice prices comes from the large market share of individual companies under central management control. If consumers *desire* stable food prices, astute supermarket managers can *supply* it. This potential to stabilize prices contrasts with traditional small, competitive, retail rice markets, where prices change regularly on the basis of daily supply and demand. Historically, “food price stability” has been a *public* good because no private entity found it profitable to provide it. The rise of supermarkets may mean that stable food prices could become primarily a *private* good. This would truly be a revolution in the food industry.

Next, for similar reasons, small countries that rely heavily on imports for their rice supplies, such as Malaysia, Singapore, or Brunei, will find it desirable to increase the level of stocks held publically, or (as in Singapore) held privately but with levels determined by public regulations.<sup>13</sup> Even a modest increase in

---

<sup>13</sup> To obtain a license to import rice into Singapore, the trading company must agree to hold three months of normal consumption in storage. In view of the increased instability and uncertainty in the world rice market, expanding

rice stocks in these countries will increase confidence that the world market remains their best long-run source of supply (which, of course, it is).

Large countries face a somewhat different situation. Because of the sheer size of their *domestic* rice economies, actions to increase production, reduce consumption, or alter the size of stocks held by public agencies will also have a noticeable impact on the *international* rice economy. These countries certainly include China and India, probably Indonesia, and possibly the Philippines and Bangladesh.<sup>14</sup> Larger rice reserves in these countries are probably desirable for reasons of domestic food security, but they will also alter the perception of global observers about the adequacy of worldwide stocks. That is, larger rice reserves in these countries will have a positive spillover impact on the global rice economy by stabilizing price expectations, and thereby actual rice prices. An important question for the international community, especially the major donors, is whether any actions can be taken to encourage the gradual build-up of rice reserves in these large countries.

#### *A Role for the International Community?*

Finally, the hardest question is whether there is any role for international ownership and control of rice stocks as a means to stabilize rice prices on global markets. Ever since the publication of the classic Newbery and Stiglitz volume, *The Theory of Commodity Price Stabilization*, in 1981, the answer has been a clear “no.” Both history and theory demonstrate that it is impossible to stabilize the price of a commodity in world markets for long periods of time—from cocoa to coffee to copper to tin to wheat to whatever—using internationally managed buffer stocks. Budget constraints and the asymmetry of storage—it can never be negative—mean that stochastic variations in supply or demand will eventually overwhelm the ability of a buffer stock to stabilize prices (Newbery and Stiglitz, 1981; Williams and Wright, 1991; Wright, 2009). No international commodity agreement (ICA) with binding provisions has been negotiated since the Newbery and Stiglitz volume.

Still, it is important to address a more modest question. Would the availability of a limited amount of rice under international control help stabilize *expectations* about the behavior of world rice prices? If expectations can be stabilized, panicked behavior on the part of multitudinous participants in the world rice economy could be sharply reduced, with self-reinforcing price bubbles and collapses made less frequent and less extreme (Timmer, 2009a). The availability of international stocks would not need to keep rice prices within some legally specified band, but could be useful if world rice supplies suddenly tighten and prices threaten to spike. Is this more limited objective possible?

#### *Four Possibilities for Holding International Rice Stocks*

There are four levels at which this question should be addressed. First would be within Asia: the ASEAN + 3 (which includes China, Japan and South Korea), or possibly a new ASEAN + 6 (to include also India, Bangladesh and Pakistan) would include nearly all of the world’s major rice importers and exporters (ex-

---

these stocks to 3.5 or even 4 months of supplies probably makes sense. Of course, higher storage costs will be incurred and these will have to be paid by consumers.

<sup>14</sup> Thailand and Vietnam, as the world’s leading rice exporters, carry substantial stocks both seasonally and as part of their normal pipeline for regular deliveries to their customers. They are unlikely to need larger stocks for food security reasons.

cept the United States), not to mention about 90 percent of world production and consumption. An expanded ASEAN rice buffer stock has been under “active” consideration for years, with little discernible progress. How do we stimulate such progress, beyond the steps underway to improve information flows and policy coordination? Would an agreement to focus on a specific quality of rice, say 25% broken long-grain rice, help build confidence that the reserve could help meet demand from the poorest consumers when prices spike?

