POLICIES FOR LONG-TERM FOOD SECURITY IN THE GREATER MEKONG SUBREGION

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Abstract

Food price trends over the last few years are contradicting decades of improved global food security and are especially threatening to the world's poor. In the Greater Mekong Subregion (GMS), extensive rural poverty persists, making a dual contribution to food insecurity. Because the poor spend the majority of their income and effort on subsistence, food price uncertainty is a paramount livelihood risk. Secondly, smallholder farm production remains dominant in the GMS. For a variety of reasons, however, smallholder productivity and income potential remain well below their potential. This merely compounds food insecurity for both producers and consumers and denies the GMS a potent catalyst for poverty reduction and sustainable growth.

In this study, we review the state of knowledge regarding recent food price uncertainty, as well as the research literature on institutional and technological determinants of agricultural and food supply chain development. This background is then synthesized in a set of policy forecasts that assess opportunities for pro-poor agrofood promotion in the GMS. Our results show that the right combination of policies to facilitate market access, productivity growth, and more efficient regional investment patterns can deliver dramatically improved food security and livelihoods.

The main message of this research is straightforward. Across the GMS, and by extension across Asia, there are large disparities in market accessibility, agrofood productivity, and savings resources for enterprise development. Policies that overcome these disparities can strongly stimulating agrofood development in ways that are economywide and pro-poor, increasing rural incomes and lowering food costs for urban populations. Investments in infrastructure and institutional reform can help remove the hard and soft barriers to greater market integration (agrofood and otherwise). Expanded agrofood research and extension services can accelerate regional agrofood productivity growth. Finally, more extensive regional capital allocation (via FDI) can shift underperforming investment resources (savings in higher income countries) to develop underperforming agrofood resources (in lower income countries and subnational localities). The result will be higher regional agrofood productivity, with higher commensurate returns to agrofood investment, and a strong pro-poor development stimulus. Poorest countries and areas have the most to gain in percentage terms because their resources have the lowest initial productivity and their domestic savings are lowest.

1. Introduction

After two generations of rising global agricultural productivity and falling average food prices, the last five years have seen disturbing signs of reversal. Surging food prices in 2007-2008 drew attention to food security issues around the world and particularly in South and Southeast Asian economies. About half the world's population, the poorest, have to commit about half their average incomes to food expenditure. This results in increased numbers of people experiencing nutrition vulnerability worldwide and worsened economic conditions in the poorest countries.

These trends are of special significance to the Greater Mekong Subregion (GMS) for two reasons. Although it include some dynamic emerging economies, the GMS is still characterized by extensive rural poverty and consequent high vulnerability to food price risk. Just as importantly, however, the GMS countries have unrealized agrofood potential that is among the world's highest. The region delineated by the Mekong River has great agricultural potential, BUT productivity of the smallholder farming population that dominates the area remains low. Moreover, poor infrastructure and institutional obstacles severely limit market access and agrofood supply chain development.

If these barriers can be overcome, increased demand in higher income Asian economies and higher food prices could support much higher agrofood production in lower income GMS countries and subnational regions, where agriculture is the primary source of livelihood. Higher agrofood productivity and improved market access could

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be potent catalysts for growth and poverty reduction, promoting sustained development and improved long-term food security.

This report surveys the state of knowledge regarding emergent food price risk, and then presents a series of long term policy forecasts showing how improved institutional change and agricultural productivity growth can transform the GMS into a dynamic agrofood exporter. The following section gives a brief profile of each of the GMS economies in terms of agrofood security. Section III the food price crisis of 2007-2008, review the literature on causes of high world food prices and discuss the possibility of another such crisis. Section IV surveys the research literature on agricultural productivity and its linkage with economic growth and development. Section V presents long term forecasts of GMS agrofood growth and development. The final section concludes.

2. Agrofood Security, Demand And Production: Overview From the GMS Perspective

Developing Asian economies were hit particularly hard by the 2007/2008 food price crisis. Sharp increases in rice and wheat prices threaten the food security of large segments of the population in developing Asian countries where large amounts of household income are allotted for food expenditure and rice and wheat represents a staple in the diet of the region. Faced with rice price increases in 2008 due to a variety of factors certain exporting countries, most notably India and Viet Nam, imposed restrictions on rice exports thus limiting supply in the global marketplace and pushing prices upwards. Meanwhile, large importers, such as the Philippines, were left scrambling for steady rice supply to avoid domestic shortfalls. A similar situation occurred in the global market for wheat in 2010.

This section elucidates the food security and food commodity demand situation in the GMS economies. China, source of the Mekong's headwaters, as the world's most populous country, is also the world's largest consumer and producer of agrofood products and thus holds the potential to greatly impact regional and global agrofood markets. The Cambodia, Lao PDR, Thailand, and Viet Nam each host the Mekong, Myanmar is embedded in the same regional watershed, and all these countries have distinct sub-regional agricultural conditions. The six GMS members also share two important characteristics in the present context: high vulnerability to food price volatility and significant unrealized potential for agricultural productivity growth. We summarize these initial conditions in this section.

2.1 Peoples' Republic of China (PRC)

Fan and Bzeska (2010) discuss the rapid increases in productivity that China has achieved over the past several decades due in large part to "major policy changes and reforms". From 1961 to 2004 production of maize, cotton, wheat and oilseed experienced average growth of 4 percent annually while rice production increased 2.8 percent annually. Area under harvest increased very little, or even experienced negative growth, as in the case of wheat cultivation while crop yields grew indicating higher rates of agricultural productivity (Fan & Brzeska: 2010).

As of 2009 China was able to meet over 95 percent of its demand for wheat, maize and rice with domestic production (ESCAP: 2009). Despite China's impressive agricultural productivity increases the country holds 25 percent of the world's population with only 7 percent of the world's arable land (Jha *et al.*: 2010). Rising incomes have resulted in an emerging middle class with increasing demand for agrofood products. For example, in the years from 1999-2009 Chinese consumption of milk and dairy rose more than 500 percent. Additionally, the country imports approximately 40 percent of global soybean production (ESCAP: 2009).

If current trends continue it appears that demand in the PRC will outpace domestic production which presents an opportunity for producing countries to meet that demand and increase output. Growing demand for agrofood imports combined with experience of agricultural productivity enhancement gives China the tools and incentive to engage in trade enhancement with promising trade partners. Investment in, and technology transfer to, agricultural supply chains in producing countries combined with tremendous market access may be a boon to agricultural production in the region.

2.2 Cambodia

GDP growth in Cambodia has been strong in recent years averaging 9 percent growth annually before the 2009 global downturn (ADB: 2009a). In 2009 the economy contracted by 2 percent (ADB: 2009a). Despite the robust economic growth Cambodia remains a poor country with more than 25 percent of the population living on less than US$1.25 per day as of 2007 (ADB: 2009a). The UN Development Program ranked Cambodia 131 of 177 countries placing it

among the poorest countries in the world (ADB: 2009e). Cambodia was hit much harder than Lao PDR by the 2007-2008 food crisis with the prices of rice and fertilizer doubling within a year while meat and fish prices rose a reported 30 to 60 percent (ADB: 2009e). The HLTF (2009b) estimates that the food price rises triggered an increase in the number of food-insecure people in the country by more than 50 percent to 2.8 million people. The impact of food price rises is particularly acute in Cambodia were food accounts for 60 to 70 percent or rural household expenditures with rice alone accounting for 40 to 50 percent (HLTF: 2009b). The lack of storage capacity, inadequate transportation linkages and poor access to market information are major barriers to the improvement of agricultural yields and food security in the country (HLTF: 2009b).

In Cambodia, as in Lao PDR, approximately 80 percent of the population lives in rural areas (FAO: 2011a). Also like Lao PDR, Cambodia's exports of maize have grown substantially over the last decade. In the early 2000s maize was not a significant export of the country and by 2008 maize had become the primary commodity export by value, exporting more than 311,000 tonnes (FAO: 2011c). Other major exports include rubber, palm oil and soybeans all of which are significant imports of the PRC (FAO: 2011c). In 2009 agricultural output expanded by approximately 4 percent with favorable rains cited as a primary cause (ADB: 2010). Aquaculture and marine fishing also increased substantially (ADB: 2010). The ADB estimates that in 2010 agricultural output will likely increase by approximately 4.7 percent (ADB: 2010).

Rainfed lowland rice is the primary crop in the country occupying approximately 69 percent of total cultivated area (Seng *et al.*: 2010). Seng *et al.* (2010) explore the possibilities of improved agricultural management strategies including irrigation strategies and crop diversification to increase yields in those areas with emphasis on the possibilities of poverty reduction through increased yields.

2.3 Lao PDR

Food security is a concern in Lao PDR where the FAO estimates that approximately 19 percent of the population is undernourished (FAO: 2011b). Just under 80 percent of the population lives in rural areas (ADB: 2010). Although the country has experienced strong economic growth since 1990 approximately one-third of the population remains below the national poverty line and as of 2002 44 percent of the population was living on less than US$1.25 per day (ADB: 2009a). According to World Bank data, although growing, GDP per capita in the country is US$940 (World Bank: 2011).

The UN System High Level Task Force for the Global Food Security Crisis (HLTF) reported in 2009 that impact of surging food prices of 2007-2008 was less severe in Lao PDR than in other countries in the region (HLTF: 2009c). The primary staple food in the country, domestic sticky rice, is not imported and thus less vulnerable to international price fluctuations. However other factors have contributed to rice price rises in the country such as severe flooding, a major outbreak of pests, US dollar inflation and rising fuel prices. Therefore, despite the barrier from the impact of global food prices the poorest segments of the population remain extremely vulnerable to domestic price fluctuations (HTLF: 2009c).

Within Lao PDR agriculture accounts for approximately one-third of GDP while employing over 70 percent of the workforce (ADB: 2010). ADB (2010) reported that in 2009 the agricultural sector grew by an estimated 2.3 percent. Increasing demand in China may offer opportunities to Lao PDR to ramp up agricultural production. Such demand has already resulted in a sharp rise in feed-maize exports destined to the PRC (World Bank: 2008). Maize and coffee are the two primary export commodities of the country (FAO: 2011c). Maize exports in particular have grown rapidly over the last decade rising from less than 1000 tonnes in 2000 to more than 126,000 tonnes in 2008 valued at more than US$14 million (FAO: 2011c).

