

**Session 1: Decade of Development, Growth, and Impacts
2001 - 2010 in the GMS**

DYNAMICS OF ECONOMIC GROWTH IN THE GMS: A RETROSPECTIVE VIEW 2000 - 2010

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Excellency, Distinguished Guests, Ladies and Gentlemen,

It is my great pleasure as a representative of the National Economic and Social Development Board to deliver this presentation. The group of countries making up the GMS-5³ had an average GDP growth rate of about 6.1% in 2000-2008. This was about 1% point higher than ASEAN-5⁴ but slower than that of the Peoples' Republic of China (PRC). The GMS-5 slowed down sharply in 2009, in the aftermath of the global financial crisis of 2008, but staged a sharp recovery in 2010 (Table 1).

The GDP per capita (in 2005 PPP\$) increased in all countries during 1993-2010, especially during the 2000s. In terms of GDP per capita, Thailand has consistently shown the best performance since 1993, although the PRC is rapidly closing the gap; Cambodia, Lao PDR, and Viet Nam are also improving though at a slower rate.

The structure of economic activities in the GMS is diverse; the PRC, Thailand, and Viet Nam have a greater share of manufacturing than Cambodia, Lao PDR, and

Table 1: GMS Economic Growth during 2000-2010

GDP Growth (%)	2000-2008	2009	2010
Cambodia	9.2	0.1	6.3
Guangxi Zhuang Autonomous Region, PRC	11.5	13.9	14.2
Yunnan, PRC	9.6	12.1	12.3
Lao PDR	6.9	7.3	7.5
Myanmar	11.8	5.1	5.3
Thailand	4.8	-2.3	7.8
Viet Nam	7.5	5.3	6.8
PRC	10.4	9.2	10.3
GMS-5	6.1	0.7	7.3
ASEAN-5	5.2	2.0	7.7

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³ GMS-5 comprises Cambodia, Lao PDR, Myanmar, Thailand, and Viet Nam

⁴ ASEAN-5 comprises Brunei Darussalam, Indonesia, Malaysia, Philippines, and Singapore (i.e. non-GMS ASEAN countries)

Myanmar, which are more reliant on primary sectors and agriculture. This difference in economic structure is reflected in the sector contributions to economic growth (Figure 1).

GMS countries have grown rapidly in the last decade, fueled partly by rapid integration with the global economy through both the trade and investment channels. Greater outward orientation and increased economic integration with the global economy have been a key pillar of the development plans of the GMS countries. The share in intra-GMS-5 exports grew slightly from 3.4% in 2000 to 6.4% in 2009; but in the same period the share of exports by the PRC jumped from 6.3% to 14%. The data show that exports of GMS-5 to PRC increased about 21% faster than among the GMS-5 and at the same time share of trade of intra-GMS-5 with the rest of the world declined (Table 2). The PRC and Thailand account for most of the intra-GMS trade.

GMS countries are increasingly linked with the global economy through both trade and FDI. Trade to GDP of the GMS countries has increased over the last two decades (Figure 2), while the outstanding stock of foreign direct investment (FDI) increased manifold between 1993 and 2010 (Figure 3).

Figure 1: Share of Major Sectors in GDP (%), 2007-2009

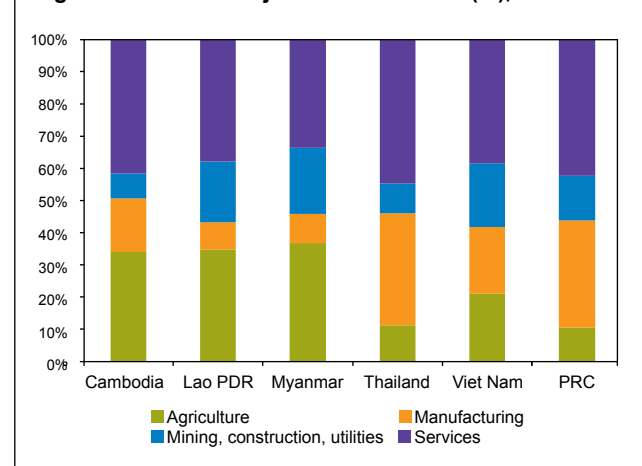
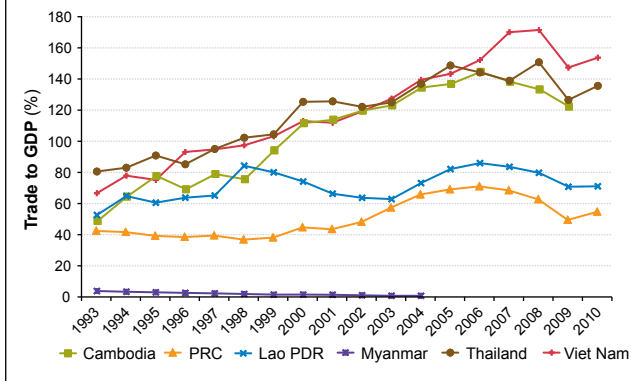


Table 2: Growing Regional Focus of GMS-5 Trade

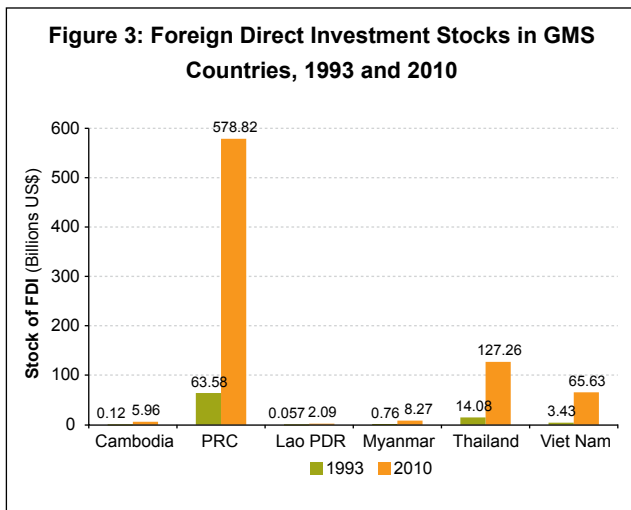
	Intra GMS-5	PRC	ASEAN-5	Rest of World
Share in Total GMS-5 Exports in %				
2000	3.4	6.3	15.1	75.2
2009	6.4	14.0	13.6	66.0
Average Annual Growth of GMS-5 Exports, 2000-2009				
	19.1%	21.2%	9.7%	9.3%

Figure 2: Trade as Percentage of GDP in GMS Countries, 1993-2010



products still have the larger share in exports of GMS-5 to both the PRC and rest of the world (Table 3).

Although the share of total FDI originating from within the subregion has increased, it still remains very small. FDI inflows from the rest of the world to the GMS-5 make up the majority. ASEAN-5 accounted for about a fifth of the cumulative FDI inflows. The share of FDI inflows originating in other GMS-5 countries and the PRC doubled during the past decade. Most of the intra-GMS FDI inflow in Cambodia, Lao PDR, and Myanmar is from the PRC and Thailand. Viet Nam is also a major source of FDI for Cambodia.



The GMS countries are expected to maintain growth in the short run, although there are risks to their growth prospects and the development challenges that each face are somewhat different. However, trade rebalancing toward regional markets can promote resilience to the economic downturn presently seen in Europe and the United States. In this regard, the GMS program has sought to integrate countries in the subregion through both hard (i.e., roads) and soft (i.e., trade facilitation measures to ensure smooth movement of trucks and goods) infrastructure measures. Growth will also be assisted by the increasing intra-GMS FDI, which will be a key driver of intra-GMS trade in the future.

GMS exports increased rapidly during the 2000s. The magnitude of PRC exports is much greater than the combined exports of the GMS-5 and has grown much more rapidly (19.1% per year for PRC vs. 10.9% for GMS-5).

The composition of GMS-5 exports, however, varies by destination: two thirds of GMS-5 exports are from manufacturing, with primary commodities making up the remaining third. But composition varies by direction of trade. The share of primary commodities in intra-GMS trade increased in the past decade but manufacturing

Table 3: Share in Exports of the GMS-5 Countries (%)

Destination	2000		2009	
	Primary	Manufacturing	Primary	Manufacturing
GMS-5 Exports to PRC	41.1	59.0	28.3	71.7
Intra-GMS-5 Exports	40.4	59.6	51.3	48.7
GMS-5 Exports to rest of the world	26.6	73.4	32.4	67.6
Total GMS-5 Exports	27.9	72.1	33.0	67.0

GROWTH IN THE GREATER MEKONG SUBREGION IN 2000 - 2010 AND FUTURE PROSPECTS

Utsav Kumar and Pradeep Srivastava¹

1. Introduction

The Greater Mekong Subregion (GMS) comprises Cambodia, Guangxi Zhuang Autonomous Region and Yunnan Province of the People's Republic of China (PRC), the Lao People's Democratic Republic (Lao PDR), Myanmar, Thailand, and Viet Nam. The GMS countries have grown rapidly since the establishment of the GMS economic cooperation program in 1992. GMS countries other than the PRC (referred to as GMS5 in this paper) have grown at an average annual rate of 5.3% during 1992-2010, over the same period PRC grew by 10.3% per annum. The rapid growth in the GMS5 countries was punctuated twice during this period—first by the Asian financial crisis in 1997-1998 and then a second time by the global financial crisis of 2008-2009. Both the times output growth decelerated sharply and output contracted in Thailand, the largest economy among the GMS5. In both instances, the GMS5 staged a V-shaped recovery.

This paper discusses the growth dynamics in the GMS during the 2000s, the structure of economic activity, sectoral contributions to growth, and also examines the patterns in welfare outcomes. While many factors have contributed to the rapid growth in the GMS during the 2000s, a key contributing factor is the continued outward orientation towards regional and global markets. Growing integration with the global economy has been on account of both increase in trade and increase in foreign direct investment (FDI). The paper looks at some of the key trends and patterns in trade and FDI in the region during the 2000s.

The low-income GMS countries have grown at a brisk pace during the 2000s. However, their per capita incomes remain far below that of Thailand which continues to have the highest per capita income in the region. One exception to this is the PRC which has closed the gap with the Thailand the most—from having 30% of Thailand's GDP per capita (in 2005 PPP terms) in 1992 to being at 90%

of Thailand's GDP per capita in 2010. Rapid growth in the GMS has been accompanied by decline in poverty levels and improvements in human development (as measured by United Nations' Human Development Index). However, inequality has edged up across the region showing that though many were pulled out of poverty in the last two decades, gains were unequally distributed.

The structure of the economic activity across the GMS countries is varied with Cambodia, Lao PDR, and Myanmar (CLM) more dependent on primary sectors—agriculture and mining—than the other three countries. With the exception of Cambodia, this is also reflected in the trading patterns of the six countries with each other and with the rest of the world—CLM countries export primary products to and import manufactured goods from other countries in the region and the outside the world. In the case of Cambodia, while intra-GMS exports are largely in primary commodities, its garments exports to the rest of the world dominate its export basket. Similarly, the share of cumulative FDI inflows in the CLM countries going to primary sectors is greater than the share of FDI going to primary sectors in Thailand and Viet Nam. The latter two, on the other hand, attract more FDI in the manufacturing sector.

The direction of GMS5 trade has changed somewhat during the last decade. The share of the GMS5 trade with PRC and other GMS5 countries has almost doubled during 2000s. PRC's share of total GMS5 exports increased from 6.3% in 2000 to 14% in 2010 and the share of intra-GMS5 exports in the total exports of GMS5 increased from 3.4% in 2000 to 6.4% in 2010. Thus, there seems to have been some rebalancing towards regional markets in the last decade. Likewise, the share of cumulative FDI coming from other GMS5 countries doubled to 2.1% and that from PRC doubled to 2.9% during 2005-2009 compared with 2000-2004. But these shares are very small and a large chunk of FDI still comes from outside the region.

To the extent that exports to markets, and FDI from, outside the GMS continues to account for a lion's share, vulnerability to developments in those markets remains. In addition, with the growing dependence on the PRC as a market for exports and for FDI, the GMS5 countries can be impacted by economic events in the PRC as well. The long-term challenges facing the GMS countries are somewhat different.

CLM countries need to diversify their economic base away from primary and low-value added goods and move up the value chain. Lao PDR and Myanmar also need to tackle

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the macroeconomic challenges arising out of resource revenues. PRC, Thailand, and Viet Nam are at varied levels of per capita income and though not yet stuck in the middle-income trap, need to move up the value chain further from product assembly to product development. This will require a stable macroeconomic environment to encourage investment, strengthening of institutional and legal frameworks to encourage research and development, and further improvements in trade facilitation so that some of the low-value added tasks can be done in countries which are further down the value chain.

The rest of the paper is organized as follows. Section 2 discusses growth dynamics in the GMS in the 2000s. Sections 3 and 4 discuss trade and FDI in the GMS, respectively. Section 5 closes the paper with a discussion of growth prospects and key challenges facing the GMS countries.

2. Growth in the GMS in 2000s

Among the six GMS member countries, PRC accounts for a lion's share of the subregion's size, in terms of both GDP and population (Tables 1 and 2). For the purposes of this paper and to avoid aggregate statistics for GMS,

as a group, being driven by PRC, GMS5 countries, i.e., GMS countries excluding PRC, are considered separately. Among the GMS5 economies, Thailand is the largest economy in terms of GDP. It accounted for the largest share (61%) in terms of GDP (measured in PPP terms) followed by Viet Nam (27%). In terms of population, however, Viet Nam is the largest country in the GMS5 with 38.6% of the total GMS5 population while Thailand accounted for 31%. Among the GMS5, Lao PDR's share in GDP and population is the smallest.

GMS5 grew at an average annual rate of 6.1% during 2000-2008 (Figure 1).² This was about 2 percentage points slower than the average growth rate of 8.1% in the period immediately preceding the Asian financial crisis, 1993-1996. The slowdown in the overall GMS5 growth rate was largely due to a sharp slowdown in Thailand, the largest economy in GMS5 in terms of GDP, from 8.1% during 1993-1996 to 4.8% during 2000-2008 (Table 3). Growth in the GMS5 during 2000-2008 was comparable to that of ASEAN5 but slower than that of PRC.³ GMS5 slowed down sharply in 2009, in the aftermath of the global financial crisis of 2008, growing at only 0.6% in 2009. GMS5, like other countries in the region, staged a V-shaped recovery registering a 7.3% growth in 2010.

Table 1: Selected indicators in GMS economies

	Population in 2010 (in millions)	GDP in 2010, current US\$ (in billions)	GDP per capita in 2000, current US\$	GDP per capita in 2010, current US\$
Cambodia	14.1	11.6	293.6	821.0
PRC	1,338.3	6,031.8	949.2	4,507.0
Guangxi Zhuang, AR, PRC	46.0	141.4	559.7	3,071.1
Yunnan province, PRC	46.0	106.7	566.6	2,321.4
Lao PDR	6.2	7.3	326.3	1,175.7
Myanmar	61.2	45.4	177.6	742.4
Thailand	69.1	318.8	1,943.2	4,610.0
Viet Nam	86.9	103.6	401.5	1,191.4

Source: World Economic Outlook database (September 2011), Asian Development Outlook Update (2011), World Bank (East Asia and Pacific Economic Update, November 2011), CEIC for data on Guangxi Zhuang autonomous region and Yunnan province of PRC, and authors' estimates.

Table 2: Share in GMS population and GDP (%), 2006-2010

	Including PRC		Excluding PRC	
	Share in GDP	Share in Population	Share in GDP	Share in Population
Cambodia	0.3	0.9	3.1	6.3
PRC	90.1	85.7		
Lao PDR	0.1	0.4	1.5	2.7
Myanmar	0.7	3.1	7.6	21.4
Thailand	6.0	4.4	60.8	31.0
Viet Nam	2.7	5.5	27.0	38.6

Source: World Development Indicators and authors' estimates. Note: Share of each country in GMS5 (or GMS6) total population and GDP is the average share during 2006-2010. Share in GDP shown is for GDP measured in PPP terms.

² GMS5 comprises Cambodia, Lao PDR, Myanmar, Thailand, and Viet Nam.

³ ASEAN5 comprises Brunei Darussalam, Indonesia, Malaysia, Philippines, and Singapore.

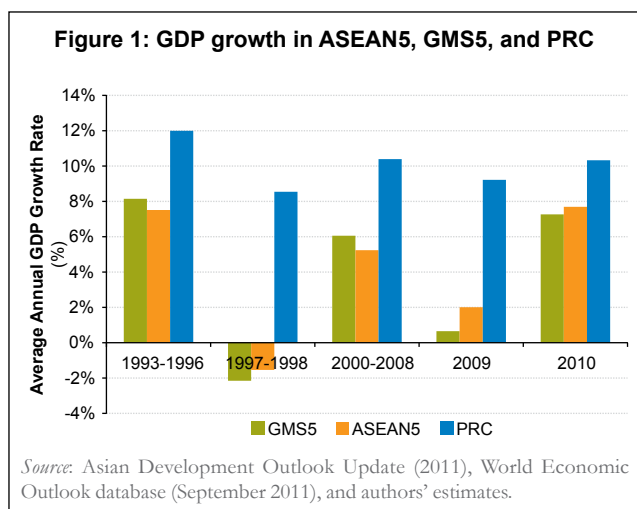


Table 3 shows the growth rate of the GMS5 member countries. Also shown in the table are the growth rates of PRC and the two provinces of PRC that comprise the Greater Mekong Subregion. Cambodia and Myanmar grew faster during 2000-2008 than they did immediately preceding the Asian financial crisis, i.e., during 1993-1996, Lao PDR grew at a similar pace during the two periods while Thailand and Viet Nam grew at a slower pace in the latter period than before the Asian financial crisis. All the economies in the GMS, except Lao PDR and Guangxi Zhuang autonomous region of and Yunnan province of PRC, slowed down in the aftermath of the global financial crisis during 2009. Cambodia and Thailand staged a V-shaped recovery in 2010 while growth accelerated in the other economies.

Thailand contributed almost three-fourth of the overall GMS5 growth in the pre-Asian financial crisis period during 1993-1996, accounting for 6 percentage points of the GMS5 growth (Figure 2). However, it contributed only 49% of the GMS growth during 2000-2008. Correspondingly, the contribution of all the other GMS5 countries to the overall GMS5 growth increased during 2000-2008 compared with 1993-1996.

GMS5 GDP per capita (weighted by population and measured in 2005 PPP constant international dollars) increased by 1.5 times from \$3,100 in 2000 to \$4,666 in 2010 (Figure 3). This increase was slightly higher than the increase in ASEAN5 GDP per capita from \$3,689 to \$5,180, an increase of 1.4 times. GDP per capita of PRC increased the most, by 2.5 times from \$2,667 to \$6,810. Using GDP

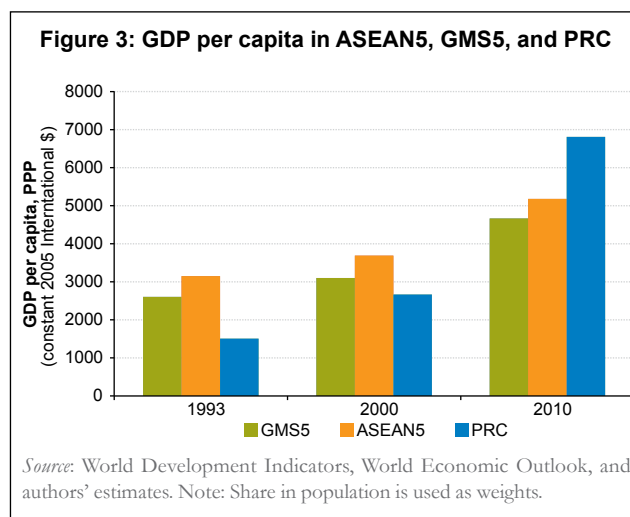
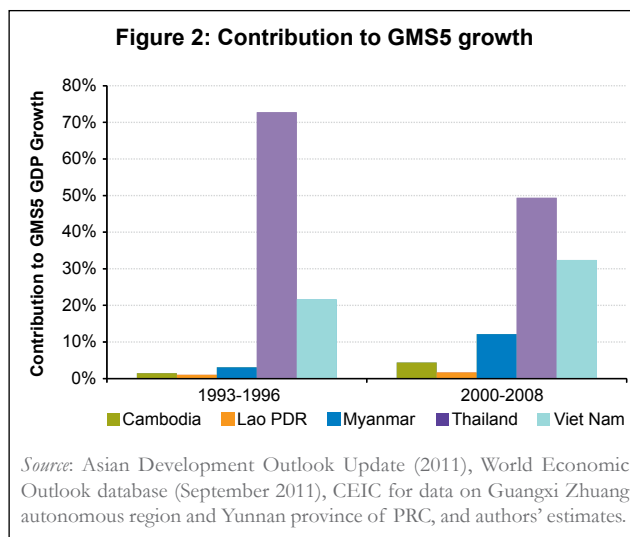


Table 3: Average annual GDP growth rates (%) in the GMS economies

	1993-1996	1997-1998	2000-2008	2009	2010
Cambodia	6.0	5.3	9.2	0.1	6.3
PRC	12.0	8.5	10.4	9.2	10.3
Guangxi Zhuang, AR, PRC	13.4	8.6	11.5	13.9	14.2
Yunnan, PRC	11.0	8.7	9.6	12.1	12.3
Lao PDR	7.0	5.6	6.9	7.3	7.5
Myanmar	6.6	5.8	11.8	5.1	5.3
Thailand	8.1	-6.1	4.8	-2.3	7.8
Viet Nam	8.9	7.0	7.5	5.3	6.8
GMS5	8.1	-2.2	6.1	0.7	7.3
ASEAN5	7.5	-1.5	5.2	2.0	7.7

Source: Asian Development Outlook Update (2011), World Economic Outlook Database (September 2011), CEIC for data on Guangxi Zhuang autonomous region and Yunnan province of PRC, and authors' estimates.

weights, however, shows a much higher GDP per capita in the ASEAN5 countries. Using GDP weights, the GDP per capita of ASEAN5 increased from \$9,299 in 2000 to \$12,331 in 2010.⁴ GDP per capita of the GMS5 increased from \$4,336 in 2000 to \$5,931 in 2010.

During the seventeen year period, 1993-2010, GDP per capita (measured in PPP terms) increased in all the GMS countries as shown by the upward movement of the dots representing the various countries in Figure 4. The GDP per capita of all the GMS countries was less than that of Thailand in 1993 and continued to be so in 2010, though PRC has caught up rapidly during this period (Figure 4 and 5). GDP per capita of the GMS countries in 1993 was 30%

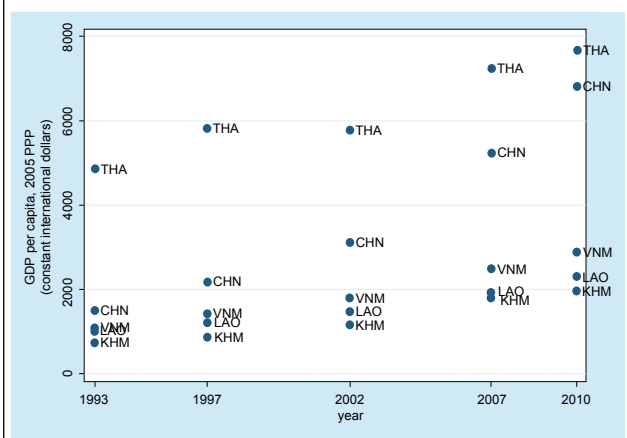
or less than that of Thailand (Figure 5). In other words, the gap of the various GMS countries with Thailand was 70% or more. Over the next two decades, 1993-2010, all the countries managed to reduce the gap with Thailand though to a different extent. PRC succeeded in reducing the gap by the most. PRC's gap with Thailand in 1993 was 70%, i.e., PRC's GDP per capita was 30% that of Thailand's. By 2010, PRC's GDP per capita was 90% that of Thailand's, i.e., the gap was reduced to 10%. Cambodia, Lao PDR and Viet Nam also closed the gap with Thailand though their per capita incomes continued to be less than 40% that of Thailand's in 2010.