Second, by an accident of international trade negotiations and strong protection of domestic rice producers, Japan holds over 1.5 million metric tons of high quality “foreign” rice that it imports under its WTO agreement but which it refuses to sell to domestic consumers. The *potential* availability of this rice in May of 2008 was sufficient to prick the rapidly exploding rice price bubble at that time (Slayton and Timmer, 2008). Would it be possible to manage these Japanese stocks with a more active concern for movements in international rice prices?

Third, could Australia, under AusAID auspices, use its mostly redundant rice industry to build up stocks of rough rice from surplus countries in Asia (shipping it to Australia in otherwise empty cargo carriers that go up to Asia filled with coal, iron ore or bauxite) and then offer these stocks, after milling, back to the world market when rice supplies get tight? The Australian rice industry has an excellent record of managing rice stocks and shipments and has little vested interest in exploiting price movements on the international rice market. Could Australia provide an important international public good by helping to stabilize world rice prices?

Finally, the question inevitably comes up: can the international community itself commit to publically managed international rice stocks that would be an effective stabilizer of world rice prices? At the height of the world food crisis, IFPRI put forward a proposal to create “virtual reserves” of grain to dampen financial speculation on world grain markets (von Braun and Torero, 2008). Whatever the merits of such grain reserves for wheat, corn and soybeans, they clearly will not work for rice. Without deep futures markets, and with less-than-transparent price discovery in the world market, virtual reserves for rice will not influence real participants in real transactions (Timmer, 2009b).

The historical record on managing an international commodity agreement, with fixed price bands and the ownership of physical stocks, is not encouraging, and it was never even tried for rice because of the difficulties of stock deterioration, quality variations, and poor information on the prices of actual rice trades. None of those problems has gone away. Probably the best that could be done from an international perspective is for the major donors interested in rice—the World Bank, the Asian Development Bank, USAID, AusAID, and perhaps the Bill and Melinda Gates Foundation, to agree on modest incentive payments to large rice consuming countries to store more rice, at the margin, than they would store under normal conditions. Knowledge of the size of such stocks (a necessary condition for receiving incentive payments to hold them) would be an important stabilizing element for participants in world rice trade, even if the trigger mechanisms for stock release, domestically or internationally, were not enforceable by the international community.

The proposals here are incremental. They seek to change the long-run incentives for stockholding behavior, and to use increased stocks to build confidence in the international market for rice, which is clearly the most efficient source of supply for many countries. Because holding larger stocks will turn out to be very expensive, a scenario can be imagined where the larger stocks gradually build renewed confidence in

the world rice market, prices become more stable, and stocks will then be reduced gradually as the reality of the fiscal burden sinks in.

The policy discussion here has been almost entirely about stocks and trade, with little discussion of policy initiatives needed in the spheres of production and consumption. There has been little discussion of access by poor households to rice—the basis of food security for individuals. Such a

discussion would focus much more on the causes of poverty and approaches to reducing it in a sustainable fashion.

These are the truly important variables in the world rice market. Productivity growth in rice production has slowed visibly in the past two decades, and renewed investments in speeding that growth are urgently needed. Rice consumption patterns are changing rapidly, with consumption by the poor rising (often stimulated by subsidies) and consumption by the better-off, especially urban, households falling. The world rice economy, and the various domestic participants in it, is a dynamic system subject to shocks and self-reinforcing behavior that creates price spikes and collapses. This instability has enormous costs, economically and politically, to farmers and consumers. Now that rice is no longer the overwhelming determinant of food security for most of Asia's consumers, or of income for its farmers, we should be able to do better for a commodity that feeds two-thirds of the world's poor