Millar and Viengxay (2008) find that Lao PDR is in a favorable position to capitalize on rising demand for meat in neighboring countries, particularly China. The authors note that livestock plays a major role in the economies of rural communities and increased livestock production and demand for livestock products may significantly contribute to poverty alleviation in the country. For detailed discussion of this issue see Millar and Viengxay (2008).

2.4 Myanmar

Among GMS economies, the Union of Myanmar has the largest share of agriculture in GDP, comprising about 40% according to independent estimates (World Bank: 2011), as well as the highest population share of low-income smallholders, of all the GMS countries. Although Myanmar is classified by it's government as a food surplus economy[4],

[4] See http://www.fao.org/countries/55528/en/mmr/

sixteen percent of its 51 million population, or a total of 7.8 million individuals, suffer from undernourishment (last recorded 2007, down from 13.5 million in 2001, FAO: 2011). Moreover, subsistence production remains the dominant pattern of agriculture in the country. All these attributes make Myanmar a leading candidate for agriculture and food oriented development strategy.

The institutions and infrastructure needed for pro-poor agricultural promotion, as well as the facilitating mechanisms for larger scale agrofood supply chain development, are at the early stages of development in Myanmar. This fact, combined with historically high capacity for rice production and evidence of substantial unexploited agricultural potential, imply that the country could become an important contributor to regional food security and strongly support its own livelihoods improvement in the process.

2.5 Thailand

With an average per capita GDP of US$3,893 Thailand has a much more robust economy than other countries in the region such as Cambodia, Lao PDR, Viet Nam and Myanmar while a far smaller segment of the population (8.5 percent) lives beneath the national poverty line (ADB: 2009c; World Bank: 2011). Impressive growth in Thailand has contributed to decreases in the number of people undernourished in the country falling from 30 percent in 1990-1992 to 17 percent in 2003-2005 (ESCAP: 2009). The drought-prone area of northeastern Thailand presents a challenge for national food security (ESCAP: 2009). In 2010 According to an FAO GIEWS report a large area in northern, central and eastern regions were affected by insufficient rainfall and rice crops were below normal (FAO: 2010).

As the world's largest exporter of rice, Thailand experienced a positive impact to its terms of trade in the face of rising food prices (Headey: 2010). However, such price rises have the result of increasing farm incomes while adversely affecting the poor in non-farming sectors (FAO: 2010).

Agricultural production in Thailand contracted by 0.6 percent in 2009 due to price declines from the 2008 highs and pest infestations (ADB: 2010). Meanwhile, the country experienced sharp declines in manufactured and agricultural exports (ADB: 2010). It is expected that this trend will reverse as global demand and food prices rise again. Food insecurity in Thailand remains less acute in comparison with its Southeast Asian neighbors. The FAO (2010) noted that the food security situation in Thailand was "satisfactory" as of March 2010.

2.6 Viet Nam

Export restrictions imposed by Viet Nam are widely believed to have played a significant role in the surging of world rice prices during the 2007-2008 food crisis (Headey: 2010). Viet Nam is the second largest exporter of rice and therefore such export restrictions can have a major impact on world markets. According to the ADB (2010) the agricultural sector (including forestry and fisheries) in Viet Nam grew in 2009 by a weaker than normal rate of 1.8 percent, however increased external demand is expected to increase growth in agriculture and manufacturing in 2010 and 2011.

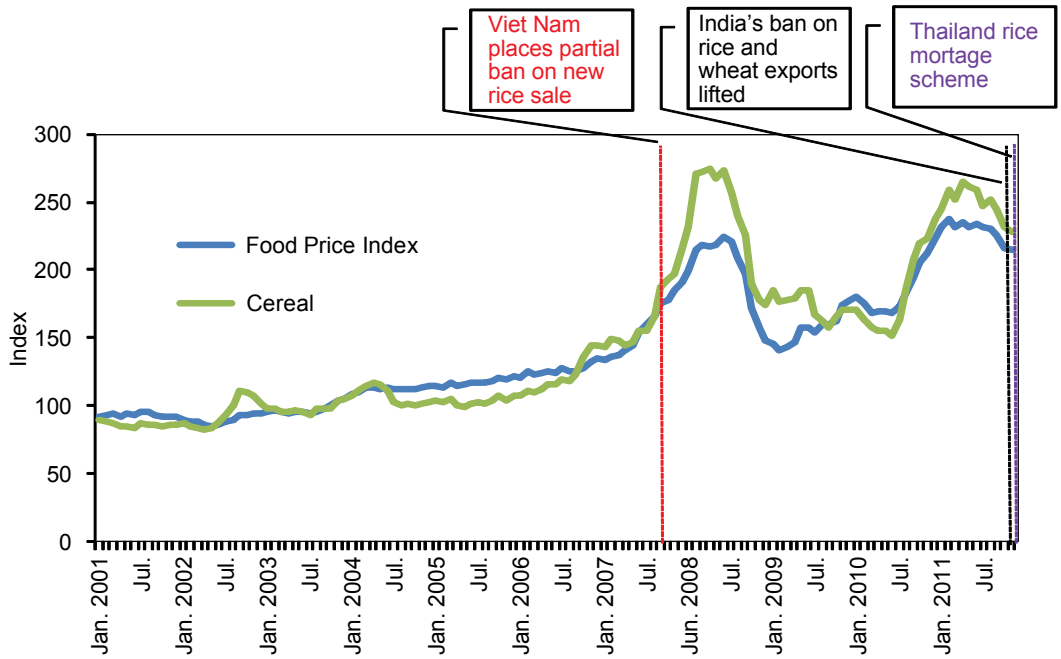
The food security situation in Viet Nam has improved dramatically over the past two decades. In 1990-1992 approximately 31 percent of the population was undernourished, a figure that fell to 14 percent by 2005 (ESCAP: 2009). GDP growth has averaged 7.1 percent between 1990 and 2009 and per capita GDP has grown from US$631 in 2005 to US$1,032 in 2009 (ADB: 2009d; World Bank: 2011). Incoming FDI has also risen dramatically in recent years which ranged from US$1.3 billion to US$1.8 billion in the 2002-2006 time period and reached US$9.3 billion in 2008. Despite this robust growth 21.5 percent of the population still lived on less than US$1.25/day in 2006 (ADB: 2009d).

3. Price Volatility and Food Security in the GMS

3.1 Summary of the 2007-2008 Food Crisis

Beginning in 2007 and peaking in mid-2008, food prices skyrocketed worldwide (see Figure 1). Many factors contributed to the price rise: Many countries' cereal stocks were depleted, causing increased demand for current production, biofuel's emergence, and the declining value of the dollar. However, policies also played a critical role in reinforcing adverse market conditions, which became significantly worse as major rice exporting countries began imposing restrictions on exports in an effort to control domestic rice prices. Countries that imposed export bans or other restrictions include Viet Nam, India, China, Egypt, and Cambodia (USDA: 2008). Thailand floated the idea of forming a rice cartel. Export restrictions also triggered "distress buying" (i.e. accelerated import contracts) by

Figure 1: Food Price Index and Cereal Prices 2001-2011



Source: Food and Agriculture Organization of the United Nations Statistics. http://www.fao.org (accessed 13 December 2011)

importing countries such as the Philippines, creating a "perfect storm" for soaring rice prices, which eventually peaked at over US$1,000/ton in April of 2008 (Brahmbhatt & Christiaensen: 2008).

Global demand for food has been increasing steadily for decades (see ESCAP: 2009 for historical details). One reason for sustained robust growth in demand for cereals has been increasing incomes in many countries in the Asia-Pacific region. With rising incomes many in the region are eating more meat, which requires escalating amounts of grain-fed livestock. "On a world average, each kilo of beef requires eight kilos of grain" (ESCAP: 2009).

Food production outpaced demand growth, causing a generation-long downward trend in food prices until the 2000s, when this trend reversed as production growth began to lag behind rising demand. World stocks of cereals began to seriously erode as consumption outpaced production for multiple years from 1999 into the early 2000s. During this time, world stocks of wheat, maize, and rice fell by 31 percent, 59 percent and 50 percent respectively resulting in the lowest level of worldwide cereal stocks in 30 years. This historical market transition instigated a new upward trend in food prices at the beginning of the last decade.

In addition to a lag in production, a sharp increase in global demand for grains was augmented by a rise in demand for biofuel which Brahmbhatt and Christiaensen (2008) claim contributed significantly to increases in grain prices. Governments around the world have encouraged production and use of biofuels due to concerns regarding oil prices, energy security and climate change. Increased demand for biofuel crops (maize, soybeans and palm oil) led to land use changes and reduced planting of wheat which resulted in depletion of world wheat stocks and sharp increases in world wheat prices (Brahmbhatt & Christiaensen: 2008). Increasing use of land for biofuel production, combined with increasing energy-intensity of agriculture and the use of natural gas as a primary input for fertilizer production has caused food prices to become increasingly linked to the prices of oil and gas.

Food price increases were 9 percent in 2006, 23 percent in 2007 and 51 percent "between January-June 2007 and January-June 2008" (ESCAP: 2009). The most rapid increases of late 2007 and January-April of 2008 were largely due to export restrictions of rice exporting countries. In September of 2007 Viet Nam, the second-largest rice exporter placed a partial ban on new sales. India, the third-largest exporter, followed with an imposed minimum export price in October. In December, China, a

mid-level exporter imposed a tax on rice exports. At the height of the crisis in March of 2008 Viet Nam, India, Egypt and Cambodia all imposed or re-imposed bans on rice exports (USDA: 2008).

This combination of export restrictions had a massive impact on world rice prices. Imposing export restrictions or export taxes may be a first response of a food-exporting country facing a rapid increase in food prices. The purpose of such policy is to control domestic rice prices and secure domestic rice supply. This may benefit domestic consumers however it will adversely affect domestic producers and consumers in food-importing countries and more broadly it can have an adverse impact on regional and global food security. This also creates a "domino effect" provoking other exporters to follow and importers to accelerate orders ("distress buying") (Brahmbhatt & Christiaensen: 2008).