With the exception of Lao PDR and Myanmar, the structure of economic activity in each GMS country has remained more or less the same during 2000-2010 (Figure 6). In Lao PDR, the share of mining etc. and services in GDP increased while that of agriculture and manufacturing declined. In Myanmar, on the other hand, an increase in the share of mining etc. was accompanied by a commensurate decline in the share of the agricultural sector.

However, the structure of economic activity is different across the GMS countries (Figure 6). PRC, Thailand, and Viet Nam have a greater share of manufacturing than Cambodia, Lao PDR, and Myanmar. The latter three, on the other hand, have a greater share of agriculture in economic activity than the former three countries. For the latest period, 2007-2009, the share of mining etc. in GDP in Myanmar and Lao PDR was higher than the share of manufacturing. Cambodia, Lao PDR, and Myanmar are, thus, relatively more dependent on primary sectors. Thailand, Viet Nam, and PRC, on the other hand, have relied more on manufacturing as an engine of growth.

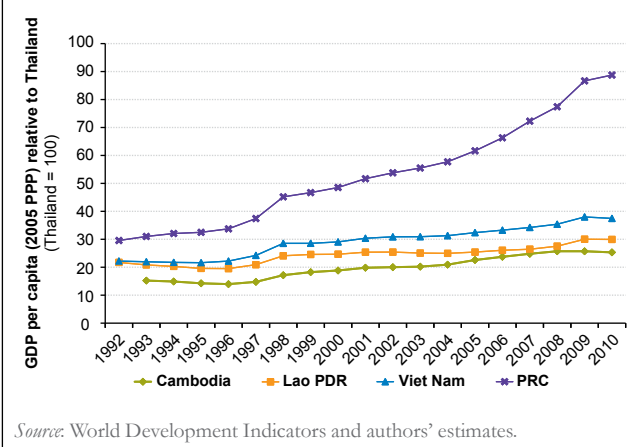
The difference in the economic structure is also reflected in the sectoral contributions to growth (Figure 7). In general, growth in services contributed the most to GDP growth in the GMS countries, except in Lao PDR where growth in mining etc. and in Thailand where manufacturing growth contributed the most to GDP growth. In Cambodia, manufacturing and services contributed the most to GDP growth during the two periods. However, the contribution of agriculture and manufacturing to GDP growth in Cambodia was lower in 2000-2008 than during 1993-2000, while that of services and mining etc. increased. The sectoral contributions to GDP growth changed the most in Lao PDR. The contribution of agricultural growth halved from 43% during 1993-2000 to 22% of the GDP growth during 2000-2008 and that of manufacturing growth also declined from 24% in 1993-2000 to 1% in 2000-2008. On the other

Figure 4: GDP per capita in GMS countries



Notes: CHN=People's Republic of China, KHM=Cambodia, LAO=Lao PDR, THA=Thailand, and VNM=Viet Nam
Source: World Development Indicators and authors' estimates.

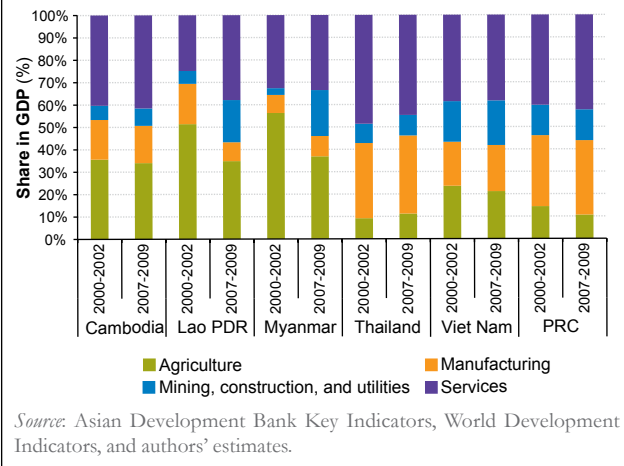
Figure 5: GDP per capita relative to Thailand.



Source: World Development Indicators and authors' estimates.

⁴ The difference in the GDP per capita of ASEAN5 when weighted by population compared with the GDP per capita when weighted by GDP is due to the smaller share of Singapore when using population weights (1.3%) as compared to its weight in GDP terms which is about 13%.

Figure 6: Structure of economic activity in GMS countries

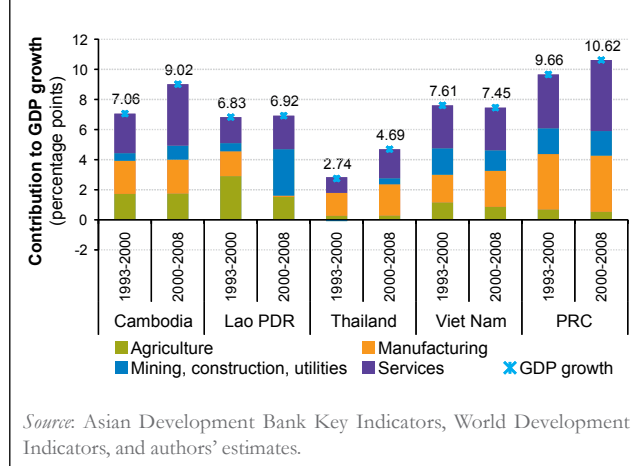


hand, the share of mining etc. in GDP growth increased from 8% during 1993-2000 to 44.7% during 2000-2008 and the contribution of services to the GDP growth also increased.

In Thailand, manufacturing growth continued to contribute the highest share to the GDP growth. In the wake of the Asian financial crisis, the mining, construction, and utilities contracted sharply and pulled back GDP growth for 1993-2000. The sector contributed positively to the GDP growth during 2000-2008 and largely accounted for the 11 percentage point decline in the contribution of manufacturing growth to GDP growth. In Viet Nam, the contribution of manufacturing growth to GDP growth increased by almost 8 percentage points, from 24% during 1993-2000 to 32% during 2000-2008, while the combined contribution of agriculture and mining etc. to GDP growth declined. In PRC, the contribution of services to GDP growth increased from 37% to 44.5% and this increase came at the expense of decline in the contribution of all the other sectors.

Enhanced integration with the global economy and promotion of exports have been central to the development strategy of the GMS countries in the last two decades. Contribution to GDP growth from the expenditure side shows that exports have contributed handsomely to the GDP growth in all the GMS countries (Figure 8). Shown in Figure 8 are the percentage point contributions to the overall GDP growth. So, for example, in the case of Thailand during 2000-2008, export growth contributed 4.4 percentage points of the total GDP growth of 4.62% which amounts to 95% of the overall GDP growth. Similarly in PRC during 2000-2008, export growth contributed 6.6 percentage points of the total GDP growth of 10.4%, i.e.,

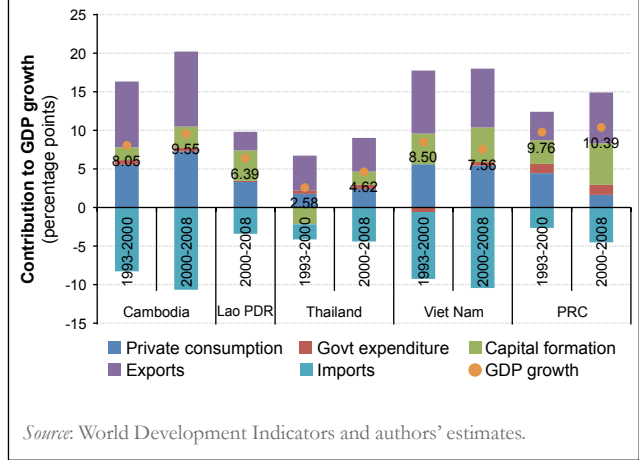
Figure 7: Sectoral contribution to GDP growth



export growth accounted for 63% of the total growth. Note that the export contribution to growth in itself is high and in some cases more than 100% (for example, Thailand during 1993-2000). At the same time, however, import growth, which has an offsetting impact in terms of contribution to GDP, is also very high. Only in PRC is the impact of export growth not fully offset by import growth.

Along with rapid growth and increase in per capita incomes, GMS countries have also seen a decline in poverty. Poverty, as measured by the headcount ratio, i.e., the share of the population below the national poverty line (Figure 9) or by the share of population living on less than \$2 (PPP) a day (Figure 10) fell during the 2000s. On the basis of the national poverty line, the sharpest decline amongst the GMS countries was seen in Viet Nam where poverty rate declined from 37.4% in 1998 to 14.5% in 2008. Poverty in rural and urban areas, based on the respective national rural and urban poverty lines, declined in all the GMS countries.

Figure 8: Contribution to GDP growth, expenditure side

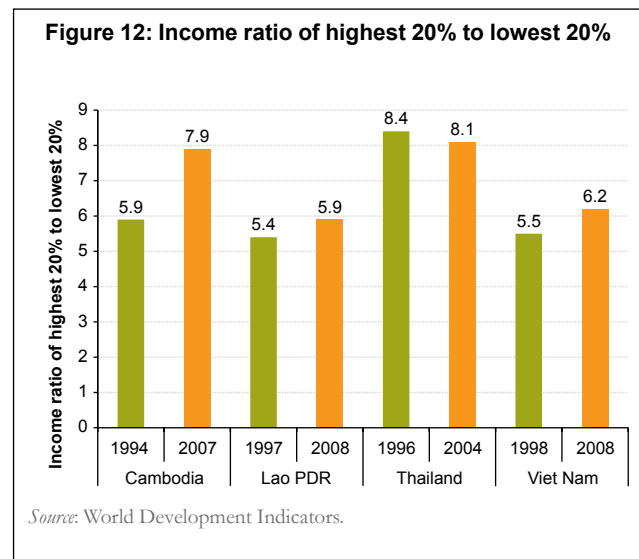
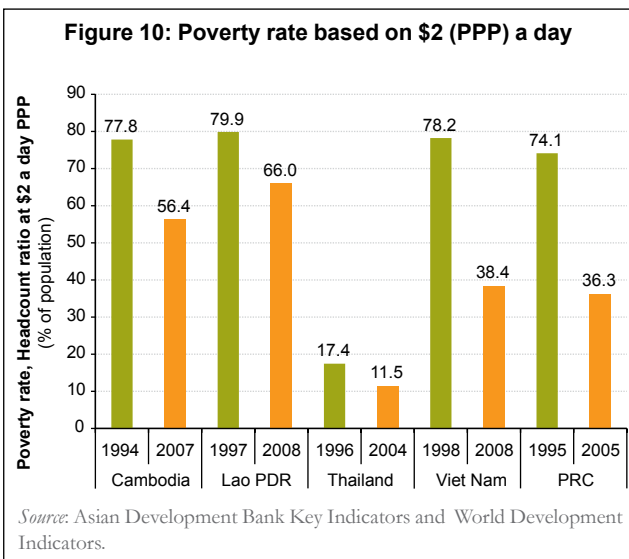
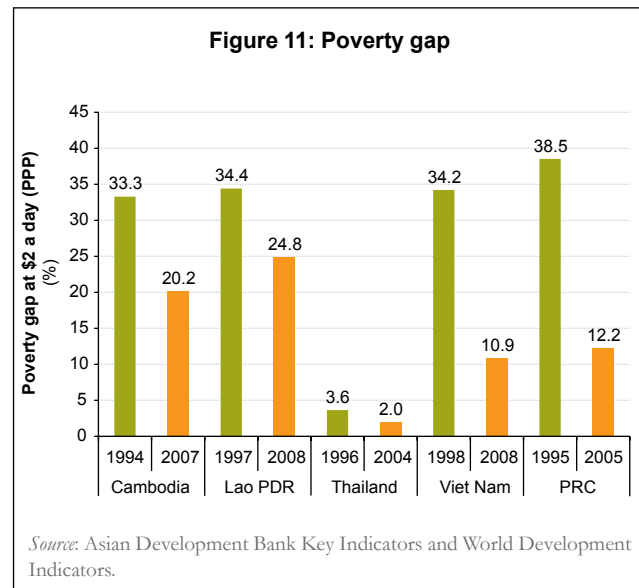
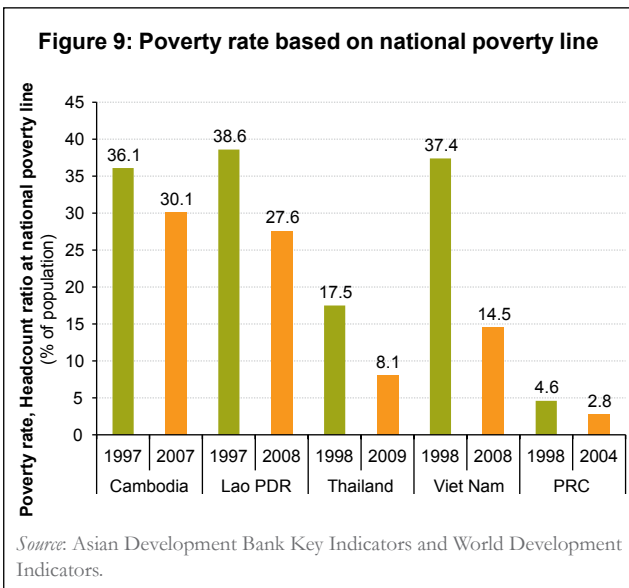


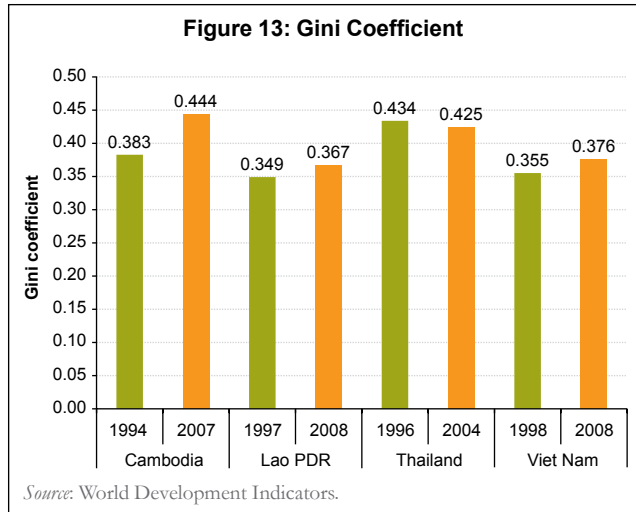
The headcount ratio shown above gives only the share of the population below the poverty line. However, it does not say anything how poor the individuals are. Figure 11 shows the poverty gap index based on the \$2 a day (PPP) poverty line. It measures the extent to which individuals are below the poverty line and is expressed as a percentage of the poverty line. Poverty gap declined across the GMS countries during the 2000s indicating that not only were there less poor (as shown by the decline in headcount ratio, Figure 10) but also the poor were, on average, less poor than they were in 1990s.

Though the continued growth in the 2000s lifted many out of poverty, it, however, did not lift all the boats equally. In other words, gains from rapid growth in the region were distributed unequally and the already rich benefited more. The ratio of income earned by the highest 20% to the

income earned by the lowest 20% (Figure 12) as well as Gini Coefficient (Figure 13) increased during the 2000s in all the GMS countries except Thailand. Thus, while growth has been inclusive to the extent that it has helped lift people out of poverty it has not been equitable as the gains in income of the richest have exceeded those of the poorest.

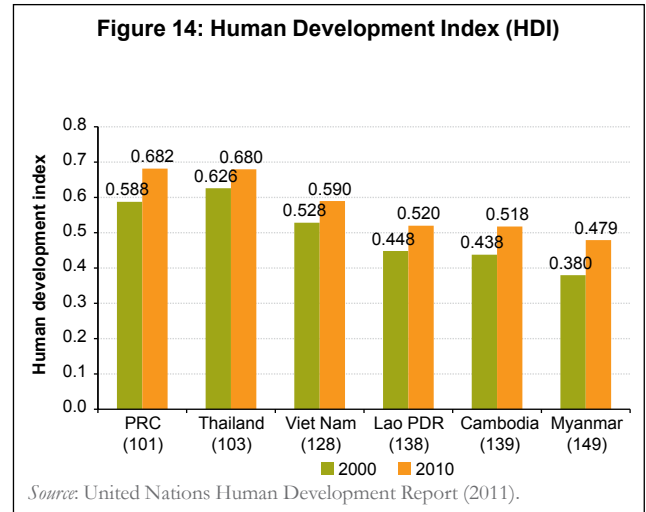
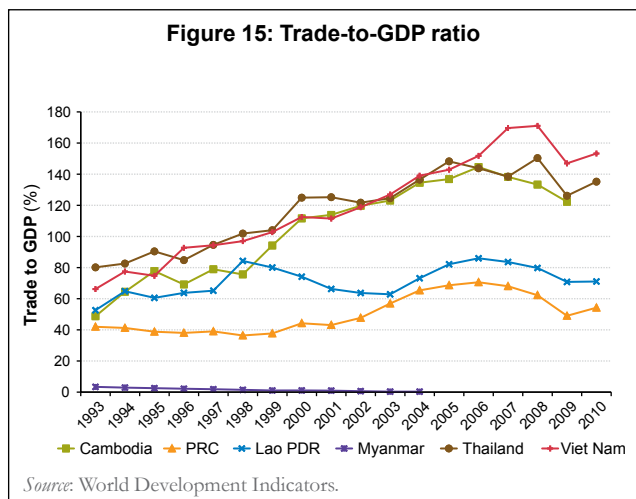
The United Nations' Human Development Index (HDI), a composite index of human development which measures achievements in health, education, and income, shows an improvement in all the GMS countries during the 2000s (Figure 14). However, all the countries in the GMS region rank low and are either in the "medium" human development or "low" human development categories (Human Development Report 2011). The rank of the GMS countries in 2011 out of 187 countries is shown next to the respective country on the horizontal axis in Figure 14.



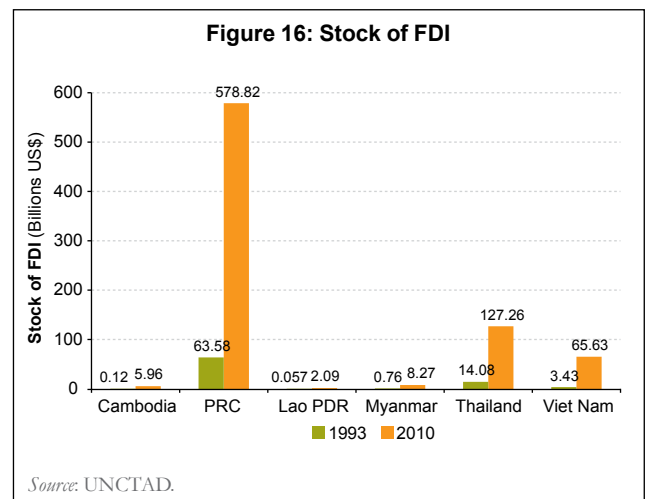


Thus, while the GMS countries have registered progress in the basic dimensions of human development, as measured by the HDI, there remains scope for improving health and education both of which contribute to human capital and therefore higher productivity, which is the key to improving living standards.

Rapid growth in the GMS countries has partly been fueled by greater integration with the rest of the world. In fact, greater outward orientation and increased economic integration with the global economy have been key pillars of the development plans of the GMS5 countries. For example, medium-term development of Cambodia, Lao PDR, and Viet Nam for 2006-2010 emphasized the role of trade in achieving various developmental goals (ADB 2008). Over the period 1993-2010, the GMS5 countries, in general, show greater integration with external markets through both the trade and the investment channels.



Openness as measured by the ratio of the sum of exports and imports of goods and services to GDP (trade-to-GDP ratio) increased in all the GMS countries except Myanmar during the last two decades (Figure 15). Cambodia's trade-to-GDP ratio increased from 48.7% in 1993 to 122.3% in 2009, PRC's increased from 42.0% in 1993 to 54.2% in 2010, from 52.6% in 1993 to 71.1% in 2010 in Lao PDR, Thailand's trade-to-GDP ratio increased from 80.2% in 1993 to 135.2% in 2010, and that of Viet Nam increased from 66.2% in 1993 to 153.3% in 2010. Myanmar's trade-to-GDP ratio declined from 3.4% in 1993 to 0.3% in 2004.⁵ Various studies have shown that, after taking into account the possibility that countries with higher incomes may trade more, countries that trade more have a higher income, i.e., higher trade *causes* higher income (for example, Frankel and Romer (1999) and Ferrarini (2010)). Thus, policies to promote trade, by reducing trade barriers or improving trade facilitation, can have a positive impact on growth and can also make a dent on poverty.



⁵ Source: World Development Indicators (2011), World Bank.

The stock of FDI in the GMS countries increased manifold between 1993 and 2010 (Figure 16). The stock of FDI in Cambodia in 2010 amounted to \$5.96 billion (an increase of 47.7 times since 1993), in Lao PDR the stock of FDI in 2010 was \$2.10 billion (36.5 times more than it was in 1993), in Myanmar the stock of FDI increased by 10.9 times from 1993 and stood at \$8.3 billion in 2010, Thailand's stock of FDI in 2010 was \$127.26 billion representing a nine-fold increase since 1993, and that of Viet Nam soared by 19 times to \$65.63 billion in 2010. In PRC the stock of FDI increased by 9.1 times during 1993-2010, from \$63.58 billion to \$578.82 billion.⁶

The next two sections examine the pattern of trade and FDI in the GMS5 countries in greater detail.

3. Pattern of trade in the GMS countries^{7,8}

Total exports (including to each other) of the GMS6 countries (GMS5 plus PRC) grew at an average annual pace of 17.4%, from \$336.2 billion in 2000 to \$1,423.5 in 2009 (Figure 17).⁹ Total imports (including from each other) of the GMS6 increased from \$307.1 billion to \$1,222.8 in 2009, an average annual growth rate of 16.6%. The dip in exports and imports in 2009 is a reflection of the collapse in trade in the aftermath of the global financial crisis in late 2008 and its impact on the real economy. Of the total exports of GMS6 to the world only 15.6% originated in the GMS5 in 2009. Similarly, GMS5 accounted for only 17.7% of the total GMS6 imports in 2009. It is, therefore, important to look at the trade patterns of GMS5 countries separately from the PRC so that inferences about GMS trade are not dominated by the trade flows of PRC.

⁶ Source: UNCTAD.

⁷ This section draws freely from a companion paper, Srivastava and Kumar (2011).

⁸ The main source for all the trade data used in this section is the United Nations' Commodity Trade (UNCOMTRADE) database. Data for the years 2000—2009 at the SITC (Rev. 2) 2-digit level is used. For the purposes of this report, following the approach of Feenstra *et al.* (2005), import side data is taken as the base data. In other words, imports of Thailand from PRC are used as exports of PRC to Thailand. In case of missing import values, export side data is used to obtain the value of the bilateral trade flow at the 2-digit level. Thus, a single series of trade values is used. It is used as exports from country A to country B if looking at exports and the same series is used as imports of country B from country A when examining the imports. Total exports to and total imports from the world are taken as reported in the UNCOMTRADE database except for Cambodia, Lao PDR, and Myanmar. For the latter three countries, data for trade with the world, at the SITC (Rev. 2) 2-digit level, was obtained by aggregating trade with individual countries. For ease of presentation of composition of trade, SITC (Rev. 2) 2-digit products were combined into a smaller number of groups. Appendix 1 shows the 2-digit SITC products that comprise each group.

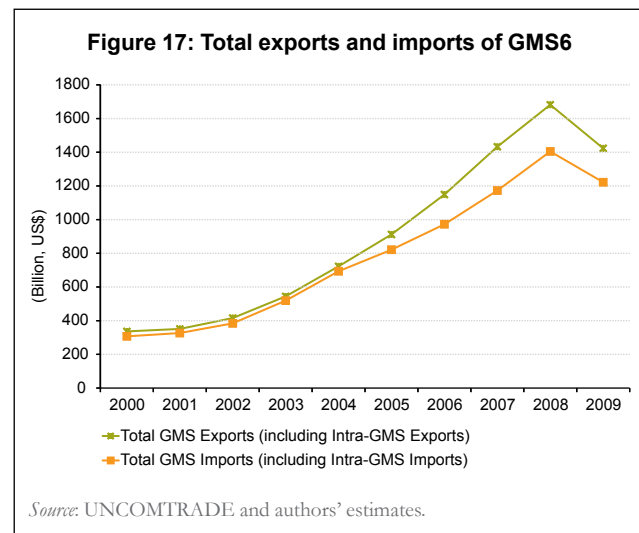
⁹ Some other recent papers that examine GMS trade flows are ADB (2008), Duval (2008), Banik (2011), and Menon and Melendez (2011).