**Table 1. Rice and the structural transformation: 1961-2007**

	Avg. Annual % Change					
	1961	1980	2007	1961/ 1980	1980/ 2007	1961/ 2007
<b>1. Total Agricultural Production, Value (in 1991 International \$)</b>						
World	607.5	956.0	1692.5	2.42	2.14	2.25
East Asia	73.8	142.3	414.1	3.52	4.04	3.82
South Asia	68.2	104.6	250.9	2.28	3.29	2.87
Southeast Asia	23.4	45.3	115.5	3.54	3.53	3.53
Africa	40.2	61.6	130.4	2.25	2.82	2.59
<b>2. Total Cereal Production, Value (in 1991 International \$)</b>						
World	130.2	233.6	360.1	3.12	1.62	2.24
East Asia	24.9	54.0	80.3	4.16	1.48	2.58
South Asia	22.4	36.5	68.9	2.60	2.38	2.47
Southeast Asia	10.4	19.3	43.1	3.31	3.02	3.14
Africa	6.39	10.0	20.1	2.39	2.62	2.52
<b>3. Cereal Production as % of Total Agri- cultural Production [2/1]</b>						
World	21.4	24.4	21.3			
East Asia	33.7	37.9	19.4			
South Asia	32.8	34.9	27.5			
Southeast Asia	44.4	42.6	37.3			
Africa	15.9	16.2	15.4			
<b>4. Cereal Production, MMT</b>						
World	877.0	1550.2	2351.4	3.04	1.56	2.17
East Asia	140.3	306.2	480.3	4.19	1.68	2.71
South Asia	120.8	198.0	375.0	2.63	2.39	2.49
Southeast Asia	50.8	95.8	216.1	3.40	3.06	3.20
Africa	46.3	72.6	139.8	2.40	2.46	2.43
<b>5. Rice (paddy) Production, MMT</b>						
World	215.6	396.9	659.6	3.26	1.90	2.46
East Asia	78.9	163.0	206.7	3.89	0.88	2.12
South Asia	73.6	112.2	206.9	2.24	2.29	2.27
Southeast Asia	46.0	84.5	185.7	3.25	2.96	3.08
Africa	4.31	8.61	21.3	3.71	3.41	3.53

<b>6. Rice as % of Cereal Production [5/4]</b>						
World	24.6%	25.6%	28.1%			
East Asia	56.2	53.2	43.0			
South Asia	60.9	56.7	55.2			
Southeast Asia	90.6	88.2	85.9			
Africa	9.3	11.9	15.2			
<b>7. Rice as a % of Agriculture [3x6]</b>						
World	5.26	6.25	6.00			
East Asia	18.9	20.2	8.34			
South Asia	20.0	19.8	15.2			
Southeast Asia	40.2	37.6	32.0			
Africa	1.48	1.93	2.34			
<b>8. Agricultural Value Added as % of GDP [from World Bank]</b>						
World	10.5	6.6	2.9			
East Asia*	36	29	12			
South Asia	42	35	18			
Southeast Asia*	36	29	12			
Africa	22	19	15			
<b>9. Rice as % of GDP [7x8]</b>						
World	0.552	0.413	0.174			
East Asia	6.80	5.86	1.00			
South Asia	8.40	6.93	2.74			
Southeast Asia	14.47	10.90	3.84			
Africa	0.326	0.367	0.351			
* East Asia and Southeast Asia are combined in the World Bank regional aggregates for agricultural value added as a % of GDP						

Source: Data from FAO and World Bank. Calculations by author. See Timmer, 2010c.

**Table 2. The Changing Role of Rice in Food Consumption in Asia**

Year	Total Calories	Calories from Rice	Rice as % of Total
1961	1805	656	36.3
1970	2069	790	38.2
1980	2200	797	36.2
1990	2443	848	34.7
2000	2606	803	30.8
2007	2668	783	29.3
	Average Annual	% Increase/(Decrease)	
1961-70	1.53	2.09	0.57
1961-90	1.05	0.89	(0.25)
1970-07	0.69	(0.03)	(0.71)
1990-07	0.52	(0.47)	(1.00)

Source: Data from FAO Food Balance Sheets. "Calories" are daily per capita energy intake.