High prices benefit the terms of trade of countries that export agricultural products and improve trade balances of such countries as was seen in Thailand. However, groups such as the rural landless and urban poor are negatively impacted by such price rises. In some countries, even farmers enjoyed relatively little benefit, much of the scarcity premium on cereals being captured by intermediaries. The poorest half of the world's population spends about half its household income on food, which makes them extremely vulnerable to food prices increases. During the 2007-2008 crisis such high prices contributed to "social turbulence or even food riots in over 30 countries.

3.2 Recent Research on Food Prices

Literature regarding the causes of the 2007/2008 food price crisis is now quite extensive, and interpretations of the causes of food price volatility are diverse, sometimes contradictory, and even contentious. Without advocating a specific perspective, we briefly review the analysis and evidence available to date.

Trostle (2008) and Abbott *et al.* (2008) survey the 2007/2008 food price crisis citing various factors contributing to sudden price escalation. Such factors include slow production growth concurrent with rapidly growing demand, biofuel production, adverse weather conditions of 2006 and 2007, the declining value of the dollar, rising energy prices, increasing costs of production in agriculture and policies imposed during periods of high food prices by exporting and importing countries to counter domestic food price inflation. Other comprehensive reviews include ADB (2008a), ADB (2008b), Heady and Fan (2008), Piesse and Thirtle (2009) and Von Braun (2008).

Timmer (2010) provides a review of the food price spike with particular focus on Asia and rice prices, noting the cyclical character of these crises. Focusing on rice prices and the impact this had on Asian markets Timmer asserts that "[p]anicked hoarding caused the rice price spike." Timmer (2009) offers an analytical model that could be implemented for determination of short-run rice prices. The author finds that using representative price elasticities (-0.1 for demand and 0.05 for supply) a "sudden and unexpected" 25 percent increase in global short-run demand for rice requires a 167 percent price rise to reach a new equilibrium.

In addition, Timmer (2010) discusses the work of Gardner (1979) that found price crises to occur roughly every three decades and notes that the 2007/2008 crisis follows 35 years after the 1972/1973 crisis, thus following very closely Gardener's observations of the cyclical nature of such events. Timmer argues that instead of focusing on short-term price signals policy must be oriented toward "stabilizing production around long-run consumption trends" and offers various suggestions for achieving such an objective.

First, investment in agricultural technology and productivity must take into account long-run consumption trends and notes that food prices "do not always send the right signals about investing in agriculture", a subject explored in greater depth in Timmer (1995). In addition, he argues for the increase of food grain reserves during times of surplus and the release of such reserves when prices rise. Timmer points to various studies that have illustrated problems with this approach, in particular when such a reserve is managed by an international agency (Newbery and Stiglitz: 1981; Williams and Wright: 1991; Wright 2009), and thus argues that such reserves are best managed on a national basis which other research has shown to be a more viable approach to stabilizing food prices (Rashid *et al.*: 2008; Timmer: 1996). Finally, recognizing the impact that the increase of biofuel production has on demand for agricultural products the author suggests that government discourage the use of food to make biofuel rather than subsidies and mandating of biofuel production that contributes to increased food prices.

There has been considerable disagreement over the role of biofuels as a driving factor of food price increases. Mitchell (2008) concluded that an increase in biofuel

production was the most significant factor contributing to food price increases between January 2002 and June 2008. The author purports that without such increase in demand for biofuel "global wheat and maize stocks would not have declined appreciably" nor would land use changes in wheat exporting countries favoring oilseed production have occurred to such an extent both of which contributed significantly to food price increases. The author finds that 70-75 percent of food price increases over this period is a result of biofuel production "and the related consequences of low grain stocks, large land use shifts, speculative activity and export bans." Mitchell points to various other studies that support the notion that biofuel production has been a primary driver of rising food prices such as Collins (2008). Conversely, one study by Mueller *et al.* (2011) finds that the role of biofuels in food price increases is very modest and points to other factors that contribute more significantly to such price rises. Such factors include increased energy prices, export policy changes, the declining value of the dollar, and lagging production in the face of increased global demand leading to diminished worldwide grain stocks.

Heady (2010) explores the role that trade events played in food price rises. The author provides a trade-based explanation of the crisis emphasizing the role that supply and demand shocks played in the 2007/2008 crisis. Contrary to studies such as Robles and Cooke (2009) and Timmer (2010), Heady finds that such supply and demand shocks do fully account for the rapid increase in food prices experienced during the crisis.

The work of Esmaeili and Shokoohhi (2011) elucidates the effect that oil prices have on food price indices. Through the application of a principal component analysis (PCA) model the authors find that crude oil prices indirectly affect food prices. Additionally, the authors reference other recent works that have contributed to the understanding of this relationship including Abdel and Arshad (2008), Chen *et al.* (2010), Gohin and Chantret (2010), Srinivasan (2009), Tokgoz (2009), and Zhang *et al.* (2010).

According a study by Brahmbhatt & Christiaensen (2008) rising energy and fertilizer costs and the decline in value of the dollar have contributed to some 35 percent of food price rise. Higher fuel costs to supply agricultural machinery, irrigation system and transport increase the cost of agricultural production, as does the increase price of fertilizers in whose production energy is a major input. Other studies have claimed that decline in the value of the dollar increases dollar commodity prices with an elasticity of 0.5 to 1.0 (Baffles: 1997; Brahmbhatt & Christiaensen: 2008).

Looking to the future Abbott *et al.* (2009) discusses food price volatility in the context of a global recovery from the recession. The authors note that it is likely that high food prices may return as the global economy recovers. Specifically, inflation, oil price rises and a decline in the value of the dollar have the potential to reemerge along with a recovery providing conditions that may make further food price increases likely.

3.3 Short Term Risks of another Food Crisis in the Region

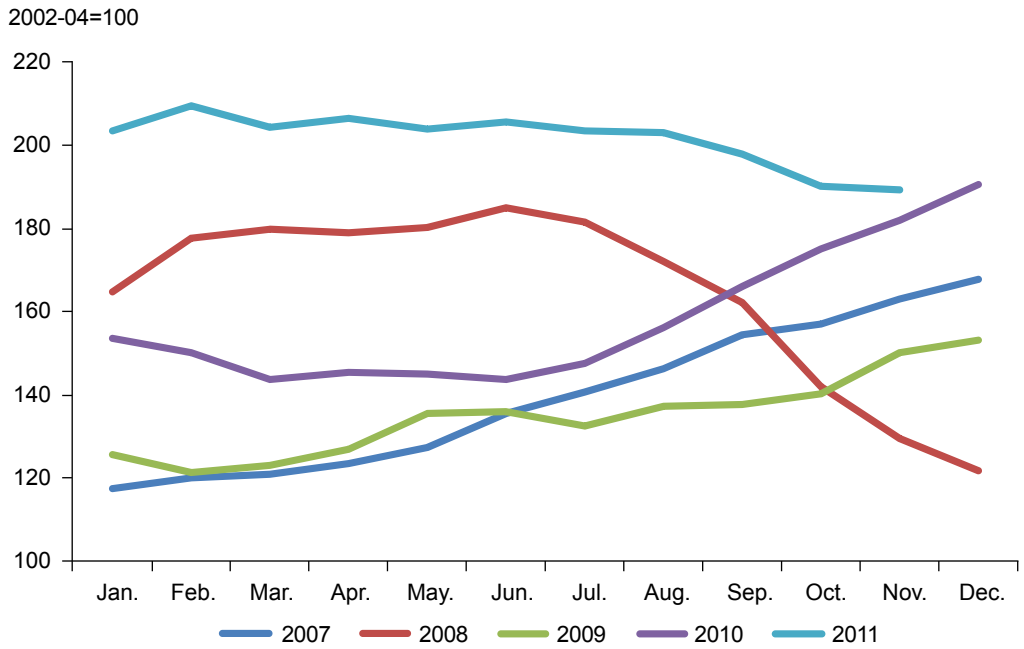
Food prices eased as the global economy slowed into recession in 2008 and by early 2009 prices were back down to levels of 2006 (in real terms) (ESCAP: 2009). However, it is widely speculated that as the global economy comes out of recession, oil and food prices are likely to rise again. The final quarter of 2010 and January 2011 have already seen rapidly rising food prices (see Figure 1). Escalation across the year has been a norm in recent years (except for unwinding in 2008). While 2011 began at very high levels and food prices subsided thereafter, they have remained stable and higher than the levels observed one year ago (Figure 2). Moreover, trends in the last year have been sharply higher than the first half of the decade across most major staples (Figure 3).

The current global wheat outlook does not appear to be favorable. Sustained export bans in Russia, last year's flooding in Canada, and drought conditions in China may converge to put considerable upward pressure on global wheat prices. Such concerns were articulated in a recent FAO (2011e) GIEWS Special Alert. Low precipitation in the major wheat producing areas of China has endangered the potential harvest and the impact could be devastating. If China is required to meet a significant proportion of its domestic needs with imports the demand shock to the world market will be felt worldwide.