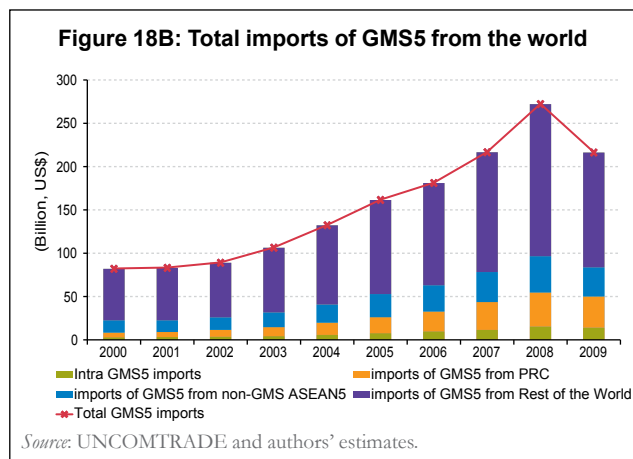
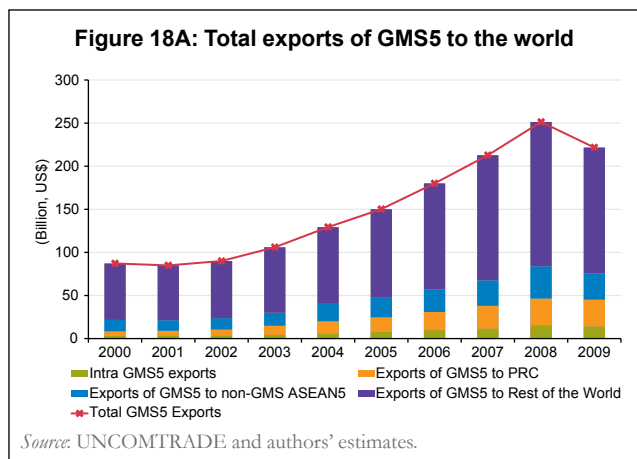
GMS5 total exports and imports. Figures 18A and 18B show the trend in GMS5 exports and imports, respectively. GMS5 exports and imports grew slower than the respective GMS6 flows indicating that the growth rates noted above were dominated by growth in the trade flows of PRC. Total exports of the GMS5 countries increased from \$87.2 billion to \$251.3 billion in 2008 before declining to \$221.7 in 2009, an average annual increase of 10.9% during 2000-2009. Total imports of the GMS5 economies grew at 11.4% during 2000-2009, and increased from \$82.0 billion in 2000 to \$272.1 billion in 2008 and declined to \$216.2 billion in 2009.

In general, greater outward orientation in the GMS countries, through both the trade and investment channels, fueled integration with the global economy (Figures 15 and 16). Lowering of own trade barriers as well as those by the importing countries such as the phasing out of the Multi-Fiber Agreement further aided integration with the global economy.

Easing of restrictions on foreign direct investment (FDI) provided an impetus to trade and growth. For example, removal of barriers to FDI and foreign ownership have resulted in relocation of garment factories from Republic of Korea, Taipei, China, and PRC to Cambodia. This has helped stimulate garment exports from Cambodia (ADB 2008). Similarly, FDI projects in agriculture and forestry and in mining have helped export growth in Lao PDR (ADB 2008).

Among other reasons that contributed to the increase in trade during the 2000s are: fragmentation of production processes across borders which was further aided by advances in transportation and communication—for





example, Viet Nam has benefited from setting up of regional production networks; easy access to finance for trade and consumption; a relatively benign global environment in the 2000s; and emergence of PRC as a key market and source for imports. Greater regional integration within the GMS has been facilitated through setting up of hard infrastructure and complementary trade facilitation measures as well as through ASEAN (five of the six GMS countries are also members of ASEAN) initiatives such as the ASEAN Free Trade Area (AFTA).

Among the GMS5 countries, Thailand accounted for 68.7% of the total exports from GMS5 countries in 2009, down by 10 percentage points compared with 2000 (Figure 19A). Table 4 shows the size of GMS countries' trade with the world. Viet Nam's share increased by 9 percentage points over 2000-2009 and the combined share of Cambodia, Lao PDR, and Myanmar (CLM) by 1 percentage point. Similarly, Thailand continues to account for a major share of imports of the GMS5 countries though its share has declined over time. During the same period, Viet Nam's share of total imports of GMS5 countries increased by 13 percentage points. The combined share of CLM countries

continues to be small though it increased marginally during 2000-2009.

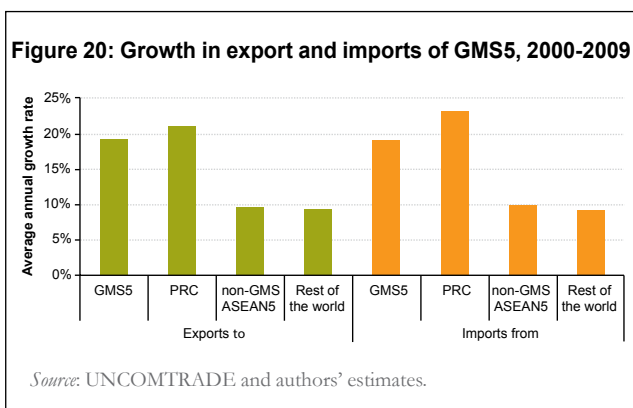
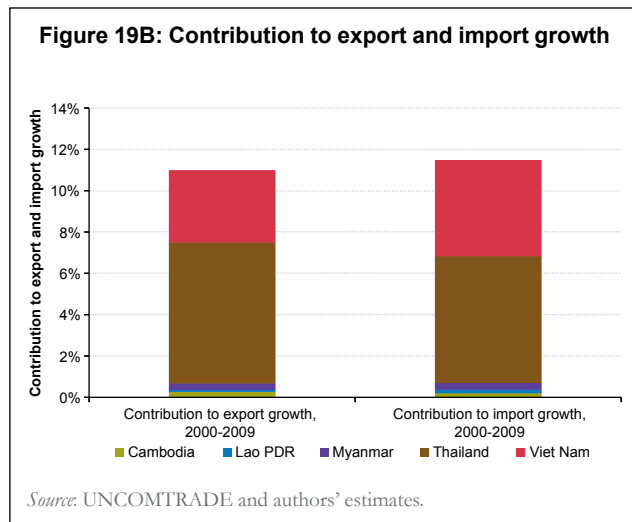
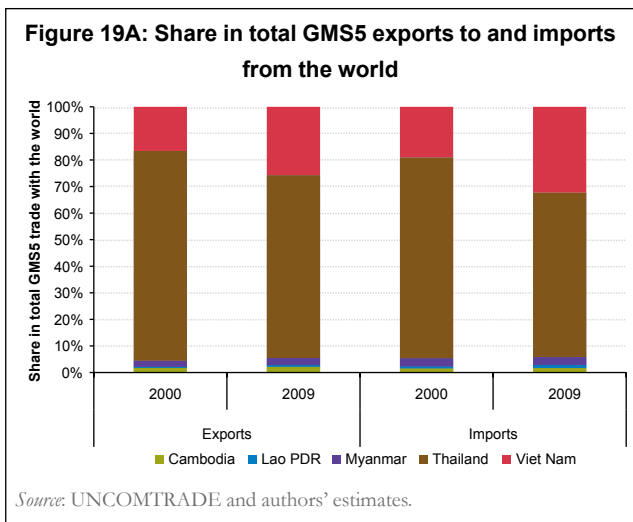
Of the 10.9% growth in the total exports of the GMS5 countries, 6.8 percentage points (i.e., 62% of the total export growth) is accounted for by Thailand and 3.4 percentage points by Viet Nam. CLM together accounted for less than 1 percentage point of the export growth of GMS5 countries (Figure 19B). Similarly, on the import side, Thailand and Viet Nam accounted for a bulk of the growth in GMS5 imports from the world.

Figures 18A, 18B, Figure 20, Figure 21 (Panel A and B) show GMS5 trade with PRC, intra-GMS5, non-GMS ASEAN5, and the rest of the world. A few things stand out. First, of the four destinations shown, GMS5 exports to and imports from PRC increased the fastest, growing at 21.2% and 23.4%, respectively, during 2000-2009 (Figure 20). This increase was faster than the increase in GMS5 exports to and imports from the world. Consequently, the share of PRC in the exports and imports of GMS5 increased. Share of exports to PRC in total GMS5 exports increased by 2.2 times—from 6.3% in 2000 to 14.0% in

Table 4: Total exports and imports of GMS countries

	Exports (US\$, billions)			Imports (US\$, billions)		
	2000	2008	2009	2000	2008	2009
GMS	336.37	1,682.03	1,423.37	307.07	1404.69	1221.8
<i>of which</i>						
PRC	249.2	1,430.69	1,201.65	225.09	1,132.56	1,005.56
GMS5	87.17	251.34	221.72	81.98	272.13	216.24
<i>of which</i>						
Cambodia	1.54	5	4.83	1.28	4.09	3.62
Lao PDR	0.35	1.39	1.34	0.6	2.52	2.6
Myanmar	1.98	6.35	5.95	2.54	6.2	6.3
Thailand	68.82	175.91	152.5	61.92	178.61	133.77
Viet Nam	14.48	62.69	57.1	15.64	80.71	69.95

Source: UNCOMTRADE and authors' estimates.



share of the rest of the world (i.e., excluding non-GMS ASEAN5) declined by about 10 percentage points.

Thus, there seems to have been a change in the direction of the trade during 2000-2009 and a “rebalancing” of sources of demand and supply away from the rest of the world towards other GMS trading partners.

The dependence of each of the GMS member countries on trade with different trading partners varies. Among the GMS countries, Lao PDR and Myanmar are the most dependent on trade with GMS followed by Cambodia.¹¹

2009 (Figure 21A). Similarly, share of imports from PRC in total GMS5 imports went up from 6.6% to 16.6%, an increase of 2.5 times (Figure 21B).

The size of intra-GMS (i.e., GMS5 and PRC taken together) trade increased from \$13.87 billion in 2000 to \$81.17 billion in 2009, an average annual growth rate of 21.7%.¹² PRC and Thailand account for the bulk of the intra-regional trade flows throughout the period 2000 to 2009.

Second, intra-GMS5 exports (and by definition imports) grew by 19.1%, from \$2.9 billion in 2000 to \$14.1 billion in 2009. Intra-GMS5 exports (imports) as share of total GMS5 exports (imports) almost doubled between 2000 and 2009. Intra-GMS5 exports as a share of total GMS5 exports increased from 3.4% in 2000 to 6.4% in 2009 and the share of intra-GMS5 imports in total GMS5 imports increased from 3.6% in 2000 to 6.5% in 2009.¹⁰

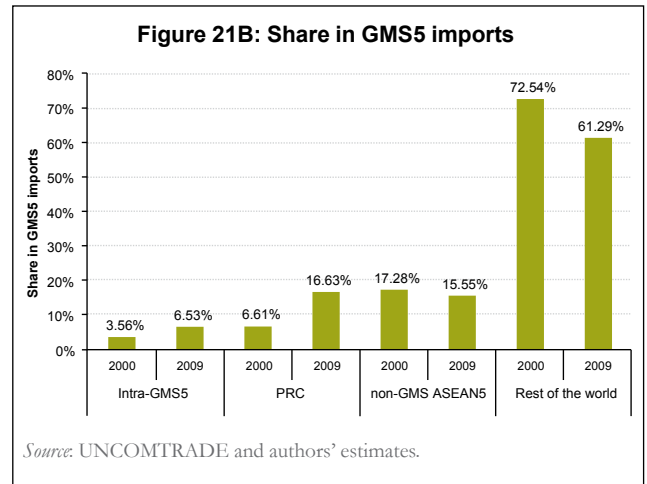
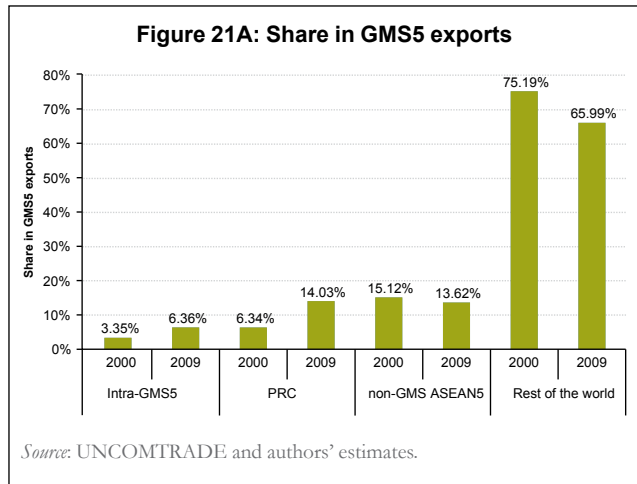
Looking at shares from the export side, 39.1% of the intra-GMS exports in 2000, and 44.3% in 2009, originated from PRC (Figure 22, Panels A and B). These were headed to other GMS countries (i.e., GMS5 countries). Similarly on the import side, 39.9% of the intra-GMS imports in 2000, and 38.3% in 2009, were headed to PRC (Figure 22, Panels C and D). These trade flows originated in the GMS5 countries. Thus, GMS5 countries imported more from PRC than from each other and exported less to PRC and slightly more to each other in 2009 compared with what they did in 2000.

Third, commensurate with an increase in dependence on markets and suppliers within the GMS5 and PRC, share of rest of the world in GMS5 exports and imports declined. However, the share of exports to and imports from non-GMS ASEAN5 as a share of total GMS5 exports and imports declined only marginally. On the other hand, the

¹⁰ By definition, total intra-GMS5 exports are the same as intra-GMS5 imports. However, the shares are different because of different denominators, total GMS5 exports to the world vis-à-vis total GMS5 imports from the world.

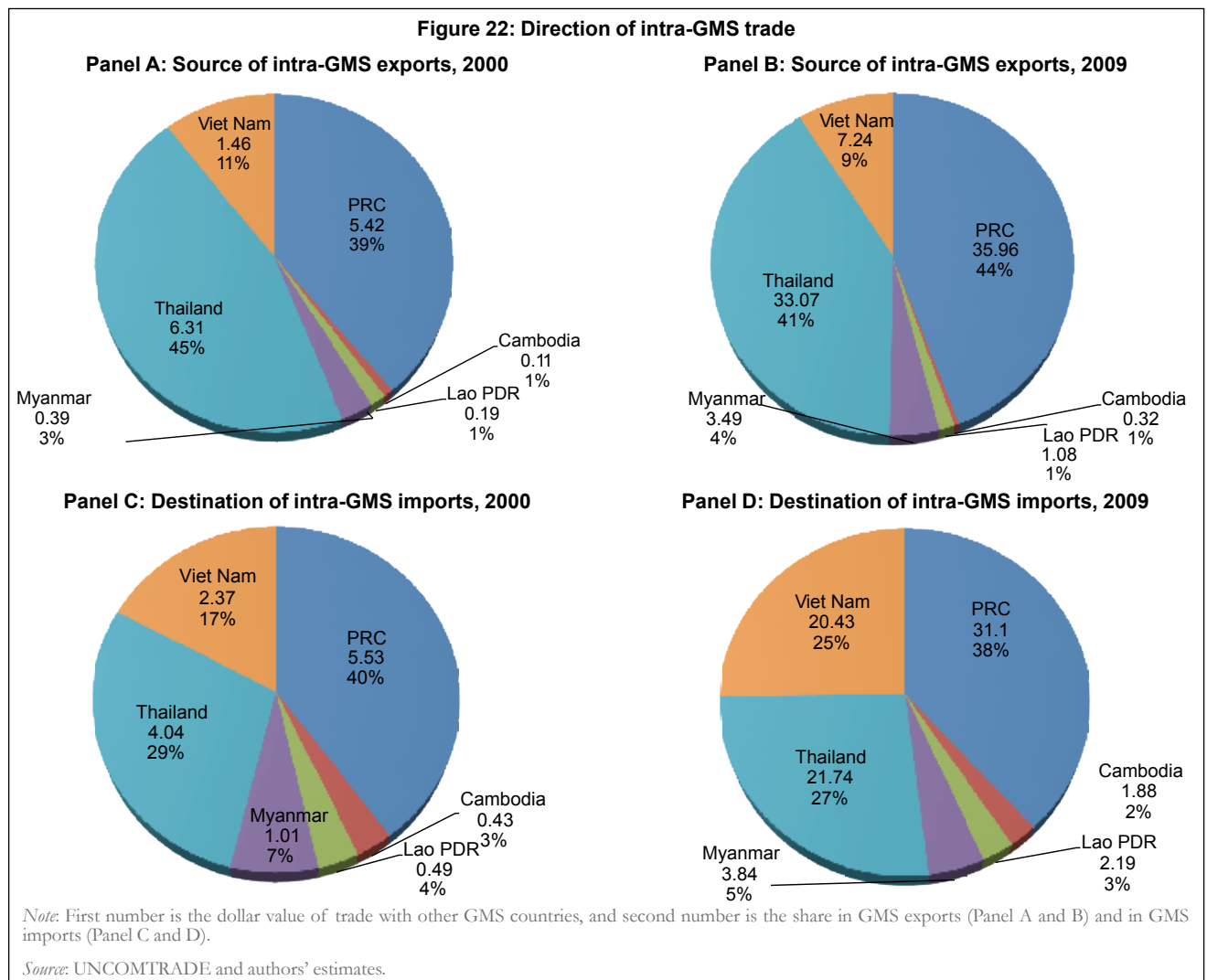
¹¹ Appendix Figure 1 (Panel A-L) shows the size and the direction of exports and imports of the individual GMS countries for the years 2000 to 2009.

¹² By definition, size of intra-GMS exports will equal intra-GMS imports.



In other words, 82% (44%+38%, Figure 22 Panel B and D) of the intra-GMS trade flows in 2009 (up from 79% in 2000) involved PRC, either as a market or a supplier for GMS5 countries. Only 18% of the intra-GMS trade in 2009 was among the GMS5 countries and did not involve PRC.

Thailand and Viet Nam are the other countries which account for a large share of trade flows within the GMS region. Thailand accounted for as much as 41% of the intra-GMS exports (note that this also includes exports to PRC as these are intra-GMS and not just intra-GMS5).



Viet Nam's share in the intra-GMS imports increased by 8 percentage points between 2000-2009.

CLM countries were the source for about 6% (including exports to PRC) of the intra-GMS exports in 2009 (compared with 5% in 2000). About 10% (including imports from PRC) of the intra-GMS imports were headed to CLM countries in 2009 (a decline of 4 percentage points compared with 2000). Thus, only 16% of the intra-GMS trade in 2009 involved CLM countries; the remaining 84% of the intra-GMS trade was among PRC, Thailand, and Viet Nam.

In terms of composition, 67% of the total exports of GMS5 countries is manufacturing and the rest, 33% is primary commodities. Similarly, on the import side, 70% of the total imports of GMS5 countries is manufacturing products and 30% is primary commodities (Figure 23A).¹³ During 2000-2009, the share of manufacturing in both total exports and imports declined by 5 and 7 percentage points, respectively. Of the 10.9% percent growth in exports during 2000-2009, 64% (i.e., 7 percentage points) came from growth in exports of manufacturing products and the rest 3.9 percentage points from primary export growth. Similarly on the import side, manufacturing accounted for two-thirds of the import growth and primary products for one-third of the total import growth of 11.4% during 2000-2009 (Figure 23B).

However, the composition varies by direction of trade as shown in Table 5. Intra-GMS5 trade (by definition export or import) is almost equally split between manufacturing and primary commodities. Further, the share of primary commodities in intra-GMS trade increased from 40.4% in

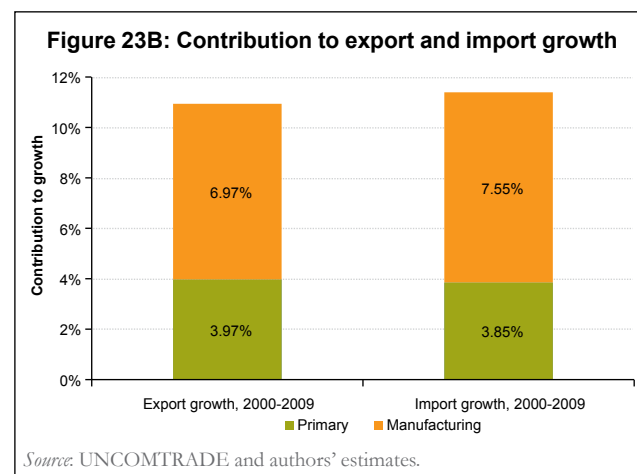
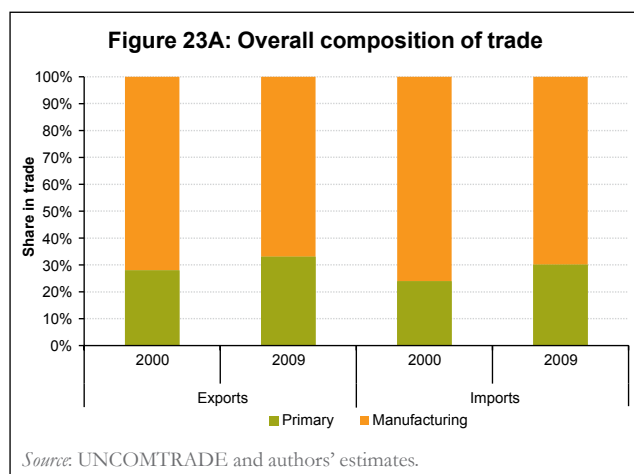
2000 to 51.3% in 2009. On the other hand, manufacturing products have the largest share in the exports of and imports of GMS5 from PRC and rest of the world and the share of manufacturing products increased during 2000-2009.

Figures 24 (Panel A-F) and 25 (Panel A-D) show a more disaggregated composition of exports and imports in 2000 and 2009, differentiating among the trading partners. The main export items (in 2009) for intra-GMS trade were fuel (32%); machinery and transport equipment (20%); food and beverages (11%); and chemicals (9%).

Almost half of exports to PRC in 2009 were machinery and transport equipment (49.7%). Other main export items to PRC include chemicals, fuel, and agricultural raw materials. In 2009, machinery and transport was the main export item to the rest of the world as well (29%), though its share declined from 37% in 2000, followed by food and beverages (18%) and textiles, apparels and travel goods (12%)

By definition of intra-regional trade, the composition of intra-GMS5 imports is the same as that of intra-GMS5 exports (Figure 24, Panel A and B). From PRC, machinery and transport equipment; chemicals; non-metallic minerals etc.; and textiles, apparels, and travel goods were the main import items of GMS5 in 2009 (Figure 25, Panel B). From rest of the world the main import were machinery and transport equipment; fuel; chemicals; and non-metallic minerals, metals, iron and steel.

The overall export structure of the GMS5 hides differences in the export structure across the GMS5 countries.



¹³ Primary commodities are defined to include SITC (Rev. 2) codes 0, 1, 2, 3, 4, 68, and 97. Manufacturing products comprise of SITC (Rev. 2) codes 5 to 9 except 68 and 97. See Appendix 1 for further details.

Table 5: Composition of trade (by direction)

Panel A: Share in exports of the GMS5 countries (%)				
Destination of exports	2000		2009	
	Primary	Manufacturing	Primary	Manufacturing
Exports to PRC	41.05	58.95	28.30	71.70
Intra-GMS5 Exports	40.41	59.59	51.31	48.69
Exports to rest of the world	26.56	73.44	32.42	67.58

Panel B: Share in imports of the GMS5 countries (%)				
Source of imports	2000		2009	
	Primary	Manufacturing	Primary	Manufacturing
Imports from PRC	13.33	86.67	11.91	88.09
Intra-GMS5 imports	40.41	59.59	51.31	48.69
Imports from rest of the world	24.07	75.93	32.22	67.78

Source: UNCOMTRADE and authors' estimates.