**Table 3. The Changing Role of Rice in Food Consumption: Specific Countries**

<b>Year</b>	<b>Total Calories</b>	<b>Calories from Rice</b>	<b>Rice as % of Total</b>
<b><i>China</i></b>			
1961	1469	444	30.2
1970	1887	730	38.7
1980	2206	798	36.2
1990	2612	872	33.4
2000	2908	831	28.6
2007	2981	799	26.8
<b><i>India</i></b>			
1961	2030	663	32.7
1970	2134	692	32.4
1980	1991	638	32.0
1990	2220	781	35.2
2000	2314	719	31.1
2007	2352	703	29.9
<b><i>Indonesia</i></b>			
1961	1743	826	47.4
1970	1882	1032	54.8
1980	2220	1245	56.1
1990	2356	1301	55.2
2000	2498	1305	52.2
2007	2538	1238	48.8

***Bangladesh***

1961	1982	1575	79.5
1970	2108	1584	75.1
1980	1846	1311	71.0
1990	1960	1473	75.2
2000	2125	1522	71.6
2007	2281	1591	69.8

***Vietnam***

1961	1876	1378	73.5
1970	2056	1422	69.2
1980	1988	1341	67.5
1990	2098	1524	72.6
2000	2493	1657	66.5
2007	2816	1629	57.8

***Philippines***

1961	1738	823	47.4
1970	1775	769	43.3
1980	2246	932	41.5
1990	2254	915	40.6
2000	2407	1019	42.3
2007	2565	1271	49.6

***South Korea***

1961	2141	1070	50.0
1970	2815	1368	48.6
1980	3023	1504	49.8
1990	2956	1052	35.6
2000	3061	945	30.9
2007	3074	825	26.8

## REFERENCES

- Anderson, Kym, ed. 2009. *Distortions to Agricultural Incentives: A Global Perspective, 1955-2007*. Palgrave MacMillan and the World Bank, Washington, DC.
- Anderson, Kym, and Will Martin, eds., 2009. *Distortions to Agricultural Incentives in Asia*. The World Bank, Washington, DC.
- Dawe, David, ed. 2010. *The Rice Crisis: Markets, Policies and Food Security*. Earthscan: London and Washington, DC.
- Fogel, R.W. 1991. "The Conquest of High Mortality and Hunger in Europe and America: Timing and Mechanisms." In P. Higonnet, D.S. Landes, and H. Rosovsky, eds., *Favorites of Fortune: Technology, Growth, and Economic Development since the Industrial Revolution*. Cambridge, MA: Harvard University Press, pp. 35-71.
- Fogel, R.W. 1994. "Economic Growth, Population Theory, and Physiology: The Bearing of Long-Term Processes on the Making of Economic Policy." [Nobel Prize Lecture] *American Economic Review*. Vol. 84, no. 3 (June), pp. 369-395.
- Sheikh Hasina, 2010. Speech of the Honorable Prime Minister at the Inaugural Ceremony of the Bangladesh Food Security Investment Forum 2010, Pan Pacific Sonargaon Hotel, Dhaka, Bangladesh, 26 May, pp. 1-6.
- Newbery, David M. G., and Joseph E. Stiglitz. 1981. *The Theory of Commodity Price Stabilization: A Study in the Economics of Risk*. Clarendon Press, Oxford.
- Reardon, Tom. 2010. "Linking Food Market Transformation to Improved Food Security in Asia." Presentation at the ASEAN Food Security Conference, Singapore, June 17. Organized by Nathan Associates, Arlington, VA with support from USAID.
- Slayton, Tom, and C. Peter Timmer. 2008. "Japan, China and Thailand Can Solve the Rice Crisis—But U.S. Leadership is Needed," *CGD Notes*, Center for Global Development, Washington, DC. May, pp. 1-6.
- Timmer, C. Peter. 1996. "Does BULOG Stabilize Rice Prices in Indonesia? Should It Try?" *Bulletin of Indonesian Economic Studies* (Canberra), vol. 32, no. 2 (August), pp. 45-74.
- \_\_\_\_\_. 2004. "The Road to Pro-Poor Growth: Indonesia's Experience in Regional Perspective." *Bulletin of Indonesian Economic Studies*, Vol. 40, no. 2 (August), pp. 177-207.
- \_\_\_\_\_. 2005a. "Food Security and Economic Growth: An Asian Perspective." [Heinz W. Arndt Memorial Lecture, Canberra: The Australian National University, November, 2004] *Asian-Pacific Economic Literature*, vol. 19, no. 1 (May), pp. 1-17.
- \_\_\_\_\_. 2005b. "Agriculture and Pro-Poor Growth: An Asian Perspective." Working Paper No. 63. Center for Global Development, Washington, DC.