3.4 Long-Term Risks to Food Security

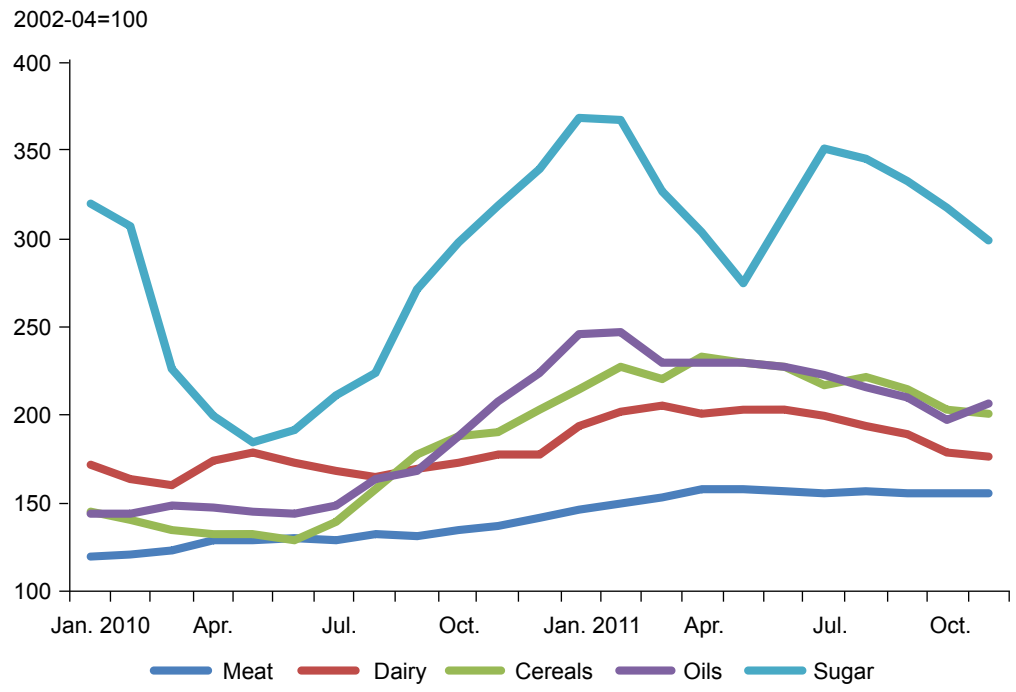
Although agrofood prices over the last decade have exhibited volatility for a variety of reasons, long term global capacity to meet nutritional needs will be determined by more fundamental issues. Among these, the most prominent are population growth, technological change, and the capacity of the natural resource base to sustain food production in concert with demand growth. As

Figure 2: Monthly Real Food Price Index by Year



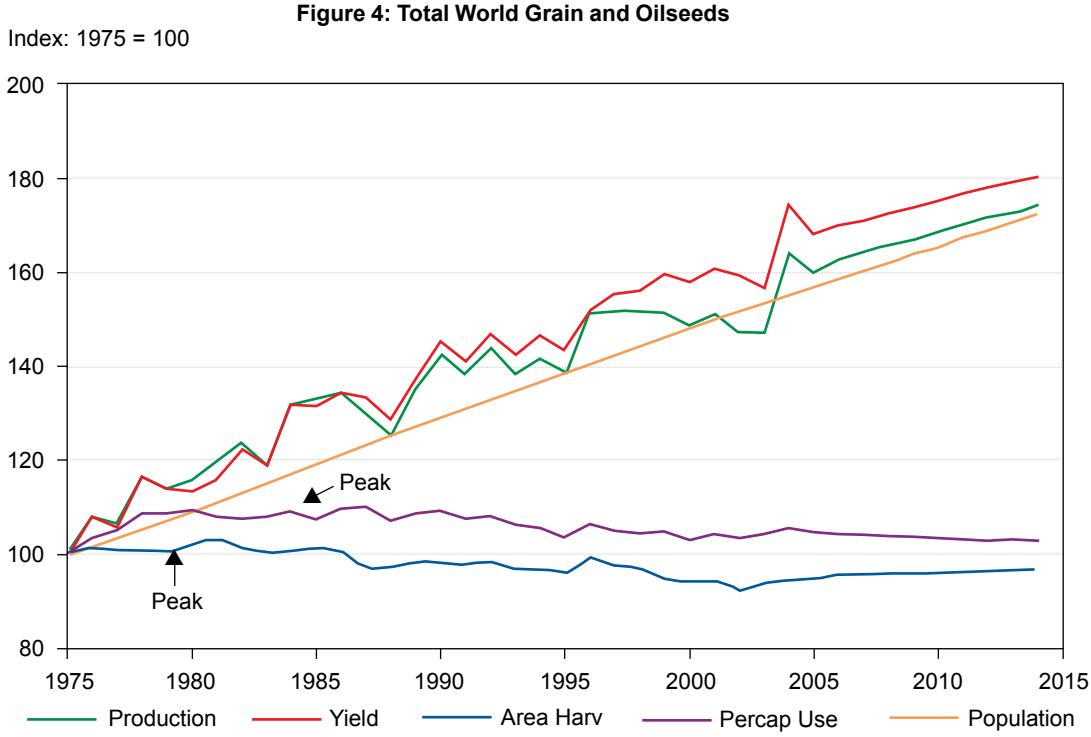
Source: Food and Agriculture Organization of the United Nations Statistics. http://www.fao.org (accessed 13 December 2011)

Figure 3: Monthly Real Food Prices Indexes



Source: Food and Agriculture Organization of the United Nations Statistics. http://www.fao.org (accessed 13 December 2011)

Figure 4: Total World Grain and Oilseeds



Source: USDA.

Figure 4 makes clear, our historic successes in this regard have come from a stable resource base and ever rising agricultural yields.

As Figure 4 indicates, the world managed its food security with relatively modest annual productivity increases, averaging 2-2.3 percent per annum since the 1970s. Whether or not this will be sufficient for the future depends on several factors. The first of these will be population growth, which is slowing globally, but at varying speeds (Table 1). If humankind can moderate its growth to total about 9 billion people, this growth will have converged to about 1% per annum. In this case, food production for today's diets could be sustained with historical yield growth. However, large emerging economies are rapidly changing their food consumption patterns, in particular shifting toward meat and specialty crops. These agrofood products are much more resource intensive, and if such trends are to be sustained much higher yield growth may be required. This the main threat to food security from the demand side is not really the standards Malthusian challenge of population but changing taste and rising purchasing power.

On the supply side, long term threats to food security are dominated by climate factors, particularly water availability and attendant risks that can be expected from rising average global temperatures. The leading global climate models have somewhat divergent views regarding temperature and precipitation trends (Figures 5 and 6), yet conclusions regarding global agricultural yields are more harmonious because of the prominence of the so-called CO_2 fertilization effect. Generally speaking, temperature and precipitation trends will induce shifting of agricultural capacity, mainly from equatorial to polar latitudes. Increased CO_2 concentrations, however, will have a more uniform and positive yield effect, moderating local adverse consequences and amplifying benefits.

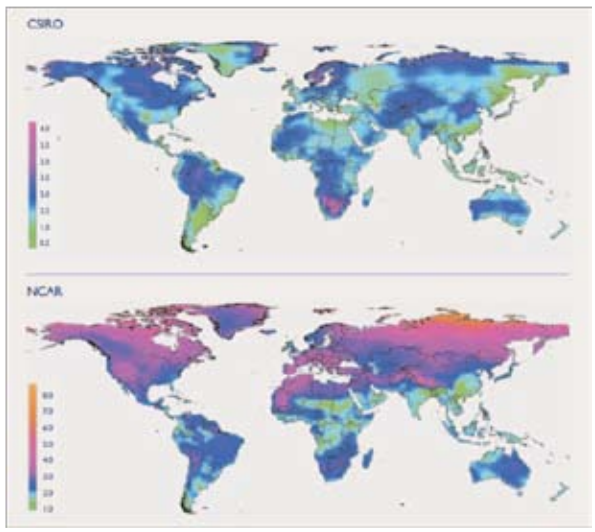
As Table 2 shows, despite significant estimated changes in temperature and rainfall patterns, increased CO_2 concentration will spontaneously contribute to agriculture yields in a way that significantly or in some cases fully offsets agricultural resource productivity declines. While these results give comfort to many who are concerned about the impact of climate change on global food security, it must be emphasized that the same research suggests that food prices will rise substantially during the same period, a predictable market response to animate needed resource shifting for adaptation in this sector.

Table 1: Global Population

	Total population (millions)					
	2000	2010	2020	2030	2040	2050
North America	306	337	367	392	413	430
Europe & Russia	752	762	766	761	748	729
Pacific OECD	150	153	152	148	142	135
Africa, sub-Saharan	655	842	1,056	1,281	1,509	1,723
Latin America	505	574	638	689	725	744
Middle East & North Africa	303	370	442	511	575	629
Asia, East	1,402	1,500	1,584	1,633	1,630	1,596
Asia, South/South East	1,765	2,056	2,328	2,553	2,723	2,839
Rest of World	210	233	249	262	272	280
Developed	1,141	1,177	1,202	1,211	1,210	1,198
Developing	4,696	5,417	6,132	6,758	7,257	7,627
Rest of World	210	233	249	262	272	280
World	6,047	6,827	7,582	8,231	8,739	9,105

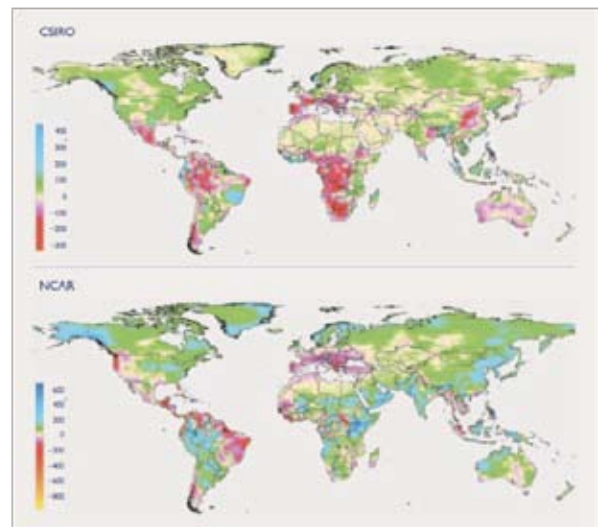
Source: United Nations.

Figure 5: Average Annual Temperature Change: 2000-2050 (centigrade)



Source: Nelson *et. al.* (2009).

Figure 6: Change in Average Annual Precipitation: 2000-2050 (mm)



Source: Nelson *et. al.* (2009).

4. Agrofood and GMS Development

4.1 Agrofood Potential and its Realization

The differential between actual, realized agricultural production and maximum potential agricultural output given available technology, current genetic material and proper management is referred to as the "yield gap". Achieving maximum yields depends on many factors among which farmers ability to access seeds, water, nutrients, pest management, soils, biodiversity and knowledge is extremely important (Godfray *et al.*: 2010).