The composition of the imports of the individual GMS5 countries is, however, fairly similar. The share of primary and manufacturing commodity export and imports in each of the GMS member countries is shown in Figure 26 (Panels A and B). Appendix Figure 2 (Panels A-L) show a more disaggregated export and import structure of the GMS countries in 2000 and 2009 (by trading partners). A few observations stand out.

First, export baskets of Lao PDR and Myanmar comprise largely of primary products (Figure 26 Panel A). Viet Nam's export basket used to have a greater share of primary products (54%) in 2000, but the share of primary product declined to 40% by 2009. PRC's and Thailand's export basket continue to consist primarily of manufacturing products.

Second, Cambodia's overall export basket is dominated by manufacturing products, mainly garments. However, composition of Cambodia's export basket differs by destination (Appendix Figure 2, Panel C). While, Cambodia's exports to other GMS5 countries and PRC comprised largely of primary products—90% and 50%, respectively in 2009, primary products accounted for only 10% of the exports to the rest of the world. Since absolute export values for trade with the rest of the world are higher, they dominate the pattern for the overall exports shown in Figure 26 (Panel A). Further, while the structure of intra-GMS5 exports and those to the rest of the world has not changed much from 2000 to 2009, share of primary products in exports to PRC increased from 13.6% in 2000 to 47.6% in 2009.

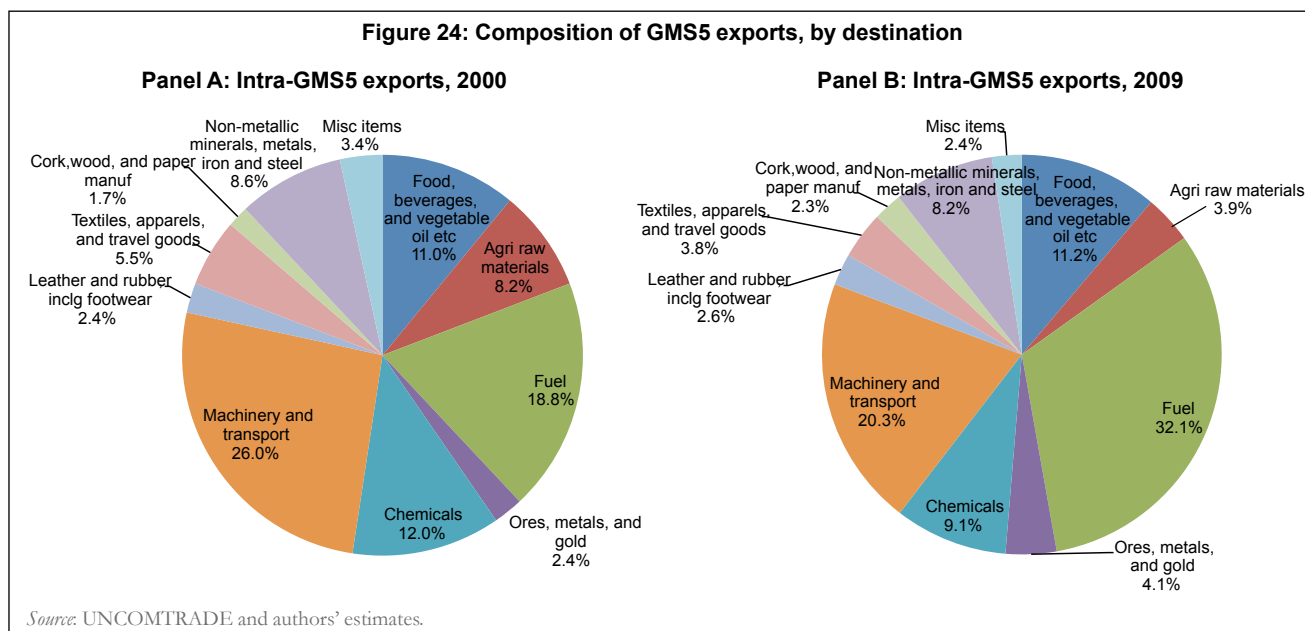
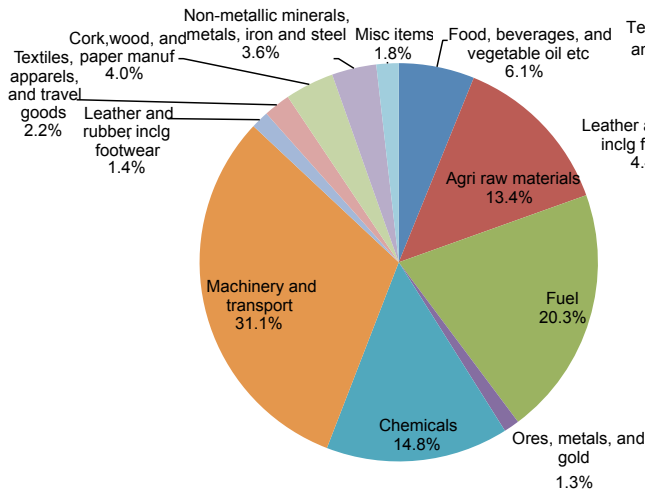
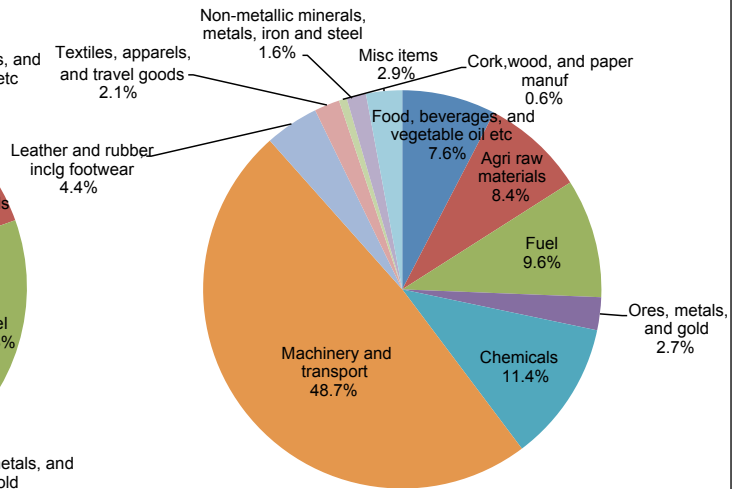


Figure 24: Composition of GMS5 exports, by destination (continued)

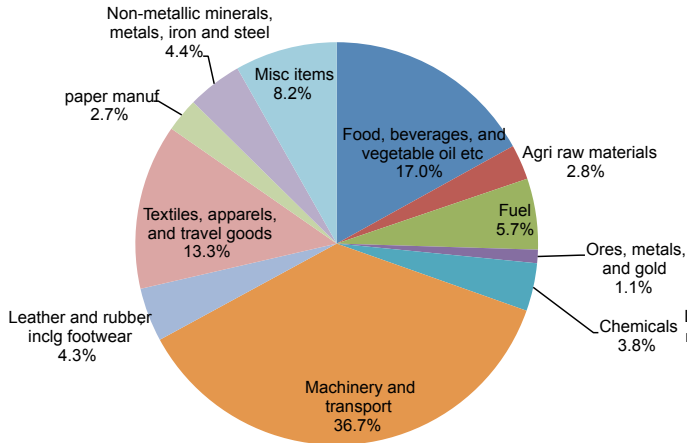
Panel C: Exports to PRC, 2000



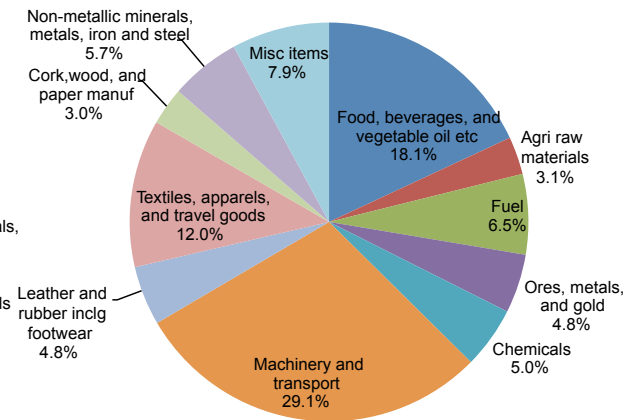
Panel D: Exports to PRC, 2009



Panel E: Exports to rest of the world, 2000



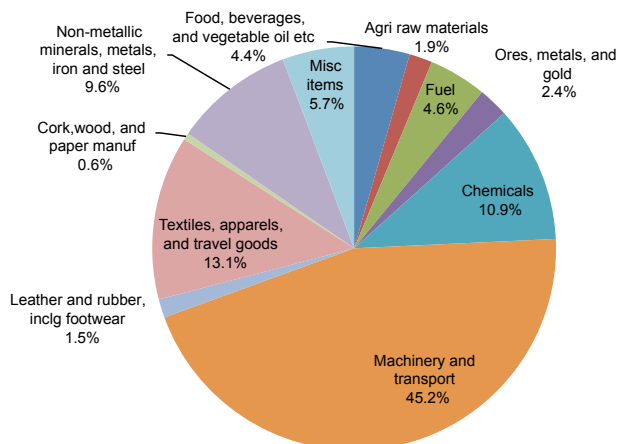
Panel F: Exports to rest of the world, 2009



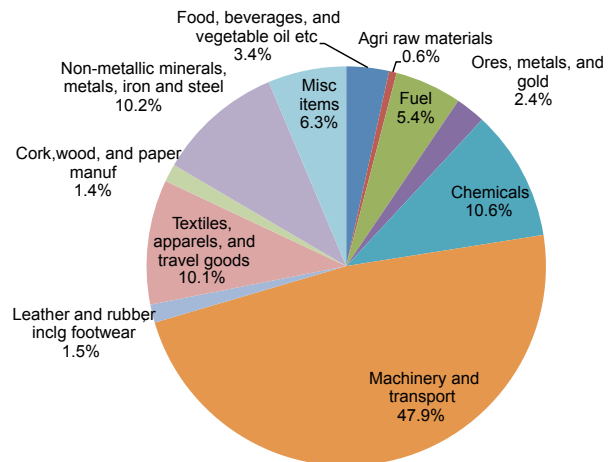
Source: UNCOMTRADE and authors' estimates.

Figure 25: Composition of GMS5 imports, by origin

Panel A: Imports from PRC, 2000

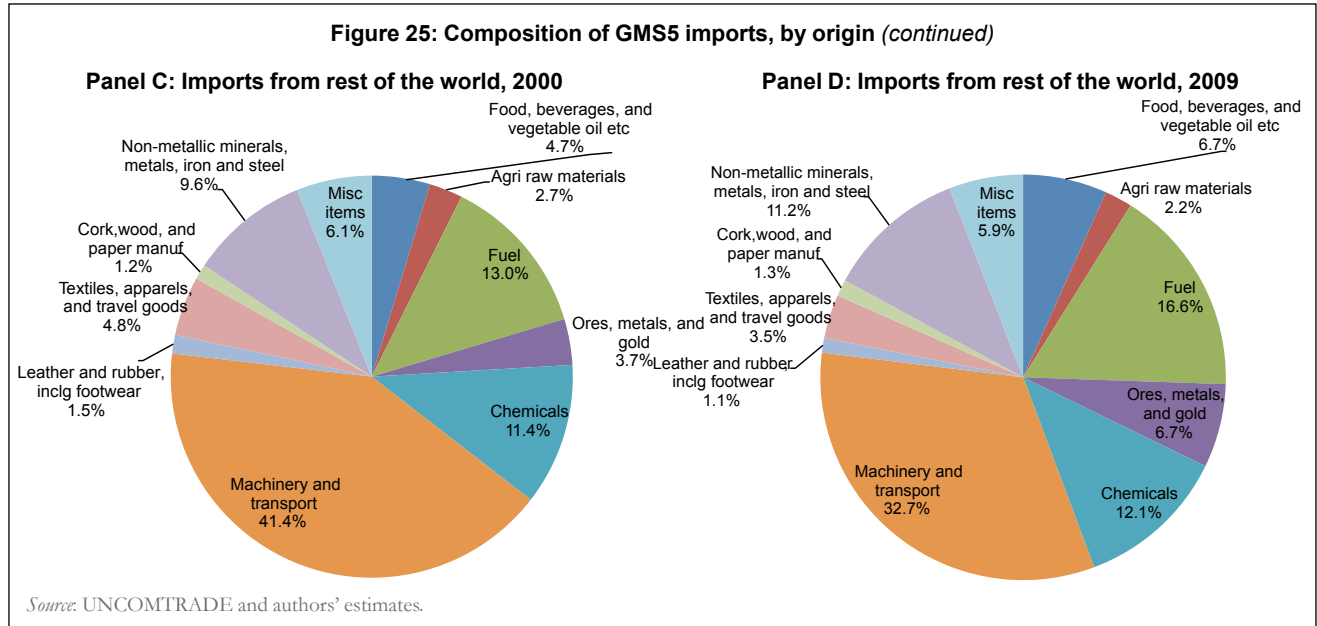


Panel B: Imports from PRC, 2009



Source: UNCOMTRADE and authors' estimates.

Figure 25: Composition of GMS5 imports, by origin (continued)



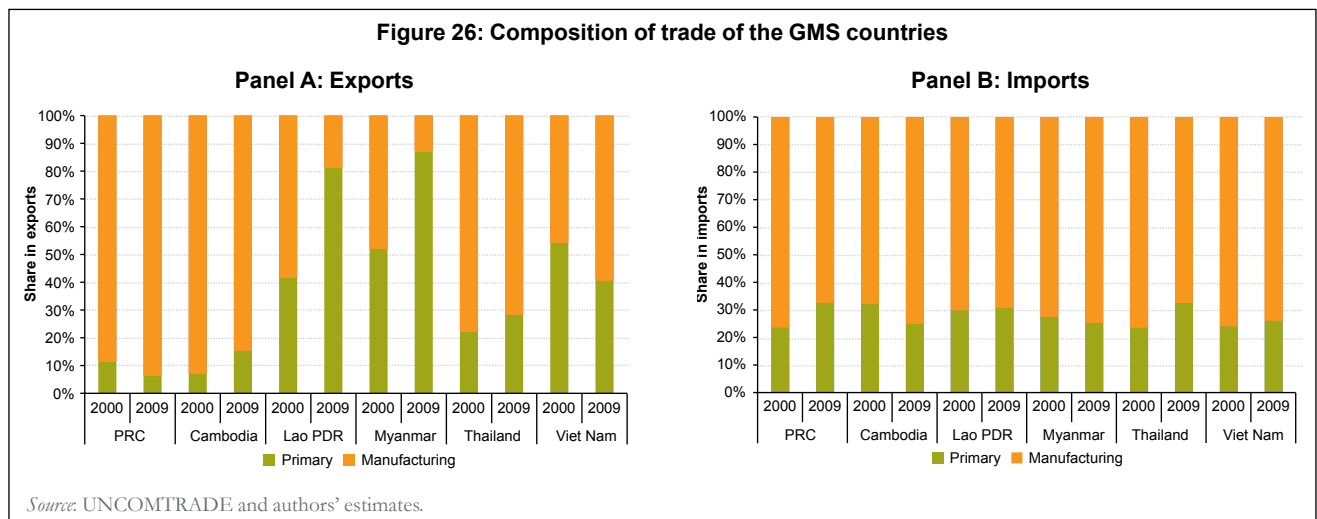
Third, similarly, there is a difference in export composition of Lao PDR, Myanmar, and Viet Nam to other GMS5 countries, their exports to PRC and to the rest of the world. In the case of Lao PDR, while intra-GMS5 exports and exports to PRC are largely primary in nature, exports to the rest of the world consist largely of textiles and garments (Appendix Figure 2, Panel E). Difference in Myanmar's export basket by destination is on account of the type of primary commodities exported to other GMS5 countries vis-à-vis PRC and the rest of the world (Appendix Figure 2, Panel G).

Fourth, as shown in Figure 24 (Panels A-F) exports of machinery and transport equipment account for roughly one-third of total GMS exports. However, machinery and transport figure prominently in the exports of only

two countries—Thailand and, more recently, Viet Nam (Appendix Figure 2, Panel I and Panel K). In other words, there is little export of machinery and transport equipment from the other GMS5 countries.

Fifth, there is little correlation in the exports of CLM countries, on one hand, and Thailand and Viet Nam, on the other hand, to other GMS5 countries and PRC (Appendix Figure 2). Similarly, exports of Thailand to the rest of the world are different from that of CLM countries and also from that of Viet Nam. Manufacturing exports from Viet Nam result in higher correlation between the exports baskets of Thailand and Viet Nam to the rest of the world. Because, Viet Nam's exports to the rest of the world also consist of primary products, its export basket to the rest of the world shows a high correlation with CLM countries.

Figure 26: Composition of trade of the GMS countries



Sixth, the import basket of all the GMS countries consists largely of manufacturing products (Figure 26, Panel B), with little difference across time or across trading partners (Appendix Figure 2). A few exceptions are noteworthy. Thailand's imports from other GMS5 countries have become more oriented towards primary products during 2000-2009 (Appendix Figure 2 Panel J). Share of primary products in Thailand's imports from GMS5 increased from 63% in 2000 to 81% in 2009. Also, imports from GMS5 are more of a primary nature than imports from PRC and rest of the world. 81% of the imports from GMS5 in 2009 were primary products, compared with 8% from PRC and 34% from rest of the world.

Finally, the structure of GMS5 exports to and imports from each of the three destinations/sources has more or less remained constant (as measured by high correlation) during 2000-2009. There are a few exceptions where the composition of export or the import basket has changed (shown in different panels of Appendix Figure 2). These include Cambodia's exports to PRC (Panel C), Lao PDR's exports to PRC and other GMS5 countries (Panel E), Myanmar's exports to the rest of the world (Panel G), and Thailand's imports from other GMS5 countries (Panel J).

4. Pattern of FDI in the GMS countries

The second channel through which the GMS countries have sought to integrate with the rest of the world is the foreign investment. Dunning's (1973) "OLI" framework categorizes the drivers of FDI into three groups: ownership (O)—why go abroad—these refer to firm specific advantages such as brand name, niche products, human capital etc.; location (L)—where to go—economic, cultural, historical factors; and internalization (I)—mode of entry—wholly owned subsidiary or a equity stake vis-à-vis other arrangements such as exports or licensing or franchising. Among these three drivers, while two are firm-specific (ownership and internalization), the third, location, which refers to host country characteristics is of greatest interest here.¹⁴

Economic characteristics driving FDI can be divided into three kinds—resource-seeking FDI, efficiency-seeking

FDI, and market-seeking FDI.¹⁵ Resource-seeking FDI is driven by the need to access particular resources in the host country. These resources could either be natural resources, raw materials, or even a large labor pool. Efficiency-seeking FDI, on the other hand, is motivated by the desire to look for efficient production centers. Factors determining this kind of FDI include productivity-adjusted labor costs, quality of skilled labor, macroeconomic environment, trade policy, and quality of hard infrastructure and soft infrastructure (for example, transport and trade facilitation). In recent years, with a fall in trade costs and advances in information and communication technologies, production processes have been fragmented to take advantage of the most efficient location for production. However, for cross-country supply chains to work, hard infrastructure and seamless movement of goods and trucks across borders are critical. Market-seeking FDI seeks to take advantage of the market size of the host country. Growth in the size of the home country markets, domestic investment regime, regional integration in the form of free trade areas which further expands the size of the market also play a role in determining the location of the market-seeking FDI.¹⁶

In some cases FDI may be driven exclusively by one of the three motives above. For example, FDI in resource-rich countries is guided by the availability of resources in host countries. However, more often than not, FDI in other cases is the interplay of all the three, i.e., its resource, efficiency, and market driven. For example, before PRC's accession to WTO, inward FDI was driven by its large labor pool (resource-driven), low labor costs after adjusting for productivity (efficiency-driven), and the size of the huge market which was protected behind tariff walls (market-driven).

The total stock of outstanding inward FDI stock in the world increased by approximately ten times from \$2.1 trillion in

¹⁵ Another type of distinction that is made in the theoretical literature is that between horizontal and vertical FDI. Vertical FDI involves fragmentation of the production process and relocation of certain stage of production to another country, and is likely to be guided by differences in relative factor endowments across countries (Helpman 1984). Horizontal FDI, on the other hand, involves operating a self-contained plant in the host country and is driven by market access and low fixed costs of setting up new plants (Markusen 1984). Markusen (2002) combines both the forms of FDI into a "knowledge-capital" model in which FDI is motivated by both market access and factor endowment differences.

¹⁶ With regard to FDI being attracted by the size of the integrated markets, not all countries in the regional integration may benefit as FDI may be concentrated in one or two countries. Also if the regional integration raises trade barriers for non-members, efficiency-seeking FDI may be undermined and this may offset some of the benefits of market-seeking FDI (Nunnenkamp 2001).

¹⁴ While the discussion here has been compartmentalized to focus on host country characteristics, the decision of a firm to invest in a country is likely to be the result of interplay among the three categories. For example, decision on the mode of entry may depend among other things on the foreign investment regime of the host country, business facilitation services as well as the strength of its legal system which will be critical for a firm to safeguard its intellectual property.

1990 to \$19.1 trillion in 2010. Of the total stock of inward FDI in 1990, 24.9% was accounted for by developing and transition economies and the rest by developed countries (Table 6). The share of developing economies in the stock of inward FDI increased to 34.7% in 2010 from 24.9% in 1990. Developing Asia accounted for 19.1% of the total FDI inward stock in 2010, up from 16.5% in 1990.

As shown in Table 6 (and later in Table 7 for outward FDI), PRC has attracted a lion's share of inward FDI and far exceeds the FDI attracted by the GMS5 countries. Among

the GMS countries, PRC had the highest share of world inward stock of FDI amounting to \$578.8 billion in 2010 (3% of the world total), up from 1% in 1990. Therefore, similar to the analysis of trade patterns above, GMS5 is discussed separately from PRC to avoid the patterns being dominated by FDI statistics for PRC. The stock of GMS5 countries in 1990 was \$10.2 billion (0.5% of the world stock of inward FDI). This increased by twenty times to \$209.2 billion (and amounted to 1.1% of the world stock of inward FDI) in 2010.

Table 6: Stock and flows of inward FDI (US\$ billions)

	Stock of inward FDI			Cumulative flow of inward FDI	
	1990	2000	2010	1990-1999	2000-2010
World	2,081.3 (100.0)	7,445.6 (100.0)	19,140.6 (100.0)	4,021.2 (100.0)	12,759.1 (100.0)
Developed economies	1,562.3 (75.1)	5,653.2 (75.9)	12,501.6 (65.3)	2,796.5 (69.5)	8,041.5 (63.0)
Developing and transition economies	519.0 (24.9)	1,792.4 (24.1)	6,639.0 (34.7)	1,224.7 (30.5)	4,717.6 (37.0)
Developing Asia	342.9 (16.5)	1,072.7 (14.4)	3,663.0 (19.1)	690.3 (17.2)	2,534.3 (19.9)
<i>of which</i>					
Cambodia	0.038 (0.002)	1.6 (0.02)	6.0 (0.03)	1.2 (0.03)	4.5 (0.04)
Lao PDR	0.013 (0.001)	0.6 (0.008)	2.1 (0.01)	0.5 (0.01)	1.5 (0.01)
Myanmar	0.28 (0.014)	3.2 (0.04)	8.3 (0.04)	3.6 (0.1)	4.8 (0.0)
Thailand	8.2 (0.40)	29.9 (0.4)	127.3 (0.7)	31.8 (0.8)	71.1 (0.6)
Viet Nam	1.6 (0.08)	20.6 (0.3)	65.6 (0.3)	13.3 (0.3)	43.4 (0.3)
GMS5	10.2 (0.49)	55.9 (0.8)	209.2 (1.1)	50.5 (1.3)	125.3 (1.0)
PRC	20.7 (0.99)	193.3 (2.6)	578.8 (3.0)	290.4 (7.2)	792.2 (6.2)
Total GMS	30.9 (1.5)	249.2 (3.3)	788.0 (4.1)	340.9 (8.5)	917.5 (7.2)
Brunei Darussalam	0.033 (0.002)	3.9 (0.1)	11.2 (0.06)	3.3 (0.1)	7.9 (0.1)
Indonesia			121.5 (0.6)		49.1 (0.38)
Malaysia	7.4 (0.35)	28.7 (0.4)	44.5 (0.2)	48.2 (1.2)	51.1 (0.4)
Philippines	1.8 (0.09)	10.1 (0.1)	15.0 (0.1)	11.9 (0.3)	18.1 (0.1)
Singapore	10.6 (0.51)	65.6 (0.9)	194.6 (1.0)	84.8 (2.1)	215.3 (1.7)
ASEAN5	19.9 (0.96)	108.4 (1.5)	386.8 (2.0)	148.2 (3.7)	341.4 (2.7)
Total ASEAN	30.1 (1.45)	164.3 (2.2)	596.0 (3.1)	198.6 (4.9)	466.7 (3.7)

Source: UNCTAD and authors' estimates. Note: Figures in brackets are percentages of world total.