- \_\_\_\_\_. 2009a. *A World without Agriculture: The Structural Transformation in Historical Perspective*, Henry Wendt Lecture, Washington, DC: American Enterprise Institute.
- \_\_\_\_\_. 2009b. *Rice Price Formation in the Short Run and the Long Run: The Role of Market Structure in Explaining Volatility*. Center for Global Development Working Paper 172, May, pp. 1-46.
- \_\_\_\_\_. 2009c. "Do Supermarkets Change the Food Policy Agenda?" *World Development*, Special Issue on "Agrifood Industry Transformation and Small Farmers in Developing Countries," guest edited by Thomas Reardon, Christopher B. Barrett, Julio A. Berdegue and Johan F.M. Swinnen, (November). Vol. 37, No. 11, pp. 1812-19.
- \_\_\_\_\_. 2010a. "Reflections on Food Crises Past." *Food Policy*, Vol. 35, no. 1, pp. 1-11.
- \_\_\_\_\_. 2010b. "Behavioral Dimensions of Food Security." *Proceedings of the National Academy of Science* (special feature on agricultural development and nutrition security), electronic version published September 21).
- \_\_\_\_\_. 2010c. "Rice and the Structural Transformation." Prepared for the 50<sup>th</sup> Anniversary Volume of the International Rice Research Institute (IRRI), Los Banos, the Philippines.
- \_\_\_\_\_, 2010d. "Food Security in Asia: The Role of Larger Rice Reserves to Build Confidence in Trade." IFPRI Policy Note, June 9. Presented at the Bangladesh Food Security Investment Forum, 26-27 May, 2010, Dhaka.
- \_\_\_\_\_. 2010e. "Did Speculation Affect World Rice Prices?" in David Dawe, ed. *The Rice Crisis: Markets, Policies and Food Security*. Earthscan: London and Washington, DC., pp. 29-60.
- Timmer, C. Peter and David Dawe. 2007. "Managing Food Price Instability in Asia: A Macro Food Security Perspective," *Asian Economic Journal*. vol. 21, no. 1, (March), pp.1-18.
- Timmer, C. Peter, Steven Block and David Dawe. 2010. "Long-run Dynamics of Rice Consumption." Prepared for the 50<sup>th</sup> Anniversary Volume of the International Rice Research Institute (IRRI), Los Banos, the Philippines.
- von Braun, Joachim, and Maximo Torero, 2008. "Physical and virtual global food reserves to protect the poor and prevent market failure." *Policy Briefs 4*, International Food Policy Research Institute (IFPRI), Washington, DC.
- Williams, Jeffrey C., and Brian D. Wright. 1991. *Storage and Commodity Markets*. Cambridge, United Kingdom: Cambridge University Press.
- World Bank. 2005. *Managing Food Price Risks and Instability in an Environment of Market Liberalization*. Agriculture and Rural Development Department Report No. 32727-GLB. Washington, DC.

Wright, Brian D. 2009. "International Grain Reserves and Other Instruments to Address Volatility in Grain Markets: Issues and Options." Technical Background Paper for the World Grain Forum, May, Russia. University of California, Berkeley.