Increasing agricultural productivity in low-income countries thus narrowing the yield gap has the potential to greatly improve rural incomes and contribute to enhanced food security and therefore has been the focus of a significant amount of economic and scientific research.

Technical constraints often contribute to large yield gaps in low-income rural communities. Godfray *et al.* (2010) note that economic conditions may prevent food producers' access to (1) "the technical knowledge and skills required to increase production"; (2) "the finances required to invest in higher production (e.g. irrigation, fertilizer, machinery, crop-

Table 2: Impacts of Climate Change on Cereal Production, with and without CO_2 Fertilization

	Change in cereal production compared to the Reference scenario (percent)											
	Hadley A2				CSIRO A2				Hadley A2, without CO_2 fertilization			
	2020	2030	2050	2080	2020	2030	2050	2080	2020	2030	2050	2080
North America	1.9	-2.9	-2.9	-0.8	2.8	0.1	5.8	7.1	0.9	-3.9	-4.6	-4.8
Europe & Russia	0.8	2.0	1.8	1.5	0.5	1.7	1.0	3.1	0.1	1.0	0.1	-1.1
Pacific OECD	-2.2	2.4	9.5	14.0	2.5	6.0	7.0	18.2	-1.8	2.8	9.3	13.6
Africa, sub -Saharan	-1.3	0.3	-2.0	-2.5	-0.6	0.4	-2.9	-7.2	-0.9	0.6	-2.0	-2.2
Latin America	0.9	4.7	5.5	6.0	1.3	3.5	-0.7	0.9	1.3	5.0	6.4	8.0
Mid East & North Africa	-0.5	0.7	1.1	-1.0	5.2	7.7	7.4	-1.0	-0.7	0.3	0.3	-2.2
Asia, East	0.1	0.7	2.0	-2.8	-2.2	-2.8	-3.4	-7.2	-0.6	-0.4	0.2	-5.3
Asia, South/Southeast	-1.3	-1.3	-3.7	-12.2	-4.8	-5.9	-8.9	-12.8	-1.6	-1.9	-4.6	-13.2
Rest of World	-1.6	-1.7	-3.1	-4.6	-2.4	-2.8	-3.4	-4.6	-2.6	-3.4	-6.1	-9.0
Developed	1.2	-0.7	-0.3	0.5	1.7	1.1	4.2	5.9	0.3	-1.7	-2.0	-2.8
Developing	-0.3	0.7	0.2	-3.9	-1.8	-1.8	-4.2	-7.3	-0.6	0.2	-0.6	-4.9
World	0.3	0.1	-0.2	-2.2	-0.4	-0.6	-0.8	-2.1	-0.3	-0.7	-1.4	-4.3

Source: Fischer (2009).

protection products, and soil-conservation measures)" or (3) "the crop and livestock varieties that maximize yields". Additionally, after harvest or slaughter, food producers in low income communities may not have access to proper storage facilities or transportation infrastructure connecting them to markets (Godfray *et al.*: 2010).

In Neumann *et al.* (2010) the authors undertake a spatial analysis of global grain production. The authors estimate global yield gaps by applying a stochastic frontier production function. Closing the yield gap is widely referred to as "intensification". Lambin *et al.* (2001) define three discrete triggers of the intensification process: (1) land scarcity, (2) investment in agriculture, and (3) intervention of government, inter-governmental or non-governmental organizations (NGO) initiatives to encourage development. However practical achievement of intensification is highly complex and defining specific measures to facilitate increased agricultural production is highly site-specific (Godfray *et al.*: 2010).

According to some estimates, in parts of Southeast Asia where adequate irrigation is available "average maximum climate-adjusted rice yields are 8.5 metric tons per hectare, yet the average actually achieved yields are 60 percent of this figure" while "similar yield gaps are found in rain-fed wheat in central Asia" (Cassman: 1999; Godfray *et al.*: 2010). Despite seemingly large yield gaps in Asia significant progress has been made in agricultural productivity. In terms of per capita food production, Asia has increased approximately twofold, however when China is considered independently this has increased by a factor of nearly 3.5 (Godfray *et al.*: 2010). However, great potential remains for increasing intensification in the region.

Improving the use of nutrient inputs is a significant factor in increasing yields and closing yield gaps. Buresh (2010) discusses scientific principles that have resulted from over a decade of research with rice in Asia regarding site-specific nutrient management. The author discusses how such principles enable determination of crop needs of pre-season and within season crop needs of fertilizer nitrogen, phosphorus and potassium rates to ensure maximum yield and sustainable soil fertility.

Irrigation is a vital component of agriculture production. In much of the developing world crop systems are rain-fed. Lobell *et al.* (2009) find that yields in most irrigated wheat, rice and maize cropping systems are generally near 80 percent of potential while rain-fed systems are often at 50 percent or less of potential. Investment in improved irrigation networks in low-income countries holds great potential for improvement of crop yields and thus greater agricultural productivity. Recent work of Alauddin and Quiggin (2008) emphasizes the need for a multi-faceted, comprehensive policy approach to intensification of agriculture in the developing world. Improved irrigation and intensification of agriculture has the potential to increase economic growth but environmental and ecological externalities must be assessed in order to achieve sustainable agriculture yields and economic growth.

Inadequate transport infrastructure and market access can raise the price of inputs and increase the price of

moving agricultural produce to markets, resulting in lower returns which may lessen or reverse economic incentives to increasing agricultural production (Godfray *et al.*: 2010). Improvement of transport networks has the potential to greatly reduce the costs of agricultural production and if such outlets are available in many areas this will incentivize greater productivity.

4.2 Agriculture and Development: Recent Insights from the Research Literature

Agriculture in developing countries accounts for an extremely large share of employment and GDP. Also in developing countries productivity in the agricultural sector is often quite low relative to other sectors. Therefore increasing the share of agricultural sector within the economy will not necessarily lead to economic improvement. If labor and capital are allocated to less productive activities this may be disadvantageous to overall economic performance. Beginning as far back as Adam Smith theories of sectoral transformation have recognized that economic growth is accompanied by a movement of labor and other resources into other activities, some so-called "agro-pessimists" argue that development assistance actually suffers from an overemphasis on agriculture (Gollin: 2010). Godray *et al.* (2010) argue that there exists a balance that must be weighed in "investing in overall economic growth as a spur to agriculture and focusing on investing in agriculture as a spur to economic growth".

Whether or not increases in agricultural productivity will lead to economic growth is very important in decisions of develop-ment agencies in targeting assistance to low income countries. For instance, if output per worker is greater in nonagriculture sectors in a particular country, then movement of labor out of agriculture and into more productive activities can be a source of economic growth. This was the view held by early development literature such as the work of Lewis and others (Rosenstein-Rodan and Rostow) which held that industrialization was necessary for modern economic growth. Such views held that subsistence agriculture represented a pool of reserve labor while the challenge for development was to expand the modern industrial sector which would then absorb such workers (Gollin: 2010).

A differing view in early development literature claimed that many low-income economies suffered from what T. W. Schultz referred to as the "food problem". In such a situation a "critically" high proportion of household income is spent on food, a situation that he termed "high food drain". Such a view holds that until a country can produce enough food products to satisfy its subsistence needs modern economic growth will not be possible (Gollin: 2010).

Not all economic theorists hold this view. There are many that have argued that increases in agricultural productivity can have a significant role in economic development. Dating back to the 1960s economists such as Mellor, Gardener and Johnston have developed models and theories indicating that increases in agricultural productivity may lead to more rapid economic development (Gollin: 2010). Mellor (1995, 1996) building on theories in early development literature of T. W. Schultz argued that agricultural productivity growth lead to a linked set of positive development impacts. This "linked set of impacts" is described by Gollin (2010):

- Increases in farm income and profitability, resulting in improved welfare of farmers and the rural poor
- Declining food prices, benefiting poor rural and urban consumers, including small farmers who might be net purchasers of food
- Reductions in the nominal wage, consistent with increases in the real wage, allowing the industrial sector to reduce costs
- Increases in the domestic demand for industrial output
- Increasing competitiveness of both agricultural and industrial exports, with positive impact on hard currency earnings
- Expansion of the domestic industrial sector, pulling labor and investment resources out of agriculture

As Gollin (2010) describes "the Mellor hypothesis" is a theory under which "agricultural productivity is necessarily the source of long-run economic growth".

Fan (2002), Fan & Brzeska (2010) and Fan *et al.* (2004) discuss the impact of investment in various factors that lead to increases in agricultural productivity and the degree to which they have resulted in economic development. The factors discussed in this work include agriculture R&D, irrigation, education and rural development. Their results found that agriculture R&D had the largest impact on agricultural GDP growth.

Certain cross-section and panel data analyses which use various econometric techniques have been employed in recent research that have found significant correlation between increased agricultural productivity and economic development (Gollin: 2010). The recent work of Self and Grabowski (2007) uses such techniques and finds strong correlation between agricultural productivity rates and rises in per capita incomes and human development indexes (HDI).

Other methods that have been employed in recent years to analyze relationships between agricultural productivity growth and economic development include computable general equilibrium (CGE) models, development accounting, growth accounting and productivity measurement. For more information on such research see Fan (2010), Gollin (2010) and Jha (2010).

Many authors have argued that trade liberalization is a major contributor to economic growth particularly in the agricultural sector (Anderson *et al.*: 2005; Anderson & Martin: 2005; Bandara: 2007). The World Bank (2008) describes three main "types of instruments" that distort trade: (1) market access (i.e. import tariffs and quotas); (2) export subsidies; and (3) domestic support. Low-income countries often "impose relatively high taxes on farmers in the export sector as an important source of fiscal revenue, while developed countries tend to heavily subsidize farmers…These differences often create a policy bias against the poor in both domestic and international markets" while such subsidies in developed countries have the effect of depressing agricultural output in developing countries (World Bank: 2008).