Table 7: Stock and flows of outward FDI (US\$ billions)

	Stock of outward FDI			Cumulative flow of outward FDI	
	1990	2000	2010	1990-1999	2000-2010
World	2,094.2	7,962.2	20,408.3	4,183.6	12,892.6
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
Developed economies	1,948.1	7,083.5	16,803.5	3,727.4	10,613.6
	(93.0)	(89.0)	(82.3)	(89.1)	(82.3)
Developing and transition economies	145.5	878.7	3,604.7	456.2	2,279.0
	(6.9)	(11.0)	(17.7)	(10.9)	(17.7)
Developing Asia	67.6	608.4	2,276.2	326.2	1,426.2
	(3.2)	(7.6)	(11.2)	(7.8)	(11.1)
<i>of which</i>					
Cambodia		0.19	0.3	0.03	0.17
		(0.002)	(0.002)	(0.00)	(0.001)
Lao PDR	0.001	0.026		0.02	(0.02)
	(0.0000)	(0.0003)		(0.0004)	(-0.0001)
Myanmar					
Thailand	0.4	2.2	25.5	4.1	19.1
	(0.02)	(0.03)	(0.1)	(0.1)	(0.1)
Viet Nam					2.2
					(0.02)
GMS5	0.4	2.4	25.8	4.1	21.4
	(0.02)	(0.0)	(0.1)	(0.10)	(0.17)
PRC	4.5	27.8	297.6	23.2	251.2
	(0.21)	(0.3)	(1.5)	(0.6)	(1.9)
Total GMS	4.9	30.2	323.4	27.4	272.6
	(0.2)	(0.4)	(1.6)	(0.7)	(2.1)
Brunei Darussalam	0.0001	0.5	0.7	0.5	0.2
	(0.000)	(0.01)	(0.003)	(0.01)	(0.002)
Indonesia			1.7		24.9
			(0.01)		(0.2)
Malaysia	0.8	15.9	96.8	15.0	64.3
	(0.04)	(0.2)	(0.5)	(0.4)	(0.5)
Philippines	0.4	2.0	6.6	1.5	5.9
	(0.02)	(0.03)	(0.03)	(0.04)	(0.05)
Singapore	7.8	56.8	300.0	46.4	142.4
	(0.37)	(0.7)	(1.5)	(1.1)	(1.1)
ASEAN5	9.0	75.2	405.7	63.5	237.6
	(0.43)	(0.9)	(2.0)	(1.5)	(1.8)
Total ASEAN	9.4	77.6	431.5	67.6	259.0
	(0.45)	(1.0)	(2.1)	(1.6)	(2.0)

Source: UNCTAD and authors' estimates.

Note: Figures in brackets are percentages of world total.

In terms of flows, the total inward flow of FDI in the world (Table 6) during 2000-2010 (2000s) was \$12.8 trillion, up from \$4 trillion during 1990-1999 (1990s). The share of developing and transition economies in the cumulative flows increased from 30.5% in 1990s to 37.0% during 2000s. Developing Asia received one-fifth of the cumulative during 2000s, an increase of approximately 3 percentage points compared with the 1990s. Among the GMS countries, PRC received \$792.2 billion worth of FDI during 2000s (up from \$290.4 billion during 1990s). PRC's share in the world flows of FDI fell from 7.2% during 1990s

to 6.2% during 2000s. GMS5 received a total of \$125.3 billion worth of FDI during 2000s (0.98% of the world total) compared with \$50.5 billion during 1990s (1.26% of the world total).

In the last two decades, not only has the share of inward FDI to the developing countries increased but their share in outward FDI has also increased. The total stock of outward FDI in the world in 2010 was \$20.4 trillion (Table 7), ten times more than the stock of outward FDI in 1990 (\$2.1 trillion). In 1990, developing and transition economies

accounted for 6.9% of the total stock of outward FDI. This share more than doubled to 17.7% in 2010. Developing Asia's share of the total stock of outward FDI increased from 3.2% in 1990 to 11.2% in 2010. The share of outward stock of FDI from PRC (\$4.5 billion) increased from 0.2% of the world stock of FDI in 1990 to 1.5% in 2010 (amounting to \$297.6 billion).

The share of developing and transition economies in the cumulative flow of outward FDI in the world increased from 10.9% in 1990s to 17.7% during 2000s. Developing Asia's share in the cumulative outward flow of FDI increased from 7.8% of the world flows in 1990s to 11.1% in 2000s. Among the GMS countries, PRC's share in the world flows of outward FDI increased by three times from 0.56% in 1990s to 1.95% during 2000s.

In addition to the drivers of FDI mentioned above, outward FDI from developing countries is likely motivated by other factors. These include expanding beyond national markets to establish a presence in regional and global markets, desire to obtain access to advanced technology in developed countries through setting up of research and development centers, and the so-called "supplier following assembler" FDI where local suppliers in the host countries follow the assembler if the latter moves to a new location outside the country (Hiratsuka 2006).

A large share of outward FDI from developing economies is of the "south-south" kind, i.e., the FDI that is headed for other developing economies (UNCTAD 2006, pp. 117). Further, bulk of the south-south FDI is intra-regional. For example, intra-regional FDI flows in East, South, and Southeast Asia accounted for half of the FDI flows to the region during 2002-2004 (UNCTAD 2006, pp. 54), majority of which is between and within East and Southeast Asia.

The phenomenon of growing outward FDI from developing economies, especially that from developing Asia, has gathered attention in the literature on FDI. Recent studies such as Hattari and Rajan (2008), Hill and Jongwanich (2009), Hiratsuka (2006), Menon and Melendez (2011), Plummer and Cheong (2007), and UNCTAD (2006) have analyzed the pattern and drivers of outward FDI flow from developing economies, and in particular from developing Asia with a focus bilateral FDI flows within Asia and/or ASEAN.

Table 6 and 7 also show the inward and outward FDI stock and cumulative flow of each of the GMS5 member countries. Among the GMS5, Thailand is the major

recipient of FDI followed by Viet Nam. For outward FDI from GMS5, Thailand is a major source of outward FDI with a small amount originating in Viet Nam as well (Table 7).

For comparison with other countries in the region, also shown are the FDI statistics of the other ASEAN countries in Table 6 and 7. The inward FDI into ASEAN5 exceeds that of GMS5, however most of it is accounted for by Singapore. Among all the ASEAN countries, Thailand is the second largest recipient of FDI after Singapore. Similarly in terms of outward FDI, ASEAN5 exceeds GMS5 and Singapore is the largest source of FDI among all the ASEAN countries followed by Malaysia.

The analysis above examined the size of the overall inward and outward FDI of the GMS5 countries. Of particular interest is the source of inward FDI and direction of outward FDI of the GMS5 countries as well as the share of those flows originating from within the GMS and from non-GMS ASEAN5 countries. This is examined next for the period 2000-2008. The shorter time period is due to the lack of availability of consistent data for the entire ten year period, 2001-2010.

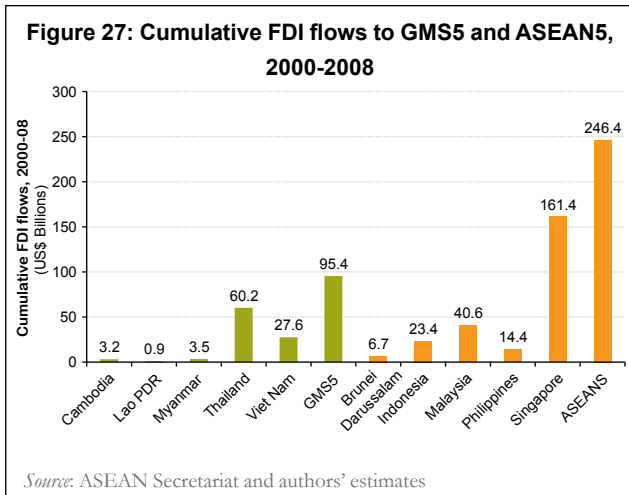
Over the period 2000-2008, total inward FDI flows into the GMS5 countries amounted to \$95.4 billion which was less than half of the cumulative FDI inflows in ASEAN5, \$246.4 billion, during the same period (Figure 27). Among the GMS5 countries, 63% of the total FDI inflow during 2000-2008 is accounted for by Thailand and 29% by Viet Nam. Lao PDR accounted for only 0.9% of the cumulative FDI in GMS5 during 2000-2009. The rest is distributed almost equally between Cambodia and Myanmar. Almost 65% of ASEAN5's cumulative FDI inflow during 2000-2008 is accounted for by Singapore.

Figure 28 shows the share of different sources in the cumulative FDI inflows to GMS5 countries during 2000-2004 and 2005-2008. FDI inflows from the rest of the world to GMS5, during both the sub-periods, accounted for the largest share of total cumulative FDI inflows and ASEAN5 accounted for about a fifth of the cumulative FDI inflows. PRC accounted for 1.4% during 2000-2004 and 2.9% during 2005-2008. Share of cumulative FDI inflow originating from within the GMS5 was 1.1% during 2000-2004 and it increased to 2.1% during 2005-2008. The share of the cumulative FDI inflows coming from the rest of the world declined marginally from 2000-2004 to 2005-2008. Commensurate with the decline in the share of FDI inflows from the rest of the world, share of FDI inflows originating in other GMS5 countries and PRC doubled.

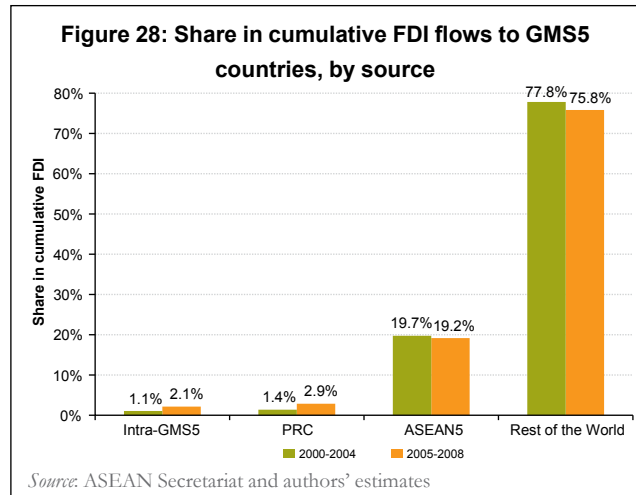
Table 8: Cumulative inward FDI flows to GMS5 countries, by source (%)

Source → Host	2000-2004				2005-2008			
	Intra-GMS5	PRC	ASEAN5	Rest of the World	Intra-GMS5	PRC	ASEAN5	Rest of the World
Cambodia	9.7	16.9	5.1	68.3	16.8	18.6	14.5	50.1
Lao PDR	18.4	20.1	7.0	54.5	20.1	7.1	1.5	71.3
Myanmar	1.8	10.0	15.8	72.4	11.9	29.8	1.2	57.2
Thailand	0.1	0.2	22.9	76.8	-0.1	0.4	23.4	76.2
Viet Nam	3.0	2.1	11.5	83.5	2.6	2.1	14.8	80.5

Source: ASEAN Secretariat-ASEAN FDI Database and authors' estimates.



Source: ASEAN Secretariat and authors' estimates



Source: ASEAN Secretariat and authors' estimates

However, the share of GMS5 and PRC in total FDI inflows into GMS5 remained low, at 2.1% and 2.9% respectively.

Table 8 shows the shares of cumulative FDI inflows for each of the GMS5 countries during 2000-2008. All the countries in the GMS5, get the bulk of their FDI inflows from outside the region (i.e., rest of the world not including GMS5, ASEAN5, and PRC) as shown in the last column under each sub-period.

Among the GMS5, Cambodia, Lao PDR, and Myanmar are relatively more dependent on FDI originating from other GMS5 countries and PRC (Table 8), though they still get most of their FDI from rest of the world. Viet Nam gets most

of its FDI from rest of the world and a small share from GMS5, which is largely from Thailand. (Table 9). Thailand, on the other hand, relies mostly on ASEAN5 and rest of the world for FDI inflows and GMS5 and PRC combined account for less than 1% of the FDI inflows into Thailand.

PRC's total FDI outflows to GMS5 countries during 2000-2008 amounted to US\$2,261 million. This was more than the total FDI outflows of any of the GMS5 countries to other GMS5 countries (Table 9, second-last row). For FDI flows originating within the GMS, Thailand is the second major source (after PRC) of FDI going to other GMS5 countries with Viet Nam a distant third. Of the total FDI inflows to GMS countries during 2000-2008 coming from PRC, the

Table 9: Bilateral cumulative FDI flows (in US\$ million), 2000-2008

	FDI Outward by						FDI inflow to GMS5				
	Cambodia	Lao PDR	Myanmar	Thailand	Viet Nam	PRC	From GMS5	From PRC	From ASEAN5	From Rest of the World	Total Inward FDI
Cambodia		-	-	264	228	586	492	586	402	1,725	3,205
Lao PDR	0.03		0.45	152	24	79	176	79	20	612	886
Myanmar	-	-		295	5	815	300	815	206	2,167	3,488
Thailand	16	(36)	21		0.33	198	1	198	13,982	46,039	60,221
Viet Nam	2	25	-	705		584	732	584	3,854	22,419	27,588
Outward to GMS5	18	-11	21	1,417	257	2,261					
Total							1,702	2,261	18,463	72,962	95,388

Source: ASEAN Secretariat-ASEAN FDI Database and authors' estimates.

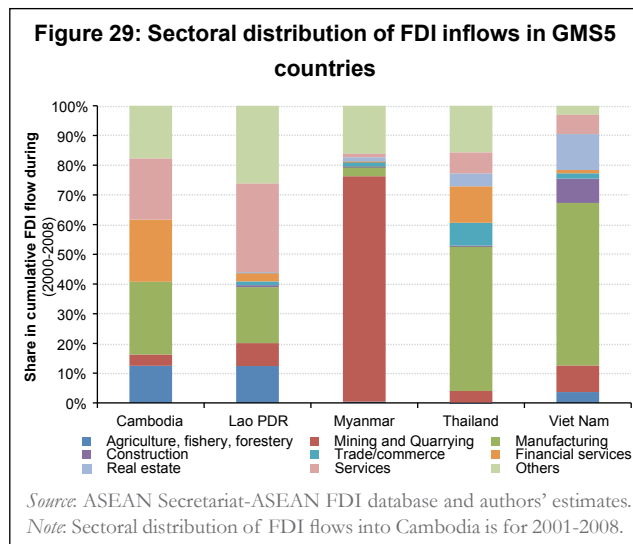
largest share, 36%, went to Myanmar. Intra-GMS FDI inflow in Cambodia, Lao PDR, and Myanmar is largely from PRC and Thailand. Viet Nam is also a major intra-regional source of FDI for Cambodia. Other than the FDI to Cambodia, Viet Nam is not a major source of FDI for other GMS5 countries. From among the GMS countries, FDI inflows to Viet Nam are largely from Thailand and PRC. FDI flows among Cambodia, Lao PDR, and Myanmar are minimal or none at all.

Figure 29 shows the sectoral distribution of the cumulative inward FDI flows in the GMS5 countries during 2000-2008. There are significant differences across the GMS5 countries. In Thailand and Viet Nam, manufacturing sector accounted for half, while in Myanmar mining and quarrying was the major recipient accounting for as much 75% of the total FDI flows during 2000-2008. In Thailand, apart from manufacturing sector, financial services also received significant FDI flows. Mining and quarrying, construction and real estate sectors also received significant FDI in Viet Nam, though their share remained below 10% compared with 55% share of manufacturing. In Cambodia, FDI was largely distributed across agriculture, manufacturing, financial services, and services. In Lao PDR the major recipients were agriculture, manufacturing, and services.

The distribution of FDI across sectors is largely in line with the share of sectors in exports. While exact comparison is not feasible due to lack of export data on similarly defined service sectors and lack of FDI data for disaggregated manufacturing sector, one can gauge the similarity of sectors receiving FDI and the key export sectors based on whether they are primary or secondary.

For example, Myanmar's exports of goods are largely primary in nature and the sector receiving the maximum share of FDI is mining and quarrying which is a primary sector. Similarly, in Thailand and Viet Nam, manufacturing products account for the largest share of exports and the manufacturing sector also is the major recipient of FDI. In Lao PDR and Cambodia, the export basket consists of both manufacturing and agricultural products and FDI inflows in both the countries is directed towards the two sectors along with FDI in service sectors.¹⁷

Since a large share of the FDI flowing into the GMS5 countries is of the resource-seeking type (for example in mining and quarrying sector in Cambodia, Lao PDR, and



Myanmar) or efficiency-seeking (in manufacturing sectors in the GMS5 countries to take advantage to the most efficient location for production), the FDI inflows seem to be directed towards sectors of comparative advantage. At the same time, size of regional markets may also be determining FDI to take advantage of not only the domestic markets but also regional markets under the AFTA

5. Growth prospects of the GMS countries: 2010-2020

GMS5 economies are expected to maintain their growth over the next five years, 2011-2016. Table 10 shows the projected growth rates of the GMS countries for 2011, 2012, and average annual growth rates for 2013-2016.

Table 10: Projected GDP growth rates (%), 2011-2016

	2011	2012	2013-2016
Cambodia	6.8	6.5	7.4
PRC	9.3	9.1	9.5
Lao PDR	8.1	7.6	7.4
Myanmar	5.3	5.4	5.6
Thailand	4.0	4.5	4.9
Viet Nam	5.8	6.5	7.2

Source: Asian Development Outlook Update (September 2011) for 2011 and 2012, World Economic Outlook Database (September 2011) for 2013-2016, authors' estimates.

Cambodia, Lao PDR, and Myanmar are expected to maintain their pace of growth while the economies of PRC, Thailand, and Viet Nam are expected to slow down a bit. In PRC, weakened external environment and tightening monetary policy measures put in place to combat inflation are expected to contribute to a moderation in growth. In Thailand, slowdown in 2011 is expected on account of

¹⁷ Note that the discussion here is in terms of the share of primary and secondary sectors in total exports and total FDI.

earthquake in Japan earlier in the year and the associated disruption in supply chains, floods in Thailand later in the year which impacted key industrial zones, and on account of cautious consumer spending. Rehabilitation and reconstruction efforts later in the year and 2012 are likely to provide an impetus to growth. In Viet Nam, tightening fiscal, monetary, and credit policies put in place in the first quarter of 2011 to contain inflation are likely to slowdown growth in 2011.

However, there are some downside risks to the growth prospects of the GMS countries. They are likely to face a weak external environment on account of the sovereign debt crisis in the advanced economies. Any deterioration of the debt situation, especially in Europe, and its ensuing impact on the banking and the financial sector are likely to directly impact the GMS economies through both the trade channel, as demand will weaken further, and the finance channel as foreign investment flows dry up to meet obligations in the home country and to seek safer avenues. Lack of access to finance will also impact FDI flows.

Though there has been some rebalancing away from dependence on demand and finance from western economies, which can help soften the impact of weakening economic conditions, GMS5 are likely to see some indirect effects. There is a potential for a second round effect on the GMS5 economies as exports for final consumption from Japan and PRC are hit by weak external demand, which will trickle down the supply chain. Finally, a slowdown in PRC due to its own domestic measures and external conditions may also impact GMS5 economies as trade and investment ties with PRC have deepened in the 2000s.

In the long run, the development challenges that each of the GMS economies face are somewhat different. The resource-rich economies of Lao PDR and Myanmar need to tackle the challenges of macroeconomic management of resource revenues as well as generate sources of long-term and sustainable growth by diversifying their respective economic bases away from mining and agricultural sectors towards modern sectors. Similarly, Cambodia needs to diversify away from agricultural commodities and low-valued added manufacturing.

Myanmar needs to implement an ambitious and a wide-ranging reform agenda which includes liberalization of agriculture and trade, strengthening of macroeconomic management which is especially important in light of the stream of resource revenues expected from increased exports of natural gas, addressing weaknesses in

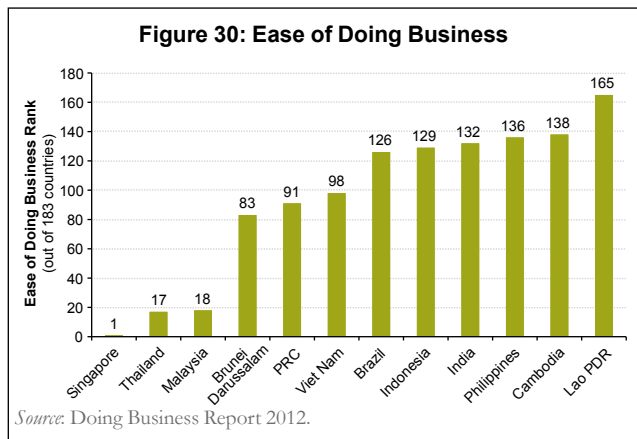
the financial sector, improving the business climate, generating fiscal resources to expand social and infrastructure spending, and reforming the tax system. Some steps have already been taken in this direction recently. These measures include (i) establishment of a new powerful Investment Commission and preparation of a new investment law to facilitate and attract FDI to non-natural resource based industries, (ii) privatization of state economic enterprises (SEEs) (60 of the 120 SEEs under the Ministry of Industry were privatized during 2011 and another 30 were expected to follow soon at the time of the writing of this paper), (iii) reduction of export taxes (from 10% to 2%) to promote exports, (iv) reducing the monetization of the deficit to fight inflation, and (v) allowing six private banks to open exchange rate windows and expanding credit for agriculture. Myanmar needs to balance its needs of using resource revenues in a way that meets the massive development needs of Myanmar without falling into the trap of “Dutch-disease”.

The long-term challenges in PRC, Thailand, and Viet Nam are somewhat different from the rest of the GMS economies. According to the World Bank’s classification, all the three countries are classified as middle-income countries. While the PRC and Thailand are in the upper-middle income category, Viet Nam is in the lower-middle income group. The challenge for PRC and Thailand is to avoid the middle-income trap, i.e., getting stuck in the middle-income category and not being able to transition to the high-income trap. In short, how do these countries keep growing? These countries not only need to continue moving up the value chain into higher value added products, away from simple assembly to product development but also implement other measures to support continued growth. These include strengthening of institutional and legal framework to encourage research and development, removing weaknesses in the financial sector, strengthening social safety nets, creating internal and regional sources of demand to reduce reliance on advanced economies which will ultimately help address the issue of global imbalances, investment in infrastructure, and a world class logistics sector, improving business climate, and promoting trade facilitation. The kind and depth of measures that will be needed across the three countries are likely to be very different. Of the various measures noted, trade facilitation is discussed in greater detail below.

As already noted, alongside pursuing policies at the regional level to further trade and investment in the GMS region, GMS member countries must improve their respective domestic business climate. The World Bank’s

Doing Business (DB) Report (2012) shows that the GMS countries have made improvements since 2005 and narrowed the gap with the best performers.¹⁸ Despite this narrowing, except Thailand which is ranked 17th (out of 183 countries), all the other GMS countries are in the bottom half of the ranking (Figure 30). Singapore, which continues to be the top performer, and Malaysia are the other ASEAN countries in the top twenty.

Countries that have implemented reforms covering multiple areas of the ease of doing business and have sustained such reforms for a long period are the ones that have narrowed the gap with the frontier the most (DB Report 2012). For example, Georgia was ranked similar to Viet Nam, 100th versus 99th respectively (out of 155 countries) in 2005 (DB Report 2006). Over the next six years, Georgia implemented reforms across multiple areas and almost closed the gap with the frontier in the areas of starting a business and registering property by 2011. Out of 174 countries, Georgia narrowed its gap to the frontier the most and by 2011 Georgia was ranked 16th (out of 183 countries) while Viet Nam was ranked 98th in 2011. Figure 31 shows the rank of GMS countries across the nine areas of doing business and compares it with that of Singapore which is the top performer in terms of the ease of doing business. GMS5 countries such as Cambodia, Lao PDR, and Viet Nam rank low across a number of areas of doing business and need to implement wide-ranging measures to reduce the cost of doing business as well as make such reforms an integral part of their respective long-term competitiveness strategy.



¹⁸ Best performer or “frontier” is defined as the most efficient performance by any economy since 2005, i.e., best performance across economies and across years from 2005 to 2011.

In addition to the ease of doing business, another area which can be a hurdle is the ease with which goods can be moved across borders. This is all the more important in today’s time when production processes are fragmented across borders (as they are in the case of GMS countries), profit margins are razor thin and timely deliveries are critical to keep the supply chain fully functional and moving. Trade facilitation is, thus, critical to not only boosting trade but also to attracting FDI. Figures 32 and 33 provide a comparison of trade facilitation and logistics in the GMS countries with other countries from the Asia-Pacific region using World Bank’s logistics performance index (LPI) and trading across borders. Singapore is the best performing country on LPI. Other than PRC and Thailand, all the GMS countries perform below the average for ASEAN5. Cambodia, Lao PDR, Myanmar, and Viet Nam (CLMV) all score low in various components of LPI (Table 11).

Another critical aspect is transport facilitation, i.e., the ease of moving vehicles carrying goods across borders smoothly. There are different aspects to transport facilitation such as traffic regulation, harmonization of vehicle standards, and backloading which depends on the structure of the domestic transport sector. Transport facilitation has been recognized as a critical binding constraint to the movement of goods across the GMS countries.

CLMV countries, which rank low on various measures of trade facilitation, need to implement further transport and trade facilitation measures across broad ranging areas from improving infrastructure to increasing the efficiency of customs administration to harmonizing traffic regulations for smooth movement of trucks. Improvements will not only help further trade but are also ultimately important to attract

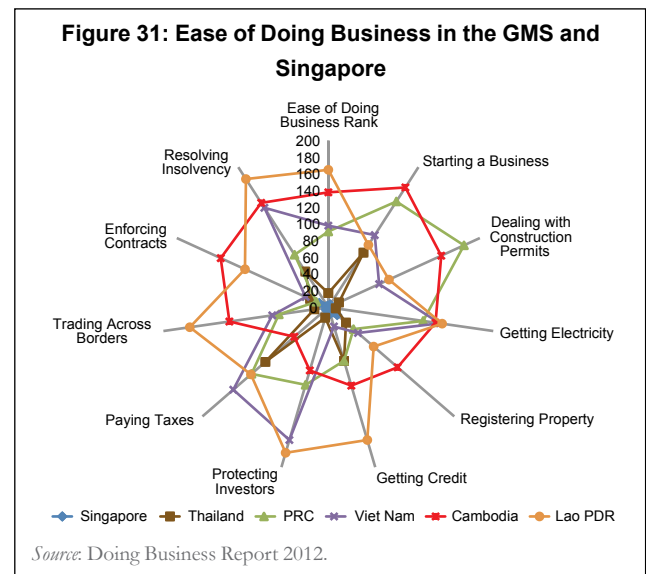
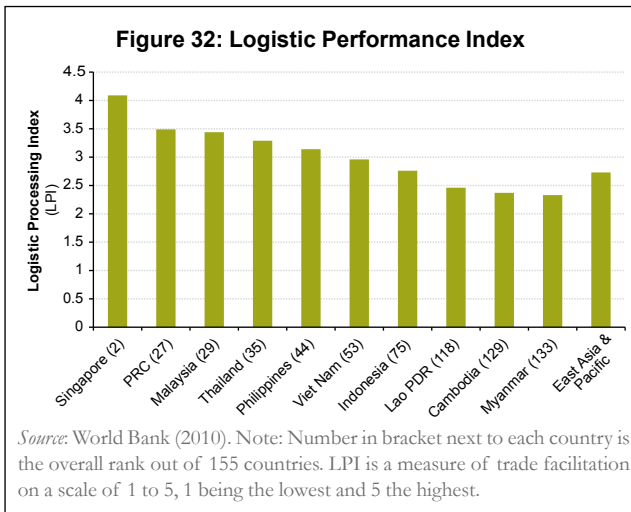


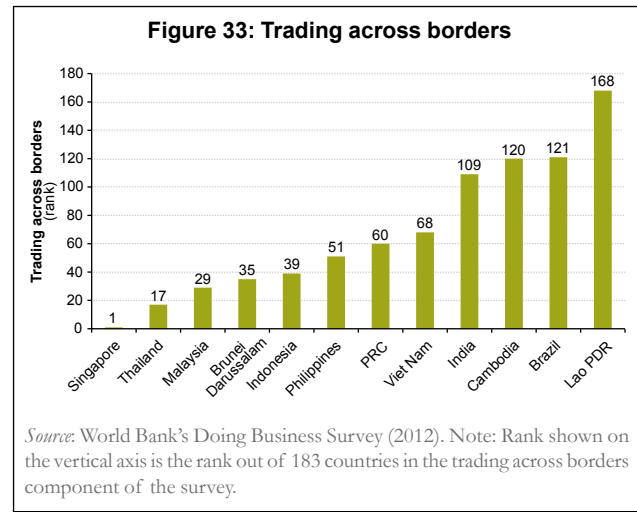
Table 11: LPI and its components, 2010

Rank	Country	LPI	Customs	Infrastructure	International shipments	Logistics competence	Tracking & tracing	Timeliness
2	Singapore	4.09	4.02	4.22	3.86	4.12	4.15	4.23
27	PRC	3.49	3.16	3.54	3.31	3.49	3.55	3.91
29	Malaysia	3.44	3.11	3.5	3.5	3.34	3.32	3.86
35	Thailand	3.29	3.02	3.16	3.27	3.16	3.41	3.73
44	Philippines	3.14	2.67	2.57	3.4	2.95	3.29	3.83
53	Viet Nam	2.96	2.68	2.56	3.04	2.89	3.1	3.44
75	Indonesia	2.76	2.43	2.54	2.82	2.47	2.77	3.46
118	Lao PDR	2.46	2.17	1.95	2.7	2.14	2.45	3.23
129	Cambodia	2.37	2.28	2.12	2.19	2.29	2.5	2.84
133	Myanmar	2.33	1.94	1.92	2.37	2.01	2.36	3.29
	GMS5 Average	2.68	2.42	2.34	2.71	2.50	2.76	3.31
	ASEAN5 Average	3.36	3.06	3.21	3.40	3.22	3.38	3.85
	ASEAN Average	2.98	2.70	2.73	3.02	2.82	3.04	3.55

Source: World Bank Logistic Processing Index (2010) and authors' estimates.



Source: World Bank (2010). Note: Number in bracket next to each country is the overall rank out of 155 countries. LPI is a measure of trade facilitation on a scale of 1 to 5, 1 being the lowest and 5 the highest.



Source: World Bank's Doing Business Survey (2012). Note: Rank shown on the vertical axis is the rank out of 183 countries in the trading across borders component of the survey.

FDI, especially export-oriented FDI and FDI flowing in as a part of cross-border supply chain, as seamless movement of trucks and goods across borders and timely delivery are critical to the success of a fragmented production network.

The need for improved trade facilitation has been recognized at the highest level of the GMS leadership. Starting with the 13th GMS Ministerial Conference in December 2004, subsequent high-level GMS forums have emphasized the importance of transport and trade facilitation. At the 3rd GMS Summit in March 2008, the leaders of the GMS called for a greater focus on the “softer” aspects of regional cooperation in GMS, so as to build on the growing regional connectivity of hard infrastructure to enhance the competitiveness of the subregion. The 16th GMS Ministerial Conference in 2010 in Ha Noi approved an action plan for Transport and Trade Facilitation in the GMS.

GMS countries have made some progress in improving trade facilitation through various initiatives at various levels. For example, at the multilateral level the five ASEAN members of the GMS have signed a number of transport agreements such as the ASEAN Framework Agreement on the Facilitation of Goods in Transit, finalizing and signing of the Cross Border Transport Agreement (CBTA) annexes and protocols by all GMS countries and its ratification by most GMS countries. At the bilateral level, GMS countries have concluded bilateral road transport agreements involving nearly all neighboring countries in the subregion. GMS member countries have taken a variety of unilateral trade facilitation measures as well such as the E-Port in the PRC and One Stop Service Centers in Thailand, both of which are examples of customs electronic single-window projects. There is, however, a need to build on the past achievements in trade facilitation and accelerate the momentum going forward.

Recognizing the changes in the regional economic landscape and to keep up with the progress made in the first two decades of the GMS program which involved developing hard infrastructure to improve connectivity, the next phase of the GMS program, under the GMS Strategic Framework, 2012-2022 marks a major shift in the GMS program.¹⁹ This new GMS Strategic Framework marks a shift from improving regional connectivity to improving regional competitiveness which involves emphasis on soft infrastructure, i.e., policy and institutional reforms that will complement the improved physical connectivity.

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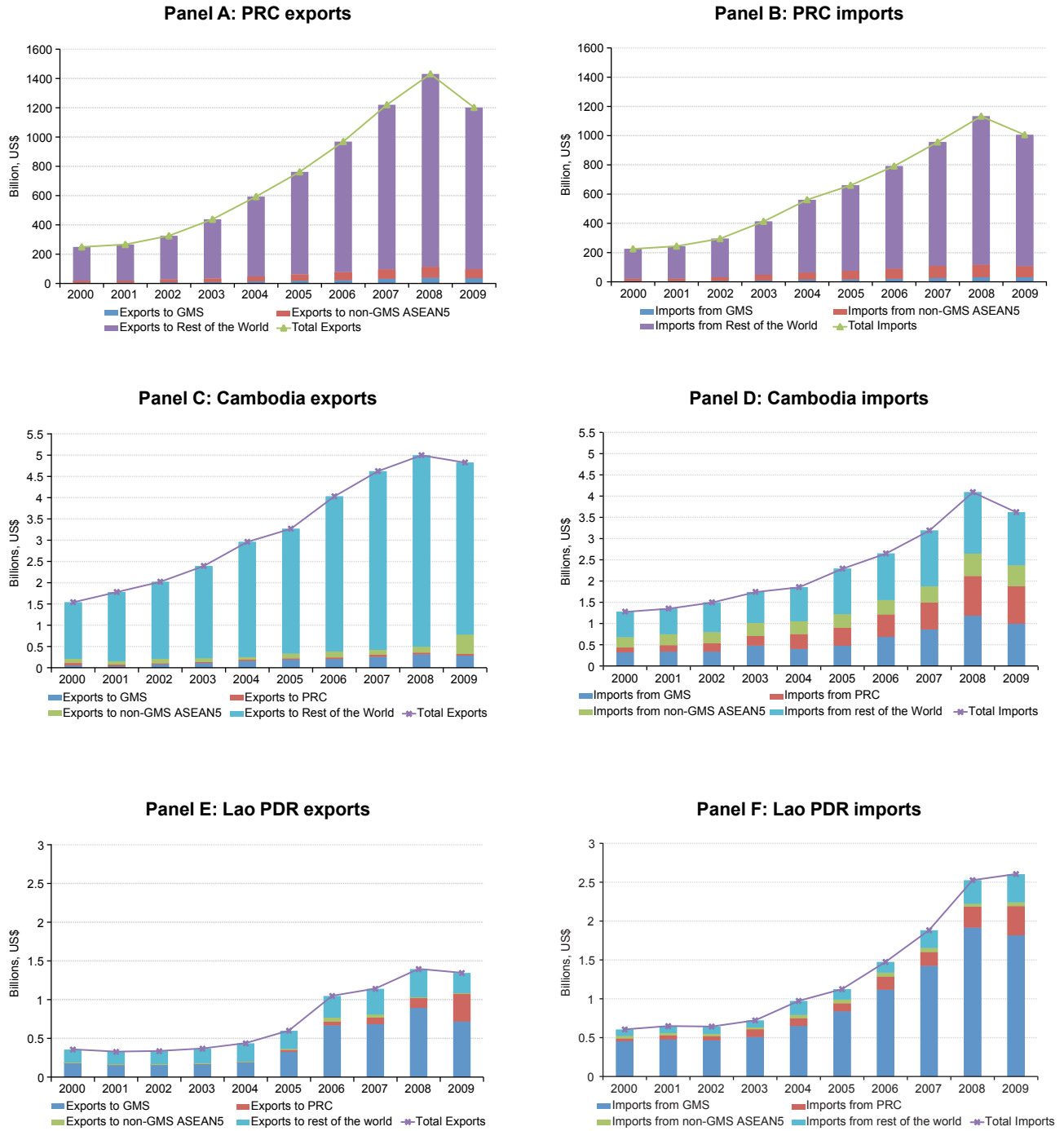
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¹⁹ GMS Strategic Framework 2012-2022 is available at: <http://beta.adb.org/sites/default/files/gms-ec-framework-2012-2022.pdf>

Appendix 1: SITC (Rev.2) 2-digit products and product categories used

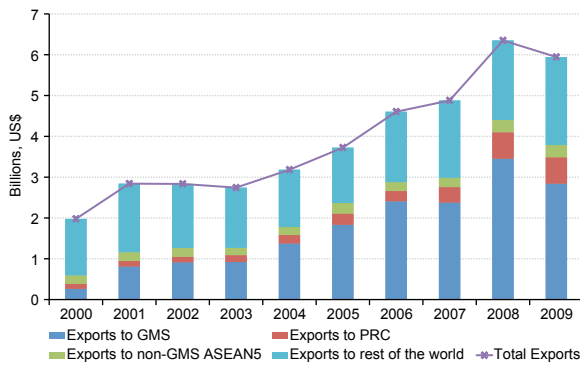
SITC (Rev. 2) 2-digit code	Product description	SITC (Rev. 2) 2-digit code	Product description
Primary Products		Manufacturing Products	
Food, beverages, and vegetable oil etc.		Chemicals	
00	Live animals chiefly for food	51	Organic chemicals
01	Meat and preparations	52	Inorganic chemicals
02	Dairy products and birds' eggs	53	Dyeing, tanning and colouring materials
03	Fish, crustacean and molluscs, and preparations thereof	54	Medicinal and pharmaceutical products
04	Cereals and cereal preparations	55	Oils and perfume materials; toilet and cleansing preparations
05	Vegetables and fruit	56	Fertilizers, manufactured
06	Sugar, sugar preparations and honey	57	Explosives and pyrotechnic products
07	Coffee, tea, cocoa, spices, and manufactures thereof	58	Artificial resins and plastic materials, and cellulose esters etc.
08	Feeding stuff for animals (not including unmilled cereals)	59	Chemical materials and products, nes
09	Miscellaneous edible products and preparations	Machinery and transport	
11	Beverages	71	Power generating machinery and equipment
12	Tobacco and tobacco manufactures	72	Machinery specialized for particular industries
22	Oil seeds and oleaginous fruit	73	Metalworking machinery
41	Animal oils and fats	74	General industrial machinery and equipment, nes, and parts of, nes
42	Fixed vegetable oils and fats	75	Office machines and automatic data processing equipment
43	Animal and vegetable oils and fats, processed, and waxes	76	Telecommunications, sound recording and reproducing equipment
Agricultural (agri) raw materials		77	Electric machinery, apparatus and appliances, nes, and parts, nes
21	Hides, skins and furskins, raw	78	Road vehicles
23	Crude rubber (including synthetic and reclaimed)	79	Other transport equipment
24	Cork and wood	Leather and rubber, inclg footwear	
25	Pulp and waste paper	61	Leather, leather manufactures, nes, and dressed furskins
26	Textile fibres (not wool tops) and their wastes (not in yarn)	62	Rubber manufactures, nes
29	Crude animal and vegetable materials, nes	85	Footwear
Fuel		Textiles, apparels, and travel goods	
32	Coal, coke and briquettes	65	Textile yarn, fabrics, made-up articles, nes, and related products
33	Petroleum, petroleum products and related materials	83	Travel goods, handbags and similar containers
34	Gas, natural and manufactured	84	Articles of apparel and clothing accessories
35	Electric current	Cork, wood, paper, and furniture	
Ores, metals, and gold		63	Cork and wood, cork manufactures
27	Crude fertilizer and crude minerals	64	Paper, paperboard, and articles of pulp, of paper or of paperboard
28	Metalliferous ores and metal scrap	82	Furniture and parts thereof
68	Non-ferrous metals	Non-metallic minerals, metals, iron and steel	
97	Gold, non-monetary (excluding gold ores and concentrates)	66	Non-metallic mineral manufactures, nes
		67	Iron and steel
		69	Manufactures of metals, nes
		Misc items	
		87	Professional, scientific, controlling instruments, apparatus, nes
		88	Photographic equipment and supplies, optical goods; watches, etc.
		81	Sanitary, plumbing, heating, lighting fixtures and fittings, nes
		89	Miscellaneous manufactured articles, nes
		91	Postal packages not classified according to kind
		93	Special transactions, commodity not classified according to class
		94	Animals, live, nes, (including zoo animals, pets, insects, etc.)
		95	Armoured fighting vehicles, war firearms, ammunition, parts, nes
		96	Coin (other than gold coin), not being legal tender

Appendix Figure 1: Direction of trade of GMS countries

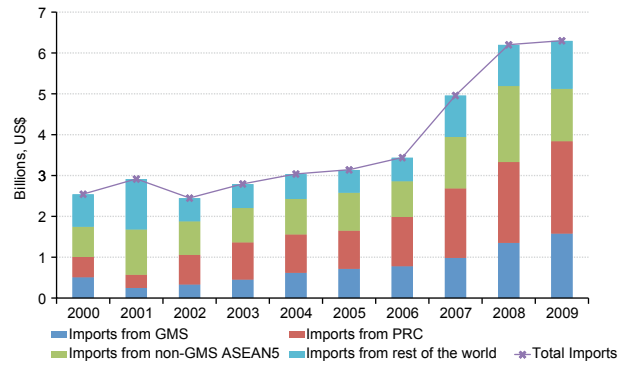


Appendix Figure 1: Direction of trade of GMS countries (continued)

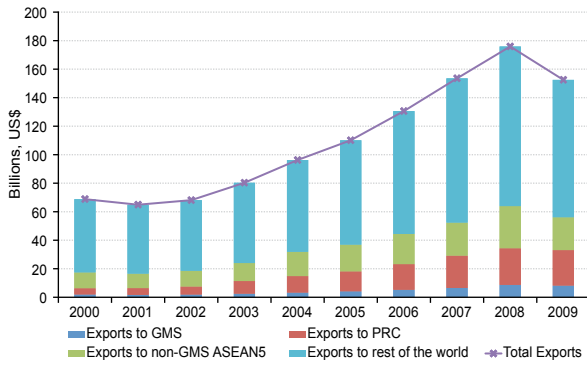
Panel G: Myanmar exports



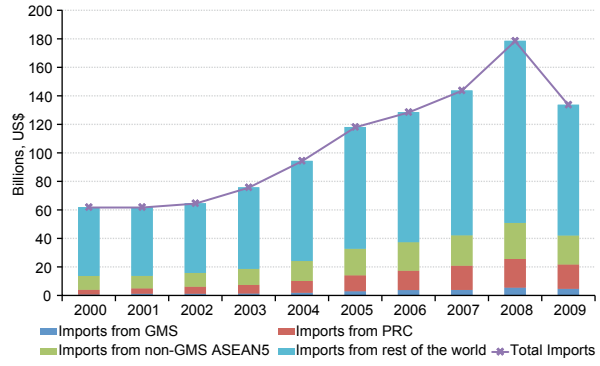
Panel H: Myanmar imports



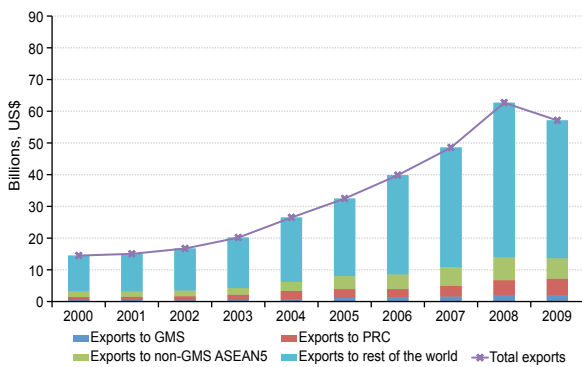
Panel I: Thailand exports



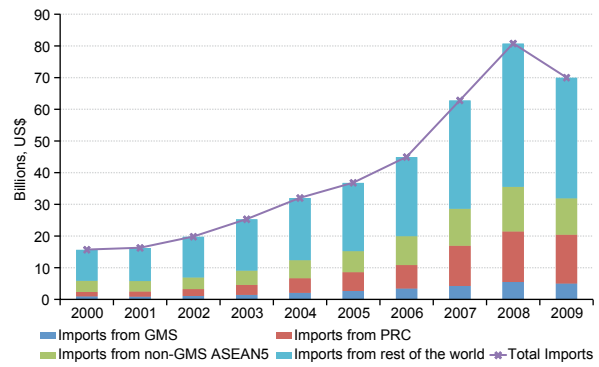
Panel J: Thailand imports



Panel K: Viet Nam exports

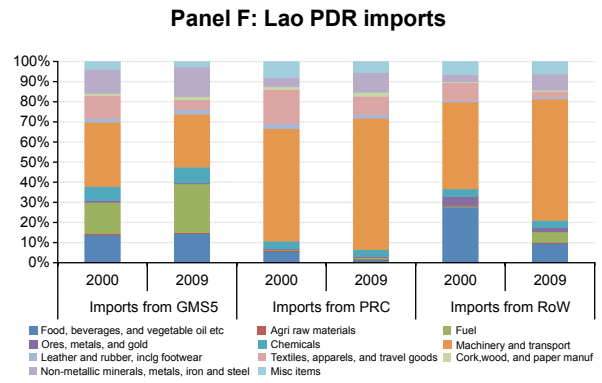
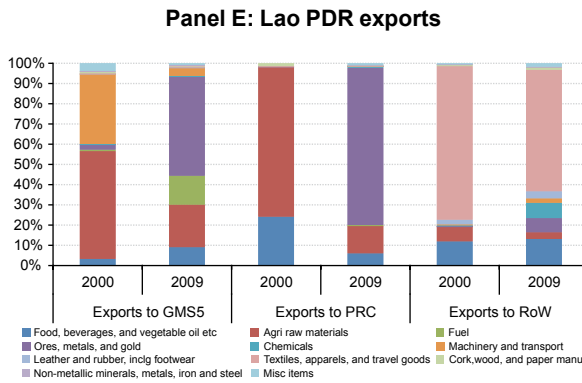
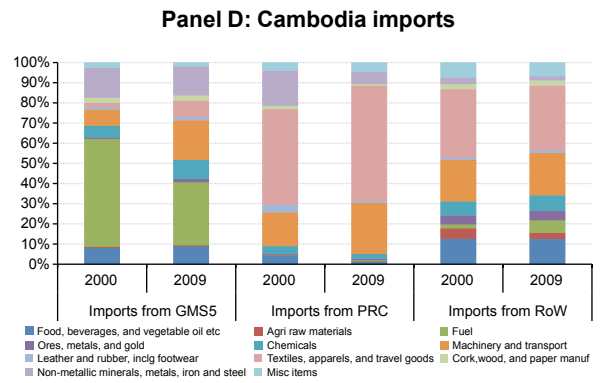
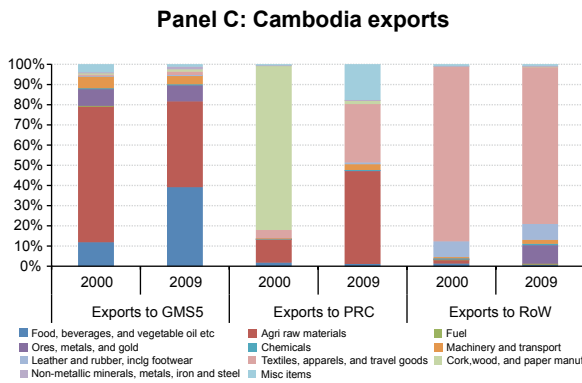
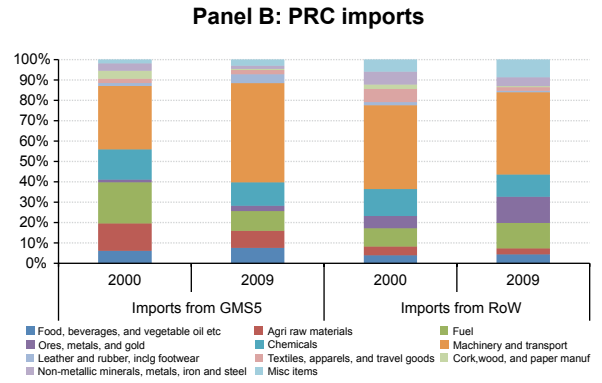
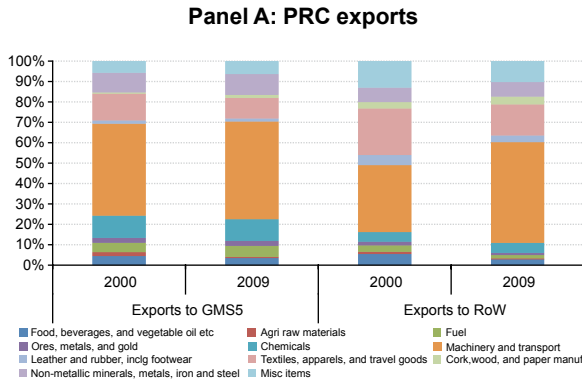


Panel L: Viet Nam imports



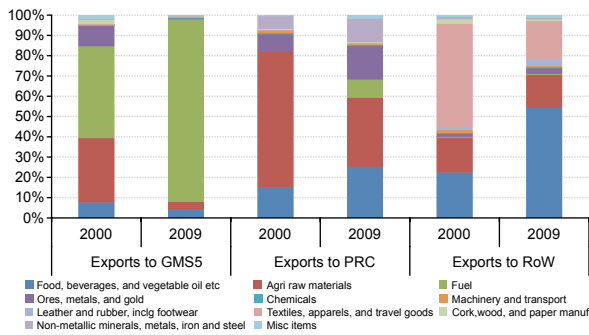
Source: UNCOMTRADE and authors' estimates.