Agriculture has been greatly protected worldwide and has been a major issue in World Trade Organization (WTO) negotiations. In particular it was a primary issue under the Doha Development Agenda (DDA). Bandara (2007) estimates that global welfare gains of the Doha agricultural liberalization scenario would amount to approximately US$74.5 billion by 2015 with 44 percent of the gains (US$32.6 billion) being enjoyed by countries in the Asia-Pacific region. However, the countries with the largest gains under this scenario are Thailand and high-income countries such as Japan, Korea, Taiwan, Australia and New Zealand with very small gains or losses occurring in other countries. Thus, this alone does little to contribute to income convergence in the region. Alternative assessments of the benefits of agricultural trade policy under the DDA include Hertel and Keeney (2005) and Antimiani *et al.* (2005).

The China-ASEAN Free Trade Area went into effect on January 1: 2010. Covering an area with a population of 1.9 billion people this is the largest free trade area in the world on a population basis and it is third only to the EU and NAFTA in terms of economic value (ASEAN: 2011). Trade is expected to increase in the region and regional integration may offer benefits of more efficient capital allocation and greater market access for lower income agrofood exports.

5. Long-Term Scenarios for GMS Food Security

5.1 Scenarios

After assessing food price risk and the state of knowledge regarding agrofood development, our next objective is to empirically evaluate the prospects for improving food security in the GMS. To do this, we consider three archetype scenarios, representing the leading policy challenges to lasting food security and prosperity. In particular, we consider three sources of greater efficiency and productivity for the region, namely, reduction in barriers to domestic and transboundary market access, higher R&D and increased FDI inflows.

Our empirical results were obtained with a global dynamic CGE mode, calibrated to the GTAP 8 database and a baseline macro time series reflecting a business-as-usual (Baseline) scenario over 2010–2030.[5] This Baseline comprises consensus forecasts for real GDP obtained from independent sources (e.g. International Monetary Fund, Data Resources International, and Cambridge Econometrics). The model is then run forward to meet these targets, making average capital productivity growth for each country and/or region endogenous. This calibration yields productivity growth that would be needed to attain the macro trajectories, and these are then held fixed in the model under other policy scenarios. Other exogenous macro forecasts could have been used and compared, but this is the standard way to calibrate these models.

5.1.1. Facilitation of Trade and Market Access

Most agricultural households in rural Asia live behind real economic and institutional "walls" restricting domestic and transboundary market access. These include high transactions and transport costs, especially for low-income farmers, who are the overwhelming enterprise majority in rural areas. These logistical barriers are often compounded by infrastructure, institutional, and information constraints within and between GMS economies. As long as distribution margins remain high, low-income agro-food enterprises with relatively low value products will be prevented from accessing markets. Worse, they are trapped in this low

[5] This work represents an update of an earlier analysis by the same authors (see. Jha *et al:* 2010). Results are congruent, but stronger in both magnitude and reliability (based on a new global data set, GTAP 8). Unfortunately, data on the Myanmar are not extensive or consistent enough to be incorporated into the GTAP database, so this country must be omitted from the current scenario analysis. It should be emphasized, however, the most of the conclusions we obtain about pro-poor agrofood development would apply with equal or even greater force to this emerging economy.

level equilibrium by insufficient savings and incentives to invest in higher value, marketable agrofood products like livestock and non-subsistence, specialty crops. By converse reasoning, lowering market access costs and related margins can enlarge the horizon of profitable trade for all, increasing commerce, capturing value added, and promoting self-directed poverty reduction.

5.1.2. Productivity Growth in Agriculture and Related Food Industries

Because of this region's geographic diversity and substantial differences in stages of development, agricultural yields and productivity in livestock production vary tremendously across the GMS (compare global variation in Table 3). In most GMS economies, agrofood production is far below its ultimate potential. Because of relatively small-scale land tenure patterns, it is unlikely that rural households in these countries can achieve significant livelihood improvements unless output per hectare improves substantially, and migration trends imply that higher output per household member will also be essential to national food security.

5.1.3 Foreign Direct Investment

One of the defining characteristics of low-income economies everywhere is limited reserves of domestic saving, which in turn limits the progress of development by restricting investment in productive assets and enterprise expansion. The era of globalization has changed the nature of this constraint, however, with the advent of transboundary or Foreign Direct Investment (FDI) that permits low-income countries to leverage foreign savings for domestic investment, technological change, and growth. To help low-income GMS economies achieve their economic potential in the timeliest fashion, FDI can be an essential catalyst. The same logic applies to rural poor enclaves within middle-income GMS economies. Savings disparities between urban and rural areas are only partially mediated by migrant remittances and public rural development schemes. Improving domestic market access and smallholder productivity could accelerate private investment from urban to rural areas, and from large to small agrofood enterprise development.

Table 4 summarizes the three core scenarios – three external shock scenarios, followed by three scenarios representing structural change and/or policy adaptation. After detailed examination of baseline regional growth characteristics, these are thought to best represent the salient policy issues addressed in the present study.

5.2 Macroeconomic Results

In terms of overall economic impact, all three types of policy can contribute to GMS regional economic expansion, but in varying degrees. Table 5 summarizes our results for GDP growth, and we see substantial heterogeneity by both country and policy category.

Table 3: Average Annual Growth of Agricultural Output

	1970–1979	1980–1989	1990–1999	2000–2006
Sub-Saharan Africa	1.31	2.6	3.1	2.2
LatinAmerica and Caribbean	3.07	2.37	2.87	3.13
Brazil	3.83	3.73	3.29	4.41
Middle East and North Africa	2.94	3.37	2.73	2.34
Northeast Asia, High	2.15	1.03	-0.01	-0.01
Northeast Asia, Low	3.11	4.55	5.06	3.85
PRC	3.09	4.6	5.17	3.87
Southeast Asia	3.68	3.59	3.13	3.54
South Asia	2.56	3.39	3	2.19
India	2.69	3.52	2.94	2
North America	2.17	0.73	2.03	1.1
Oceania	1.79	1.25	2.93	-0.04
Western Europe	1.54	0.94	0.46	-0.35
Eastern Europe	1.8	0.25	-2.18	-0.19
Russian Federation	1.32	0.98	-4.62	2.7
Developing countries	2.82	3.46	3.64	3.09
Developed countries	1.88	0.86	1.21	0.39
Russian Fed. & Eastern Europe	1.47	0.77	-3.88	1.81
World	2.23	2.13	2.04	2.22

Source: United States Department of Agriculture, World Bank.

Table 4: Generic Policy Scenarios

1. Infrastructure Investment and Trade Facilitation (TTT):	Assume that investments and institutional changes effect a 50% reduction in trade, transport, and transit (TTT) margins for Asian countries. Meanwhile, Asia is also assumed to achieves abolition of nominal trade distortions (import taxes and subsidies) across the region.
2. Agro-Food Productivity (AgProd):	Assume that total factor productivity grows at 4% annually in agriculture and food processing sectors. Includes Scenario 4.
3. Foreign Direct Investment (FDI):	In addition to Scenario 2, assume that, for DMC's, the stock of FDI rises to at least 15% of GDP by 2030. Includes Scenario 5.

Notes: Scenarios are inclusive from 1-3.
FDI = foreign direct investment

Generally speaking, these results are consistent with intuition and a large body of related work on regional trade, agrofood productivity, and investment. The most salient findings are summarized as follows:

- Reduction in trade, transport, and tariff margins (TTT) – As many studies of regional and global trade liberalization have already demonstrated, removing hard and soft institutional and price barriers to trade would realize substantial efficiency gains and increase regional incomes. The benefits depend on two factors: prior protection/margin levels, and export competitiveness. Many lower income countries would see greater gains because they face higher margins and trade barriers, yet they have significant initial domestic cost advantages. These results strongly support the argument that GMS regional trade facilitation is Pareto improving and promotes regional livelihoods convergence, small in overall impact, but more positive for poorer countries (Figure 7).
- Agrofood Productivity Growth (AgProd) - Given the importance of agrofood to incomes for most of the GMS poor, where rural dwellers still constitute a significant majority of total population, it is hardly surprising that rising productivity for agrofood has a dramatic effect on regional real GDP.[6] Because higher income countries are more diversified and less impacted on the income side, the aggregate impact is modest, but again we see much larger benefits for lower income economies. Even moderate productivity growth like that specified in Scenario 5 would increase cumulative GDP significantly in the GMS and other DMCs.[7] Here we also see a distinct Pareto impact, improving real incomes across the region, but most so among lower income economies.
- Greater Asian Regional Foreign Direct Investment (FDI) - More intensive and extensive use of FDI within and across the GMS would sharply increase long term growth prospects for the region. These monies significantly increase real growth rates, particularly in lower income countries, in most cases more than doubling the benefit of agrofood productivity growth. Overall, they contributed to more than USD20 trillion in additional real GDP (Table 6). Clearly, regional allocation of investment resources can be a dramatic catalyst for regional agrofood productivity growth. The reason for this is the joint regional disparities in productivity and domestic savings. Re-allocating regional capital would significantly increase average regional yields, but most so in countries in lower income countries with initial low productivity where domestic savings are a serious constraint.