Appendix Figure 2: Composition of trade of GMS countries

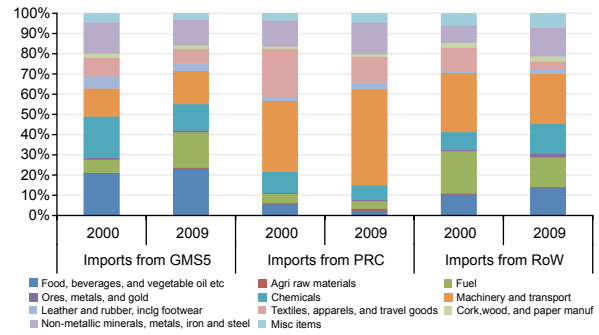


Appendix Figure 2: Composition of trade of GMS countries (continued)

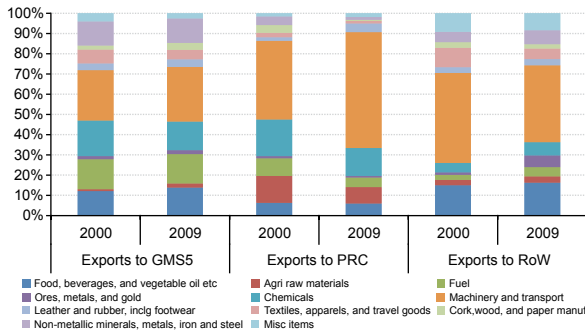
Panel G: Myanmar exports



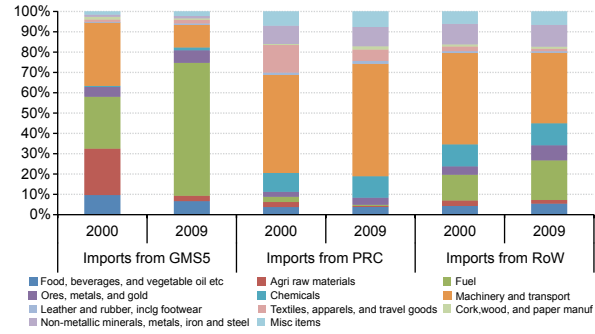
Panel H: Myanmar imports



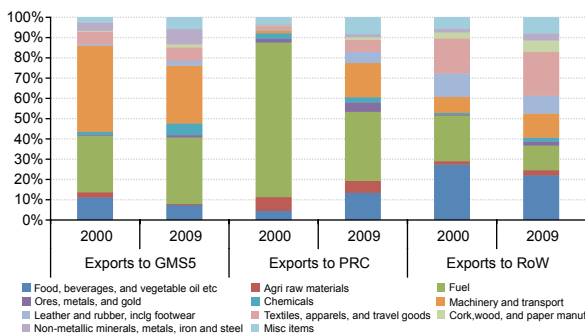
Panel I: Thailand exports



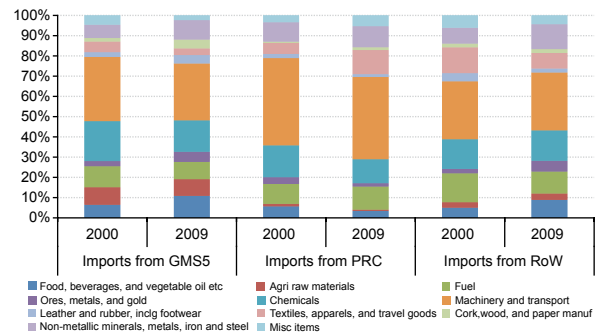
Panel J: Thailand imports



Panel K: Viet Nam exports



Panel L: Viet Nam imports



Source: UNCOMTRADE and authors' estimates.

ECONOMIC GROWTH AND DEVELOPMENT IN CAMBODIA, 2001 - 2010, AND STRATEGIES AND PLANS FOR 2011 - 2020

Hing Vutha¹

Abstract

Cambodia went through a remarkable period of rapid growth during 2001–2010 with an average economic growth rate of 8% per annum. This rapid growth raised per capita income from \$309 in 2001 to \$735 in 2010 and highlighted several main lessons for Cambodia. First, political stability and effective macroeconomic management together with a liberal trade and investment regime are key to sustaining high growth performance. Second, growth was very narrowly based and unlikely to be sustainable in its current form. Third, high growth has reduced poverty but increased inequality. The aspirations for Cambodia in 2020 should be for a country that is no longer aid-dependent, has graduated from least-developed-country status to lower-middle-income status, and has made significant progress in achieving sustainable socioeconomic development, poverty reduction, and more equitable distribution of national wealth. These will be achieved through, among other things, high levels of gross domestic product growth based on economic diversification and enhanced competitiveness; strategic integration of Cambodia's economy into subregional, regional, and global trading systems; investment in soft and hard infrastructure; improvement in quality of education and the labor force; and strengthening of democratic development and public institutions.

1. Economic Transition and Policy Priorities

Cambodia has undergone profound transformation from a centrally planned to a market-oriented economy over the last two decades. This economic transformation can be classified into three major phases. The first phase (1989–1993), involved a gradual departure from a planned economy. Policy reforms included (i) end of state interference in economic production and privatization of state-owned enterprises; (ii) private ownership of

agricultural land and unrestricted private crop sales; (iii) re-establishment of the national bank and transformation of the banking system into a two-tiered system; and (iv) restoration of macroeconomic stability. These policy reforms were aided by peace brought about by the Paris Peace Agreement in 1991, and by political stability resulting from establishment of the coalition Government in 1993.

The second phase (1994–1999) involved more widespread economic rehabilitation and reconstruction. Guided by the National Programme to Rehabilitate and Develop Cambodia (NPRD) and Socioeconomic Development Plan 1996-2000 (SEDP I), economic policies focused on (i) developing the productive base by increasing rice yields, promoting livestock production, and diversifying commercial agriculture; (ii) developing a strong private sector, including small and medium enterprises; (iii) promoting foreign direct investment; and (iv) reintegrating the Cambodian economy into regional and international economic systems. The trade regime gradually became more outward-looking and liberal, and development plans made trade a major development agenda. Trade restrictions were abolished and exports were heavily promoted through unilateral market access and regional trade agreements. Cambodia re-established normal trade relations with the United States (US) in 1996. This was followed by a series of bilateral trade agreements with the US and European Union (EU) on textile and apparels and membership of the Association of Southeast Asian Nations (ASEAN) in 1999.

The third phase began in 2000 and has been characterized by rapid economic growth, expanded trade, investment and private enterprise, and deeper integration into regional and international economies. The current policy objective is to ensure inclusive sustainable economic growth that can contribute to poverty reduction and social development. The policy priorities are to (i) create a favorable macroeconomic and financial environment; (ii) actively participate in subregional, regional, and global economic cooperation; (iii) foster economic and trade diversification and competitiveness; (iv) strengthen private sector participation; and (v) attract investment through a more conducive business and investment climate. Deeper economic integration has become a main pillar of Cambodia's economic strategy. Cambodia has been admitted to the World Trade Organization (WTO) in 2004 and actively participated in ASEAN and several ASEAN-initiated schemes, including the ASEAN Free Trade Agreement (FTA), the ASEAN-China FTA, the ASEAN-Republic of Korea FTA, and the ASEAN-Japan FTA. Cambodia has adopted reforms to ensure that its

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trade policy and practices are fair and nondiscriminatory, transparent, and predictable. With a view to increasing exports, trade policy focuses not only on finding export markets, but also on improving trade facilitation, export diversification, and competitiveness and trade finance.

2. Cambodia's Growth during 2001 - 2010

2.1 Growth Performance: High Growth with Structural Change

Cambodia has gone through a remarkable period of rapid growth over the last decade. During 2001–2010, growth has averaged 8% per annum and per capita income increased from \$309 to \$735. Growth was interrupted by the recent global financial crisis, which badly affected key sectors, including garment and footwear, construction and real estate business, tourism, and finance and banking. As a result, the economy contracted to record low rate of 0.1%. There is a sign of quick recovery indicated by recovery in garment production and exports, a resilient finance and banking sector, and impressive growth of the agriculture sector. The economy rebounded to 5% growth in 2010.

Industry is the fastest growing sector followed by services. They accounted for 10.2% and 8.6% contribution to growth over the decade, respectively, against 5.1% growth for agriculture. As a result, the economy has undergone profound transformation with agriculture by 2007 ranking behind both industry and services in terms of value-added. Agriculture's share of gross domestic product (GDP) dropped from 34.4% in 2001 to 27.4% in 2010, while industry's share increased from 22.5% to 26.4% during the same period. The service sector grew steadily from 38.2% of GDP in 2001 to 40.6% in 2010.

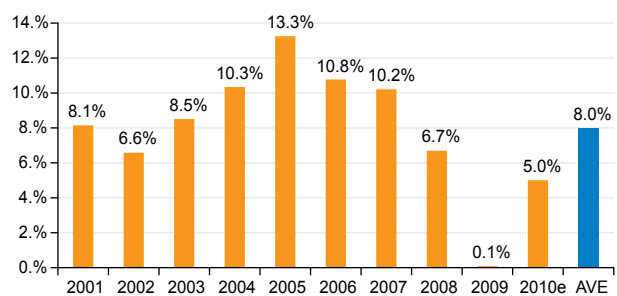
2.2. Key Drivers of Growth: from Peak Growth to Contraction

Most of the growth over the past decade has been driven by 4 sectors: garment and footwear, hotel and restaurant, construction, and agriculture. Apart from agriculture, which was resilient to the global financial crisis, these sectors registered high growth during 2001–2007 but were very volatile during 2008–2010.

Garments (and Footwear). Being the country's leading export sector, the garment and footwear industry accounted for 12% of 2010 GDP and has been growing at an average of 12.6% per annum. Exports went from almost zero in 1994 to \$4.54 billion in 2010, equivalent to 86% of total exports. Most garment factories are foreign owned, with estimates somewhere between 90% and 95%, and mainly focused on 'cut, make, and trim' (CMT), the lowest end of the garment value chain. Two key factors could explain the vibrant growth of this subsector. First is preferential treatment given by the US and EU for Cambodia's exports. They accounted for about 65% and 20% of garment and footwear exports, respectively. The second factor concerns resource endowments, in which Cambodia is labor abundant with relatively cheap labor costs.

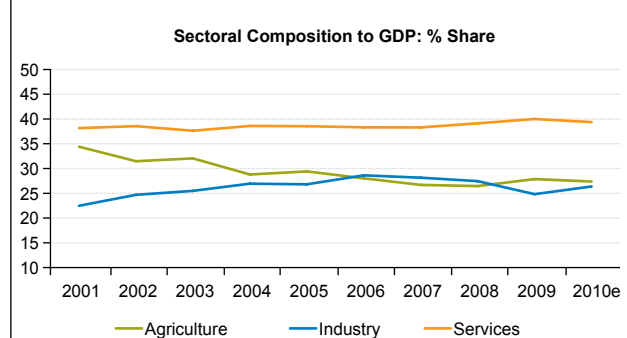
Growth was disturbed by the global financial crisis. The US recession caused the subsector to slow down in 2008, with its export value reaching \$2.9 billion. Garment exports dropped alarmingly from a monthly average of \$250 million in 2008 to \$100 million in January 2009. In terms of employment, 51,000 garment workers were laid off between September 2008 and February 2009. Apart from the layoffs, higher underemployment was also expected and in fact is already underway, with workers reportedly forced to work fewer hours (ODI, 2009). Consequently,

Figure 1: GDP Growth Rate 2001-2010



Source: National Institute of Statistics.

Figure 2: Composition of GDP 2001-2010



Source: National Institute of Statistics.

value-added of this sector went down sharply to 2.2% in 2008 and further to -9% in 2009. In 2010, growth recovered slightly yet recorded a very low growth rate at 2.2%.

Hotels and Restaurants. This sector accounts for 4.4% of 2010 GDP and has been growing at an average of 11% per annum. The growth of this sector is largely driven by tourism. Cambodia is one of the fastest growing tourist destinations in Southeast Asia. Tourist arrivals reached 2.5 million in 2010. The rapid growth of tourism is due to Cambodia's exceptional cultural heritage and its natural endowment (and its location in a dynamic region), recent stability, and key policies such as the Open Sky Policy introduced in late 1997 (World Bank, 2009a). Like garments and footwear, growth of this sector was interrupted by the 2008 crisis. Tourism arrivals at Cambodia slowed down. Growth of passenger traffic at Phnom Penh International Airport plunged rapidly, from 21% in May to a mere 3% in September 2008. The situation at Siem Reap International Airport was even worse, with the same statistic reaching -10% in September 2008. As a result, value-added of this sector went down sharply growing to 9.8% in 2008 and 1.8% in 2009. In 2010, growth recovered slightly at 4.2%.

Construction. The construction sector accounted for 6.2% of 2010 GDP and has been growing at an average of 11% per annum. Construction in Cambodia has closely followed real estate development, with most construction projects in commercial and residential real estate. The growth boomed in 2002–2006 but it has significantly decelerated since then, with signs of overheating (rising prices of labor and construction materials) and concerns about a bubble in the real estate sector. Just like other growth drivers, construction registered contraction in 2008. Some mega projects were cancelled or scaled back; while new investments decelerated by 12.5% during the first 11 months of 2008 over the same period in 2007 (ODI, 2009). In terms of employment, approximately 15,000 construction jobs in mid-2008 were lost (Kang *et al.*, 2009). An even more worrying estimate is that around 30% of the country's construction workers have so far lost their jobs following the closure or suspension of construction projects (ODI, 2009). Value-added of construction grew at only 5.8% in 2008 and decelerated further to 5% in 2009 and 3.5% in 2010.

Agriculture. Agriculture accounted for 33.2% of 2010 GDP and grew at an average of 5.1% during 2001–2010, driven by crops (mainly rice) and, to a lesser extent, livestock and fisheries. Accounting for 53% of 2010 agricultural

production and 14.5% of GDP, crop production grew at an average of 7.2% during 2001–2010. Fisheries are the second largest source, followed by livestock and poultry, representing 25% and 16%, respectively, registering an average growth rate of 3.2% and 5%, respectively, during the same period. Agriculture was the only sector not severely affected by the 2008 crisis. Unlike industry and service sectors which are highly volatile during a recession, agriculture grew at average rate of 5.3% during 2001–2007 and then fell slightly to 4.8% during 2008–2010.

2.3. Lessons from a Decade of Economic Growth

A decade of rapid economic growth highlighted several main lessons for Cambodia. First, political stability and effective macroeconomic management are key to sustaining high growth performance. Second, more liberal trade and investment policies in the context of deeper integration in regional and global economies was and will continue to be the major drivers of private sector development and economic growth. Third, growth achieved in the previous decade was very narrowly based and unlikely to be sustainable in its current form. The economy needs to increase competitiveness and diversify sources of growth. Fourth, high growth has reduced poverty but increased inequality.

The Government implemented a series of reforms focusing on macroeconomic management, public financial management, and governance of the financial sector. It also made significant headway in rehabilitating and reconstructing physical infrastructure, especially national road networks.

The Government managed to maintain macroeconomic stability in 2001–2010. Although the economy is highly dollarized,² which limits the power and effectiveness of monetary policy, the Government was able to keep inflation below 5% and maintain a stable exchange rate while maintaining a credible fiscal position.

Also, the Government continued to pursue a more liberal trade policy through opening access to markets and securing access for its products in overseas markets. Economic integration has become a main pillar of Cambodia's economic strategy. As well as joining WTO

² Measured as the ratio of foreign currency deposits to broad money, dollarization has risen from about 60% in the late 1990s to about 80% in recent years (Duma, 2010). Significant inflows of aid, FDI, and tourism receipts, and the growth of the garment export sector that transacts exclusively in dollars, have all contributed to the rise in dollarization.

and ASEAN and the associated FTAs, Cambodia has been actively participating in the Greater Mekong Subregion (GMS) and the Ayeyawady-Chao Phraya Mekong Economic Cooperation Strategy (ACMECS). Cambodia has also adopted reforms to ensure that its trade policy and practices are fair and nondiscriminatory, transparent, and predictable. Trade policy focuses not only on finding export markets, but also on improving trade facilitation, export diversification, and competitiveness and trade finance.

The investment regime was likewise liberalized, making it more attractive to private investment, especially foreign direct investment (FDI). A law on investment was adopted in 1993, setting rules and incentive schemes for FDI. The Government then set up the Cambodian Investment Board (CIB) under the Council for Development of Cambodia (CDC), as the organization responsible for approving foreign investment applications. As a result, FDI grew from almost zero in the late 1980s, to an annual average of \$163 million in 1993–2004 and \$604 million in the second half of the 2000s. FDI stock during 1993–2010 reached \$5.58 billion, accounting for 34% of total private investment, or an annual average of 5.4% of GDP. There are still some major impediments to investment, notably including corruption, bureaucracy, inefficient public institutions, and a poor regulatory framework. This prompted the Government to introduce some key measures in an attempt to improve the investment climate. For example, in 2005, the investment law was amended to make the investment regulatory framework more conducive to both domestic and foreign investment. The Government-Private Sector Forum was established, with meetings held twice a year among the Cabinet and representatives of the private sector. The forum is widely perceived as a useful platform for identifying and overcoming policy constraints to private sector development. The Government also established special economic zones (SEZs) in 2005 through a special decree, in an attempt to attract industrial and export-oriented investment projects.

Most of the growth over the last decade has been driven by a rapid expansion in garments exports, tourism, real estate, and agriculture. Such narrow-based economic

growth is highly vulnerable to external shocks and is unlikely to be sustainable in the long run. The 2008 crisis dealt a huge blow to Cambodia's garments, tourism, and construction sectors, and brought growth down to 0.5%. This experience demonstrated, more acutely than ever, the necessity for diversification.

Sustained growth has led to a dramatic decline in Cambodia's poverty levels over the last decade and a half, with the national poverty rate dropping from 39.0% in 1994 to 30.1% in 2007. Poverty levels remain higher in rural than in urban areas. Unfortunately, income disparities between the rich and the poor increased during the same period, with the Gini coefficient—derived from national consumption data—rising from 0.35 to 0.43 (Table 1). High levels of rural poverty and rising inequality are therefore a cause of concern for Cambodia. High and rising inequality can constrain the poverty reducing impact of growth, as well as the sustainability of growth itself. The challenge now is to sustain rapid growth and poverty reduction while also addressing growing inequality.

3. Aspirations for a Positive 2020 Scenario

The core of a positive set of aspirations for Cambodia in 2020 would be for a Cambodia that is no longer aid-dependent, has graduated from least-developed-country status to lower-middle-income status, and has made significant progress in achieving sustainable socioeconomic development, poverty reduction, and a more equitable distribution of national wealth. This will be achieved through

- high levels of annual GDP growth of at least 7% based on economic diversification, increased competitiveness and productivity, strengthening of key export-oriented sectors (such as agriculture, light manufacturing, and services), and the flow of benefits from exploitation of offshore oil and gas resources;
- success as a major rice exporter to markets in Asia, Africa, and the Middle East, with the model of the government's rice production and export

Table 1: Poverty and Inequality in Cambodia, 1993–2007

	Poverty Rate			Gini coefficient		
	(% below national poverty line)			(0= perfect equality, 1 = perfect inequality)		
	1993/94	2004	2007	1993/94	2004	2007
Rural	43.1	39.1	34.7	0.27	0.33	0.36
Other urban	36.6	25.8	21.9	0.44	0.43	0.47
Phnom Penh	11.4	4.6	0.8	0.39	0.37	0.34
Cambodia	39.0	34.8	30.1	0.35	0.39	0.43

Source: World Bank (2006, 2007, 2009b).

promotion strategy also applied to production and export of other crops, and associated food processing industries;

- strategic integration of Cambodia's economy into the GMS, ASEAN, and the broader ASEAN+3 (People's Republic of China, Republic of Korea, and Japan, or East Asian) region, through maintenance of open regionalism and outward-looking policies, active involvement in the evolving regional architecture (such as an East Asian Free Trade Area or Economic Community), while remaining open to other international market opportunities;
- significant progress in poverty reduction; improved infrastructure for affordable energy and transport; greater investment in social development in key areas of health care, particularly for women and children; access to affordable quality primary, secondary, vocational and tertiary education in response to market needs and changing demography; opportunities for youth; and broader human security and social protection;
- strengthening of democratic development, public institutions, and national and subnational governance, with progress in key areas of public sector reform, including service delivery, civil service salaries, capacity building of civil servants, judicial reform, the rule of law, and anti-corruption measures;
- effective use of income from offshore oil and gas exploitation for primary national development priorities, thus avoiding the so-called resource curse. In order to achieve this, the establishment and effective operation of a Cambodian sovereign wealth fund could be considered. Such a fund could work closely with other regional sovereign wealth funds on regional investment and development opportunities;
- in addition to oil and gas, improved management and governance of other natural resources (land, water, forest, and fishery) and environmental management; adaptation in response to climate change, particularly for the agricultural sector; more transparent and equitable access to natural resources for rural livelihoods and poverty reduction; and a more effective land management policy for the productive use of economic and social land concessions.

To achieve these aspirations the following factors will be key:

- A stable and well-managed macroeconomic environment that enables and promotes economic diversification, competitiveness, and productivity,

and domestic consumption.