Table 5: Real GDP by DMC, Cumulative Percent Change 2010-2030

	TTT	AgProd	FDI
Cambodia	7%	27%	71%
PRC	1%	11%	24%
India	1%	15%	43%
Lao PDR	1%	59%	196%
Thailand	2%	17%	40%
Viet Nam	3%	22%	62%
Other DMC	1%	14%	41%
HiInc Asia	0%	2%	4%

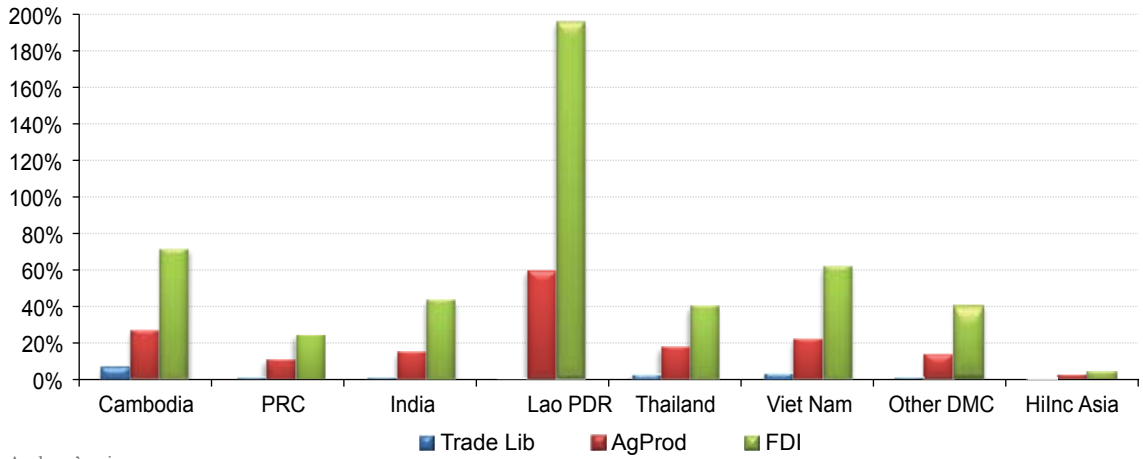
Notes: In this and subsequent tables, countries/regions are listed in order of increasing per capita income. Other DMC denotes the Rest of ADB Developing Member Countries.
Source: Authors' estimates.

The next three tables (Tables 7-9) give more detailed macroeconomic results for combinations of the generic policy scenarios. Results from a composite scenario of external risks (energy and food prices), combined with a first set of policy responses (regional trade facilitation), presented in Table 7, show that such regional integration

[6] See Jha *et al* (2010) for more on this aspect of growth, particularly its historical context.

[7] China's agrofood productivity was not increased in these scenarios because it is already at high growth rates in the baseline.

Figure 7: Real GDP by DMC, Cumulative Percent Change 2010-2030



Source: Authors' estimates.

Table 6: Real GDP by DMC, Cumulative 2010 USD Billions: 2010-2030

	TTT	AgProd	FDI
Cambodia	8	30	79
PRC	420	4,213	9,584
India	102	1,768	5,087
Lao PDR	0	23	76
Thailand	39	295	672
Viet Nam	23	157	439
Other DMC	81	1,346	3,947
HiInc Asia	79	1,148	1,789

Source: Authors' estimates.

is a credible "first line of defense" in the sense that it benefits every member country and some significantly so. Indeed, real GDP benefits understate the gains to Asian households, more accurately reflected in the Equivalent Variation (EV) income effects of the last column. Although consumption prices (CPI) increase because of the adverse shocks, trade facilitation expands income opportunities to more than offset this. Significantly if not surprisingly, trade volumes increase sharply for member countries, further accelerating regional integration.

The second line of policy initiatives, promoting agrofood productivity growth, dramatically increases the benefits of a more liberal regional trading environment (Table 8). Indeed, trade volume increases in many cases are multiples of that under simple trade facilitation (TTT). This clearly underlines the need for complementary policies to reap the full benefits of regional integration, particularly in a sector like agrofood, which has strong intersectoral linkages and pro-poor multiplier effects. In terms of incomes, we see very strong stimulus to both GDP and EV income for lower income economies, logically as these are still comprised of agrarian majorities.

On the demand side, this scenario is particularly significant because it shows the reversal of consumer price effects in many low income countries. This finding reminds us that household real income depend critically on food prices. Livelihoods protection and promotion, it is clear from these results, begins at the foundation of basic needs for the poor, food. We are also reminded here that rural development can benefit the urban poor.

Table 7: Trade Liberalization and Margin Reduction (TTT), Macroeconomic Impacts

(cumulative percent change: 2010-2030)

	GDP	Output	Exports	Imports	Cons	CPI	EV Inc
Cambodia	4%	6%	11%	19%	13%	2%	16%
PRC	1%	1%	8%	11%	2%	2%	5%
India	0%	1%	9%	12%	2%	2%	5%
Lao PDR	0%	1%	5%	13%	5%	4%	10%
Thailand	-2%	1%	3%	8%	8%	2%	11%
Viet Nam	1%	1%	9%	17%	13%	3%	17%
Other DMC	1%	1%	6%	11%	4%	2%	7%

Source: Authors' estimates.

Table 8: TTT and Agrofood Productivity Growth (AgProd), Macroeconomic Impacts

(cumulative percent change: 2010-2030)

	GDP	Output	Exports	Imports	Cons	CPI	EV Inc
Cambodia	22%	21%	14%	25%	45%	-4%	35%
PRC	10%	7%	1%	8%	19%	-1%	17%
India	16%	11%	22%	20%	20%	-4%	13%
Lao PDR	54%	53%	50%	39%	73%	-7%	54%
Thailand	9%	12%	19%	15%	19%	2%	22%
Viet Nam	21%	14%	24%	27%	33%	-1%	31%
Other DMC	15%	12%	16%	17%	19%	-2%	16%

Source: Authors' estimates.

Table 9: TTT, AgProd, and FDI, Macroeconomic Impacts

(cumulative percent change: 2010-2030)

	GDP	Output	Exports	Imports	Cons	CPI	EV Inc
Cambodia	64%	56%	23%	45%	99%	-10%	67%
PRC	28%	19%	-10%	21%	40%	-4%	34%
India	49%	32%	38%	67%	53%	-6%	40%
Lao PDR	186%	180%	122%	120%	222%	-13%	147%
Thailand	28%	29%	50%	24%	28%	2%	31%
Viet Nam	67%	43%	62%	54%	62%	-3%	53%
Other DMC	47%	34%	37%	41%	45%	-4%	35%

Source: Authors' estimates.

Policy complementarity between more open trade and higher agrofood productivity is also further amplified by expanded investment opportunity, as it plainly evident in the FDI results. Here we see strong growth across the entire region and most so among lower income, more saving-constrained economies (Table 9). FDI is of course not merely an income transfer, but an agent for labor/resource employment, technology transfer, and access to export opportunities. All three of these features act in synergy, especially where resources are relatively abundant and low cost. For this reason, reallocation of Asian financial reserves from lower growth, higher income economies can be expected to yield higher absolute returns, returns that can benefit both the investors and those in the destination countries. It remains an ironic fact that some of the destination countries of the last great race for emerging market investment (1990-2010) are now in a position to join the other side of this process, yet they have left large financial reserves at the starting gate.

In any case, increasing the depth and scope of FDI should be a high priority for GMS policy makers, particularly in an era of global growth uncertainty. Taken together, Asian economies are no longer small relative to their historical destination markets, and it is not realistic to expect high growth rates via rapid expansion of domestic market share in slow growing OECD economies. For this reason, the GMS represents a logical source of investment diversification for itself not only for the usual portfolio risk reduction benefits, but because the region represents most of the world's superior national growth rates already.[8]

5.3 Food Security

National policies in all countries are strongly influenced by the most basic forms of economic security, i.e. personal health, safety, and nutrition. In lower income countries, the risks associated with these basic needs are higher because a larger proportion of the population is economically vulnerable, not meeting basic needs, or worse. In countries with large poor urban populations, food vulnerability relates mainly to consumption goods, while for rural poor it affects income as well as consumption. We have seen above that the entire Asian region faces many uncertainties regarding food output and availability, and that there are many ways to measure the attendant risks. In this section we look at the long-term forecasts from this perspective.

We saw that trade facilitation, agrofood productivity growth, and greater FDI all have the potential to contribute substantially to GMS livelihoods. What they can do for food security is suggested first by the results of Table 10, which presents national changes in total agrofood output for each scenario and country/region analyzed. As above, we focus attention on the last three scenarios.

[8] See Roland-Holst and Weiss (2004), Roland-Holst *et al* (2005), and Roland-Holst and Brooks (2007) for extensions of these arguments.

The impact of trade facilitation on national agrofood output is ambiguous, as would be expected from the logic of basic Ricardian theory. Although regional trade facilitation increases efficiency and thus induces higher aggregate income in all member countries, simply removing trade distortions has the effect of intensifying pre-existing patterns of comparative advantage. Thus countries with established and emerging competitiveness, and low resource cost in rural areas, will see resources pulled from agriculture toward light and heavy manufacturing. Even countries like Thailand, with high levels of agrofood industrialization, are more constrained by trade margins and tariffs against other industries. When these come down, the latter expand at the expense of agrofood. This threat to agrofood competitiveness has been a persistent controversy in trade agreements, particularly between (heavy agro-subsidy) North and South partners, for decades.

Agrofood's loss of competitiveness is by no means inevitable, however, and the most constructive approach to realizing the aggregate gains from greater regional trade efficiency is to promote agrofood productivity growth as a complementary policy. When this is done (AgProd scenario), our results indicate that the benefits are uniformly positive across the region (Figure 9). In particular, even moderate productivity growth (4%/annum) is enough to reverse large adverse effects and achieve over 30% higher cumulative agrofood output in some countries by 2030.

The intuition behind this process is simple. Higher farm productivity not only keeps domestic agrofood production competitive, but it enables the release of labor resources to other sectors stimulated by trade facilitation, creating a win-win growth setting for both rural and urban sectors. Finally, higher levels of FDI consolidate these gains in both sectors, improving national efficiency, further raising labor productivity and real wages.

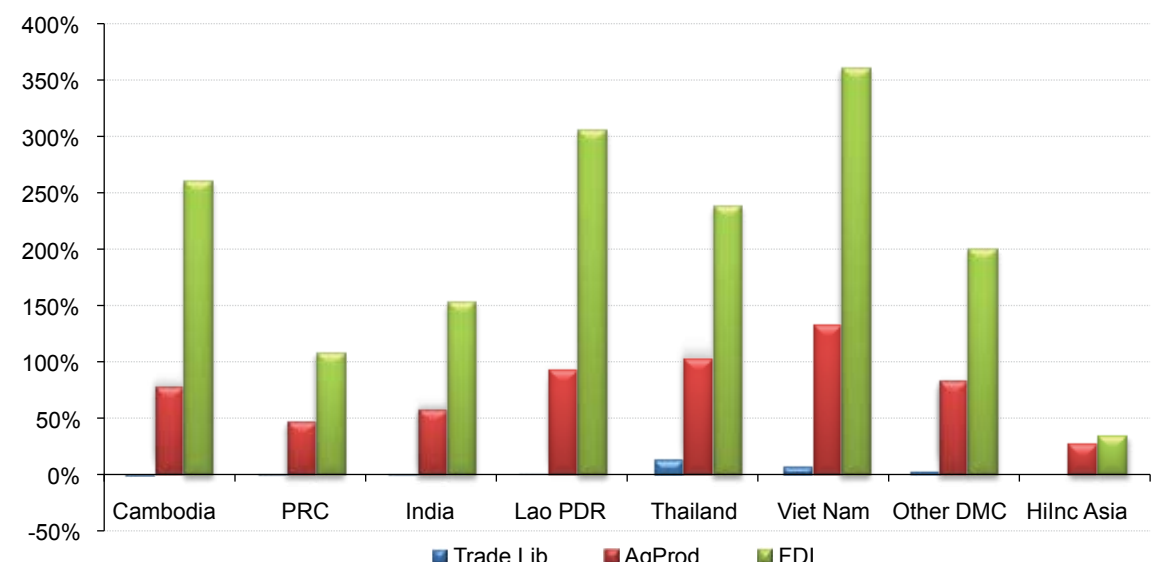
Table 10: Agrofood Output by DMC, Cumulative Percent Change 2010-2030

	TTT	AgProd	FDI
Cambodia	-1%	77%	261%
PRC	-1%	47%	108%
India	-1%	57%	153%
Lao PDR	0%	93%	306%
Thailand	13%	103%	238%
Viet Nam	7%	133%	360%
Other DMC	3%	83%	200%
HiInc Asia	0%	27%	35%

Source: Authors' estimates.

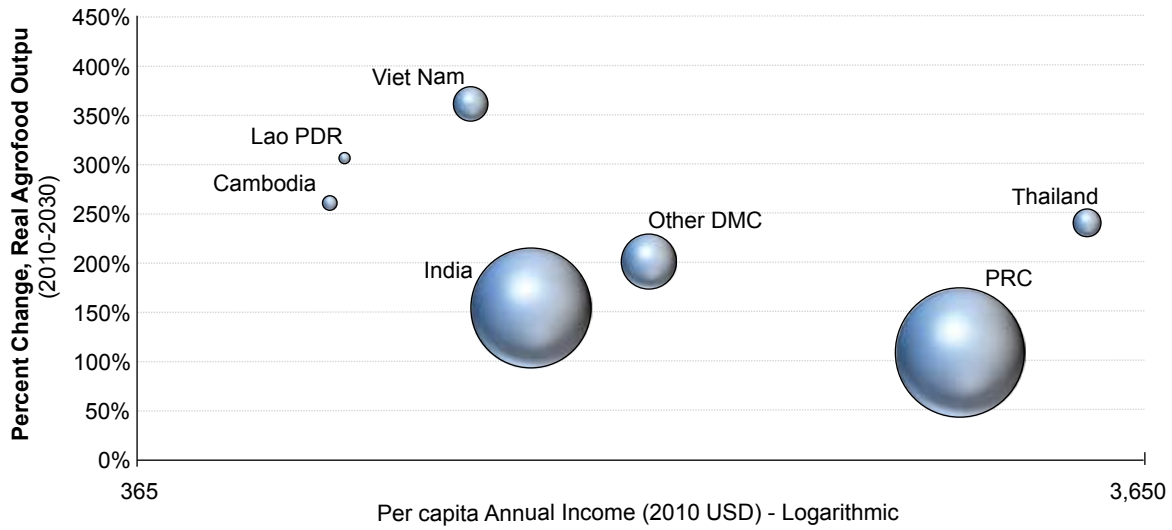
As discussion of adjustment mechanisms suggests, the primary agrofood benefits in these scenarios relate to more efficient recruitment of relatively low wage and low price resources in the rural sectors of low-income countries. This logic has a corollary that the policies should be pro-poor across GMS countries. We discuss the concept of regional economic convergence in a later section, but for the present consider Figure 10, which plots percent change in agrofood output against per capita income for the AgProd Scenario. Although outcomes vary for reasons other than average income levels, there is a clear downward trend in these national results, particularly when weighted by population.

Figure 9: Agrofood Output Changes, cumulative percentage: 2010-2030



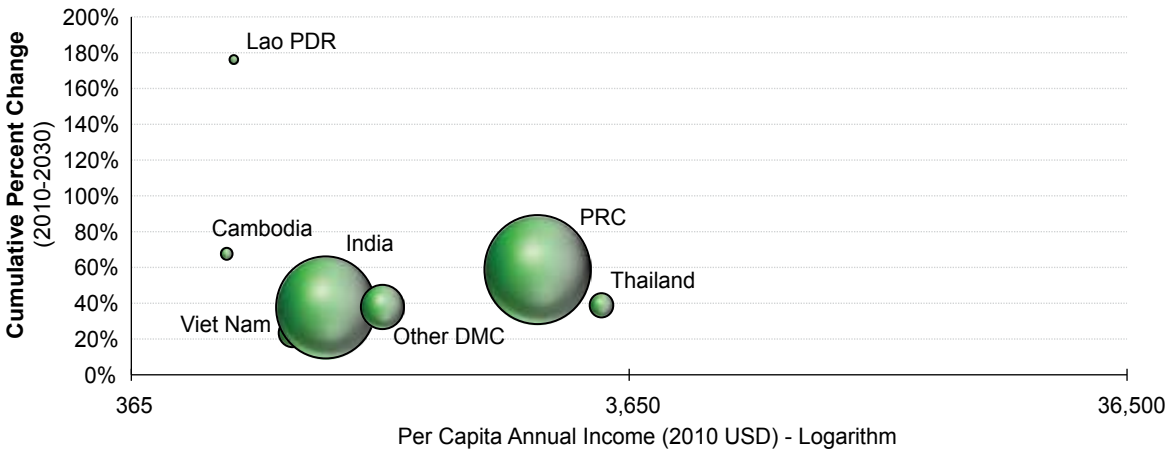
Source: Authors' estimates.

Figure 10: Changes in Agrofood Output Resulting from Productivity Growth
(cumulative percent: 2010-2030)



Source: Authors' estimates.

Figure 11: Change in Per Capita Real Income, FDI Scenario



Source: Authors' estimates.

5.4 Asian Regional Economic Convergence

Since the policy response scenarios considered here have far reaching growth, income, and institutional implications, it is reasonable to ask how they relate to regional convergence in the GMS and across Asia. Generally speaking, this is an important long-term ADB policy priority. It can be interpreted generally to mean that lower income countries should experience higher growth rates, enabling them to improve livelihoods faster and narrowing the degree of inter-country inequality across the region.

The results in Figure 11 give direct perspective on the issue of convergence, showing percent changes in real income per capita over 2010-2030 as a result of the composite Scenario 3 (FDI). Against an x-variable of per capita baseline income, there is a clear pro-poor benefit to this combination of policy approaches. When account is taken of the size of the countries involved, it is even more obvious that promoting GMS and broader Asian regional integration, in concert with agrofood productivity growth and greater regional FDI, will contribute to higher growth rates for poorer countries.

6. Conclusions

As the emergence of Asian economies continues, with attendant rising incomes and demographic transition,

food security will become an ever more important issue. Moreover, most regional economies continue to face the challenge of extensive rural poverty, and economic growth presents the risk of dualism if these populations are left behind. The Greater Mekong Subregion (GMS) is typical of this growth dilemma, but it also suggests a solution that we examine in this report. Across the GMS (and indeed across Asia), there are large disparities in market accessibility, agrofood productivity, and savings resources for enterprise development. Policies that overcome these disparities can strongly stimulating agrofood development in ways that are economywide and pro-poor, increasing rural incomes and lowering food costs for urban populations.

In this study, we review the fundamentals of recent food price insecurity and agrofood potential, then carry out an empirical assessment of policies for more sustainable agrofood development in the GMS region. Our general findings suggest three promising areas of policy emphasis. Investments in infrastructure and institutional reform can help remove the hard and soft barriers to greater market integration (agrofood and otherwise). Expanded agrofood research and extension services can accelerate regional agrofood productivity growth. Finally, more extensive regional capital allocation (via FDI) can shift underperforming investment resources (savings in higher income countries) to develop underperforming agrofood resources (in lower income countries and subnational localities). The result will be higher regional agrofood productivity, with higher commensurate returns to agrofood investment, and a strong pro-poor development stimulus. Poorest countries and areas have the most to gain in percentage terms because their resources have the lowest initial productivity and their domestic savings are lowest.

These results have many detailed lessons at the national and sector level, but a few salient conclusions emerge:

- Reduction in trade, transport, and tariff margins would realize substantial efficiency gains and increase regional incomes. The benefits depend on two factors: prior protection/margin levels, and export competitiveness. These results strongly support the argument that GMS (as well as larger Asian) integration is Pareto improving and promotes regional livelihoods.
- Given the importance of agrofood to incomes of most of Asia's poor, where rural dwellers still constitute a significant majority of total population, it is hardly surprising that rising productivity for agrofood has a dramatic positive effect on regional real GDP. Even moderate (~4% annual) productivity growth like that specified in our scenarios would increase cumulative GDP by double digit percentages in most DMCs. Again we see a Pareto impact, improving real incomes across the entire region, but most so among lower income economies.
- More intensive and extensive use of FDI within Asia would significantly increase long term growth in the region. These monies significantly increased real growth rates, particularly in lower income DMCs, in some cases doubling the benefit of agrofood productivity growth. The results show clearly that more efficient regional allocation of investment resources can be a potent catalysis for growth, particularly in lower income countries where domestic savings are a serious constraint.

Finally, we see strong complementarity between the policies considered, and generally very beneficial effects on two primary policy objectives – food security and economic convergence. The evidence from this study indicates that the GMS's vast reserves of food potential can be more fully utilized by policies that facilitate regional trade, agrofood productivity growth, and more extensive use of regional and international investment resources. These policies would significantly increase the region's food output and availability, and they are also good for growth, good for every country, and even better for the poor.

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