- Increased investment in both soft and hard infrastructure, including education, trade facilitation, energy, and infrastructure. Hard and soft infrastructure for "connectivity" in the GMS, ASEAN, and ASEAN+3 in rail, road, energy generation, and regulatory and institutional capacity building.
- Improved agricultural productivity, better rural infrastructure, crop diversification, access to credit, extension services, vocational education and training.
- Improved aid effectiveness, harmonization, and alignment, with official development assistance more strategically focused to reflect key national priorities and long-term institutional capacity development; and eventual graduation from aid dependency.
- Strategic integration of Cambodia's economy and its key trade and investment relationships in the GMS, ASEAN, and ASEAN+3.

4. Policy Options

To achieve these aspirations the following policy options will be key:

- Cambodia's economic growth remains narrowly-based and vulnerable to external shocks. Economic diversification can be achieved by expanding current sources of growth. Further development of the agricultural sector, expansion of industrial manufacturing, and diversification of export products and markets are all wise economic diversification strategies.
- Growth has helped reduce poverty but has done little to address inequality. Economic policy should aim to achieve sustainable and inclusive growth.
- Trade and investment will continue to be the main drivers of growth. Deeper economic integration and more active participation in subregional, regional and global economic framework are necessary to increase trade and investment. Special and differentiated investment incentives are needed to develop other sectors where Cambodia has a comparative advantage and growth potential, particularly the 19 products and services identified in the United Nations Development Programme (UNDP) diagnostic trade integration study (DTIS) in 2007.
- A stable macroeconomic environment must be achieved by keeping inflation below 5%, ensuring

- cautious and disciplined use of revenue from oil and gas sectors, closely monitoring the real estate and banking sectors, and providing enough employment opportunities to absorb to the growing labor force.
- Government budget spending must become flexible and less dependent on official development assistance. Revenue collection can be improved by strengthening the capacity of tax administration, expanding the current domestic tax base, and encouraging informal businesses to register.
 - A well-managed sovereign wealth fund can be established to finance national development priorities and stimulate private sector investment in support of economic diversification, learning from the experience of other ASEAN countries.
 - Public investment in priority sectors—healthcare, education, agriculture, rural development, and transport infrastructures—should be expanded in order to extend coverage of public service delivery to the poor.
 - To achieve more sustainable growth and economic development, the Government, in cooperation with development partners, must prioritize the development of human capital. In the medium and long term, by (i) developing an integrated approach to improving the quality of education in all levels, and ensuring that technical and vocational education and training meet the needs of the labor market; and (ii) making research one of the missions of higher education institutions, and using such institutions as focal points for research and development.
 - Investment in physical infrastructure remains a priority. Spending must be increased for building and upgrading rural infrastructure, such as rural roads and irrigation systems. Production capacity and efficiency of power generation must also be improved in order to reduce costs and achieve rural electrification.
 - The agricultural sector should be promoted to make the most of factor endowments such as land and labor. Efforts to achieve poverty reduction and economic diversification will be supported by enhancement of the agricultural sector. Improving agricultural productivity and diversifying the agricultural base should be the primary objective. This will require investment in infrastructure and promotion of exports to encourage production. The growth of the sector should generate spill-over effects that will help develop the manufacturing sector, which is still in its infancy.

- Cambodia must demonstrate a commitment to sustainable use of natural resources. Governance of natural resources must be improved to ensure sustainable use and increase value-added. This includes efficiency and transparency in management processes and appropriate investment of revenues from resource use, taking into account the environment impact of natural resource extraction.

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RECENT ECONOMIC DEVELOPMENT PERFORMANCE AND SOME PERSPECTIVES ON ECONOMIC DEVELOPMENT STRATEGY FOR 2020 LAO PDR

Leeber Leebouapao¹

Abstract

The objectives of this report are to present the recent economic performance, the Lao Government Development Strategy until 2020 and to propose some policy recommendation for achieving the goals by 2020.

The main contents of this report can be summarized as follows:

After the Lao economy was hit remarkably by the East Asian Financial Crisis in 1997, which caused hyperinflation of 3 digits (134% in 1999), a slow down of economic growth, the lowest growth rate of about 4% in 2008, a decline in GDP per capita from about \$379 in 1996 to \$176 in 1998 and recovered the level of 1996 in 2003, the Lao economy has grown then relatively rapidly and been relatively stable, in particular for the last five years (2006-2010), despite the impact of the global financial crisis in 2008, the average GDP growth accounted for about 7.9% per annum, the average inflation rate was about 5%. In 2011, GDP growth is about 8.2% and GDP per capita is estimated about \$1,233. As a result, the World Bank has shifted Lao PDR from the list of low income countries to a low middle income country.

The long term socio-economic development goals of the Lao Government are to meet the Millennium Development Goal's by 2015 and to free from the status of Least Developed Country (LDC) by 2020. The Vision 2020 and the The VIIth Socio-Economic Development Plan (NSED) for 2011-2015 are the main development policy framework of the Lao Government.

To achieve the development goals by 2020, Lao PDR needs to make use of its potentials and opportunities and maximize the benefits from these potentials and opportunities. However, in parallel with these potentials and opportunities, there are a number of challenges

to development, which Lao PDR will be facing and needs to overcome. In this regard, the author proposes some policy recommendations on directions for a Lao PDR development strategy to achieve the country's development goals by 2020.

1. Recent Macro-economic Performance

1.1 Growth and Compositions of the Lao Economy

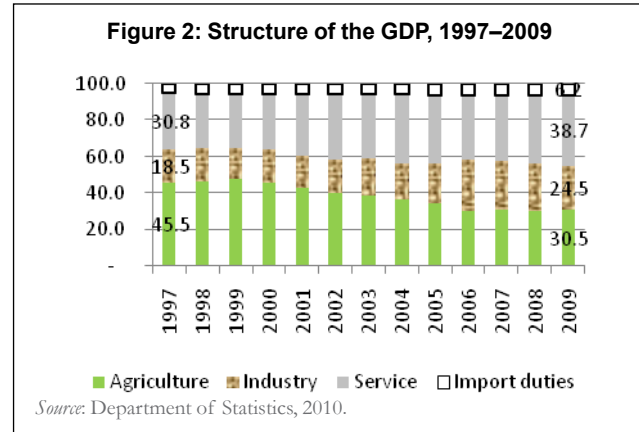
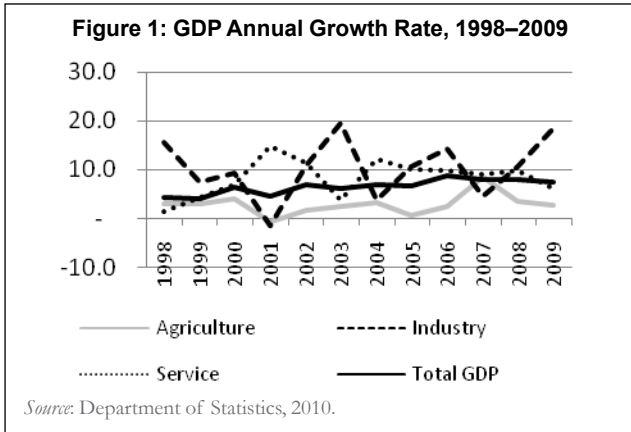
After the introduction of the New Economic Mechanism (NEM) to shift from the centrally planned economy to a more open market oriented economy in 1986, the Lao economy has grown relatively rapidly. However, the East Asian Financial Crisis erupted in 1997 and hit the Lao economy drastically, with a slow down of economic growth to the lowest point of about 4% in 2008, a decline in GDP per capita from \$379 in 1996 to \$176 in 1998, then recovered the level of 1996 by the middle of 2000's. Since the middle 2000s, the Lao economy has grown relatively rapidly with relative stability, in particular over the last five years (2006-2010), the average GDP growth accounted for about 7.9% per annum, of which agriculture, industry and services sectors have grown at an average of 4%, 12.6%, 8.4% respectively, which become the main drivers of growth. In 2011, GDP growth is about 8.2% and GDP per capita is estimated about \$1,233. As a result, the World Bank has shifted Lao PDR from the list of low income countries to a low middle income country.

With regards to economic structure, over the last decades, agriculture which was traditionally the determinant sector of the Lao economy until the early 1990's, was declining from about 45% of GDP in the middle 1990s, to about 30.5% in 2009 (Figure 2). In contrast, the industry's share increased dramatically by about 7% to 24.5% for the period 2001-2010. The industrial GDP consists of 46% manufacturing share and mining 26% share. The share of the services sector increased significantly from 30.8% in 1997 to 38.7% in 2009. The major share of service sector are hole sale and retail trade and repair covering about half of the services sector. Other major subsectors were public service (15%) and transportation and communication (12%).

1.2 Inflation Rate

After the East Asia financial crisis erupted in 1997 hit the inflation in Lao PDR increasing dramatically as

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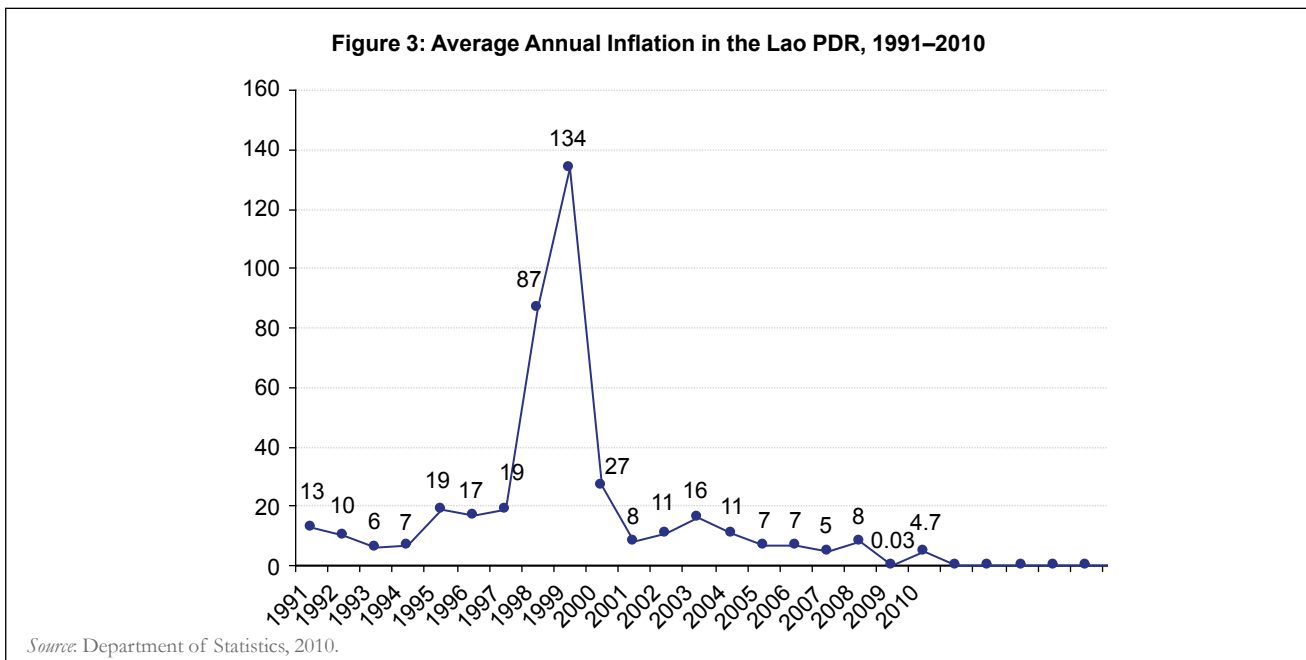
hyperinflation in the history of the Lao economy by 87% in 1998 and 134% in 1999 (Figure 3), then inflation gradually fell to a single digit, with an average rate of 7.7% for the time period 2001- 2010 and about 5 % for the time period 2006-2010. In 2009, inflation fell to 0.7%, the lowest level in the history of the Lao economy because of the recent global financial crisis which led in particular to the fall of global demand and in particular to the fall of world oil prices significantly and finally to lowering the transportation cost in the country. However, inflation has increased gradually again since 2010 (4.7%), as a result of the recovery of the world economy from the global financial crisis which has increased the world oil prices compounded with the severe flood in some parts of the country leading to the increase

in food prices and transportation cost as the main causes of the inflation (Figure 3).

1.3 Exports and Imports²

Overall, the Lao PDR remains relatively as a closed economy in terms of trade openness (exports plus imports), which accounted for about 54% of GDP in 2010 and 48% for the time period 2006-2010, compared to neighboring Cambodia (80%) and Viet Nam (87%).

Over the last 5 years(2006-2010), exports amounted to \$5.11 billion, accounting for 20.72% of the GDP. Imports amounted to \$6.49 billion and accounted for 26.1% of the



² Trade data from Interactive Tariff and Trade Data Web is mainly used for the detail analysis, instead of the official data from Lao PDR's Ministry of Industry and Commerce because the former provides the data in the harmonized system, suitable for international comparison.

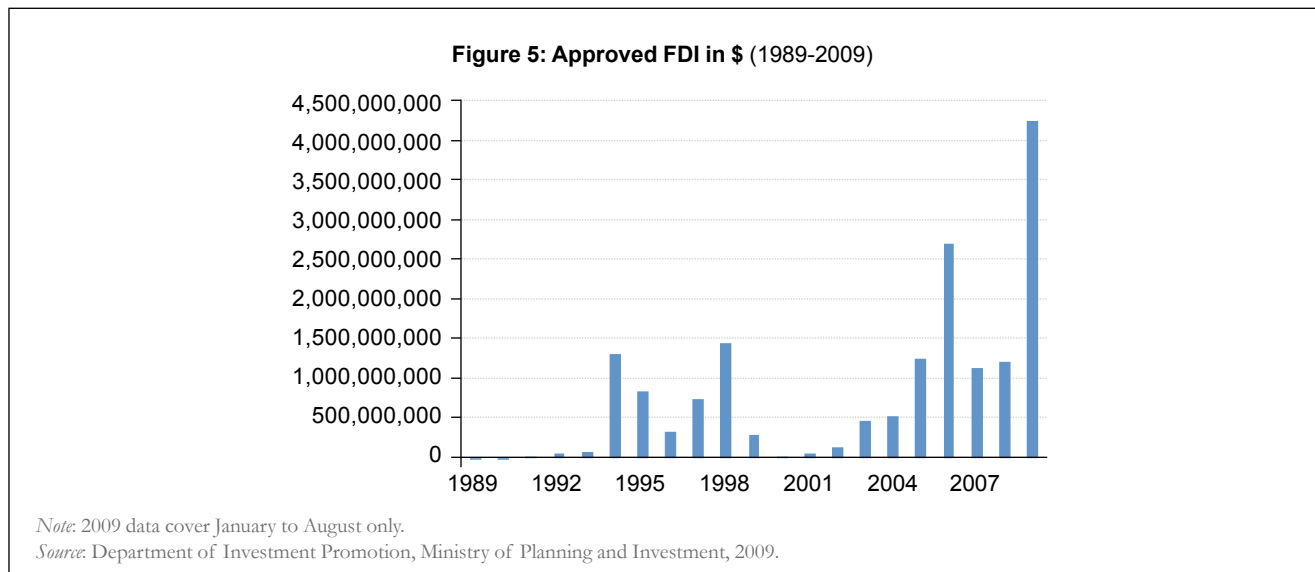
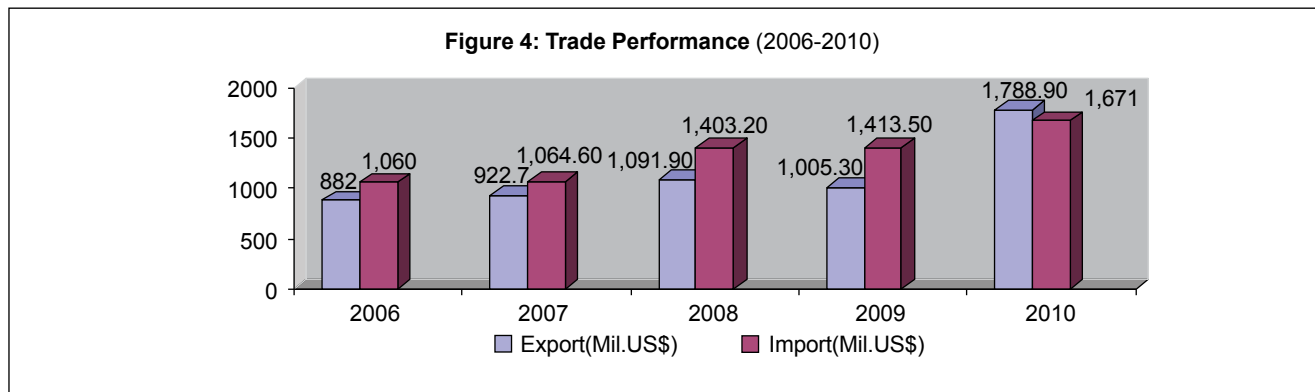
GDP (Figure 4). Trade deficit amounted to \$1.38 billion, accounting for 5.3% of the GDP. On average, annual trade deficit of \$276.80 million, which is 27.1% of the total exports. During the recent global financial crisis in 2008, exports and imports declined by 21.4% and 15.3% respectively, in the fiscal year 2008/09. Particularly, exports in mining, garments, and wood and wood product declined sharply, by 32%, 44%, and 22%, respectively.

Since 2006, major export products are in particular mineral products and hydro electricity. In 2010, mineral products and hydro electricity consisted of about 73% of the total export, of which mineral products and hydropower electricity consisting for about 57% and 16% respectively. Mineral export destinations mainly to ASEAN member countries (63%), Republic of Korea (13%) and PRC (4%). The main hydroelectricity export destination is Thailand. The next largest exported products are textiles and agriculture products, accounting for about the same shares of 9% for both representing the 3rd and 4th largest products for export

in 2010. Main export destinations for textiles are the EU (82%) due to preferential regulations for garment exports, followed by the USA (6.3%) and Japan (3.4%).

Imported items are in particular fuel, machinery, electrical products, and vehicles and spare parts. The top 6 imported products accounted for more than 60% of total imports in 2008. The import of mineral fuel, the largest import item, cost more than \$427 million in 2008 and came mainly from Thailand (91%). The second largest import products are vehicles and vehicle parts primarily from Thailand (65%), PRC (14%) and Japan (8%). Finally, machinery imports, primarily from Thailand, PRC and Germany, were the third largest imported product in 2008.

Thailand represents the most significant trading partner of the Lao PDR, with a trade volume accounting for more than 50% of the Lao PDR's total trade. Viet Nam and PRC are the second and third largest trading partners, respectively. Thailand, Viet Nam and PRC accounted for



about 75% of the Lao PDR's total trade volume for the period from 2001-2008 and more than 80% in 2008. Lao PDR imported more than 87% of imports from Thailand and PRC alone. Among its top three trading partners, Laos - PRC bilateral trading volume achieved the highest annual growth rate of 34% while the growth rate for Laos-Thailand and Laos-Viet Nam bilateral trading volume were 26% and 1% respectively.

1.4 Foreign Direct Investment (FDI)

Since the adoption of the open-door policy (the first Law on FDI Promotion in 1998), FDI has increased from about \$4 million in 1989 to over \$4 billion in 2009. FDI inflow³ increased significantly in particular before the Asian

financial crisis in 1997 at an average of \$88 million per year⁴ (Figure 5). After slowing down during the crisis, it resumed rapid growth again in early 2000, in particular by the booming in electricity generation and mining sectors. Over the time period 1989 to 2009, on average, FDI inflows into the Lao PDR increased at about 173% per year.

Figure 6 indicates that the major FDI is concentrated in hydropower and mining sectors, on average about 32% and 8.8% of the total investment respectively. In addition, FDI in the labor intensive sector is also significant. For instance, FDI in industry and handicraft (excluding electricity and mining) covers about 17% of total FDI. The most outstanding business is the garment industry, which grew quite rapidly mainly due to the preferential access of

Figure 6: Approved FDI Capital by Sectors in % of total FDI (1989-2009)

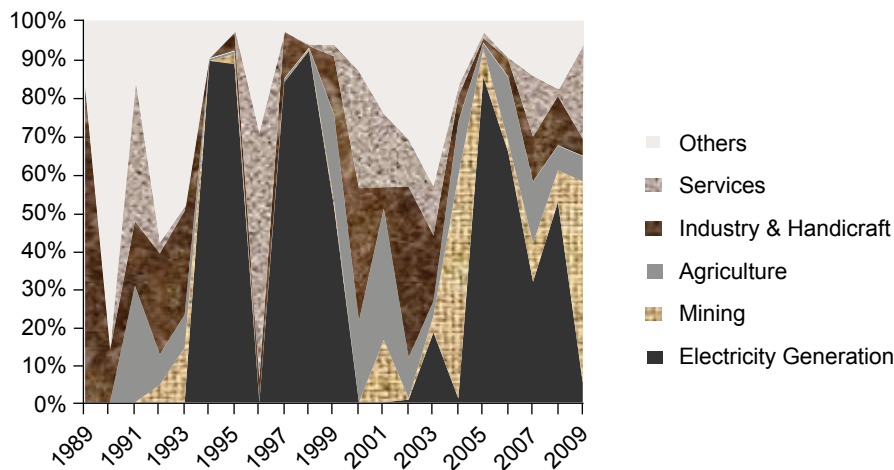
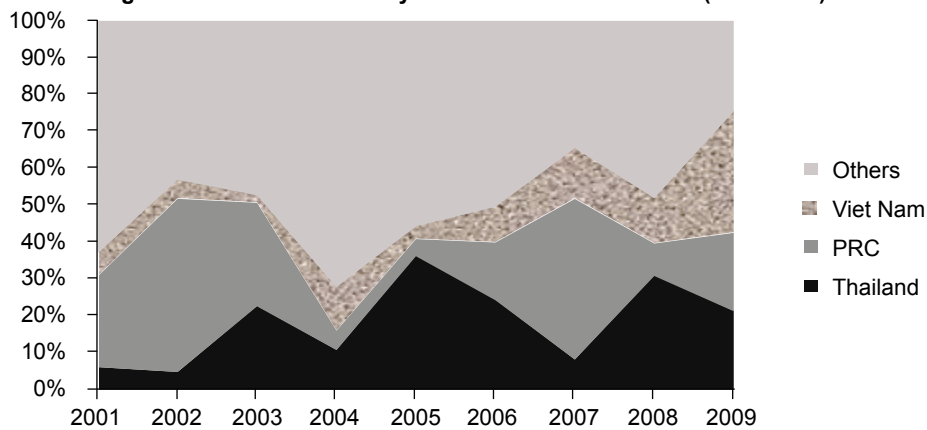


Figure 7: Main FDI Inflows by Countries in % of total FDI (2001-2009)



Note: 2009 data cover January to August only.

Source: Department of Investment Promotion, Ministry of Planning and Investment, 2009.

³ Approved investment capital.

⁴ Excluding FDI in the electricity generation sector; FDI in this sector is massive and volatile.

the Lao PDR in many export markets with “least developed country” status. Further more, FDI in the service and agriculture sectors covers about 11% and 10% of total FDI, respectively, and, while relatively small, are more stable.

The main source of FDI inflows into Laos are largely from its neighboring countries. Over the last nine years (2001-2009), the top investors were the People’s Republic of China, Thailand and Viet Nam (Figure 7), on average accounted for about 21.8%, 19.8%, and 11.4% of total FDI respectively. Other important investors include France, Japan, the Republic of Korea, India, and Australia.

2. Some Perspectives on Economic Development Strategies for 2020

2.1 Lao Government’s Development Goals and Strategy for 2020 and Steps towards Achieving the Goals

The main long term development strategy of the Lao Government is the Seventh Five Year Socio-Economic Development Plan (NSED7), which has been formulated to determine the policy directions, main macroeconomic targets and action plans for the socio-economic development of Lao PDR over the period of 2011 to 2015 as the fundamental step towards achieving the development goals by 2020. The NSED7 is considered to be the most research driven plan that comprehensively reviews both external and internal environments, presenting both opportunities and challenges for the development over the next five years. The visions of the Lao government (GOL) by 2015 and 2020 are to move the country towards a modern and industrialised society; enjoy rapid economic growth with stability; visibly improve the living standards of the people; achieve the Millennium Development Goals (MDG) by 2015 and graduate from Least Development Country (LDC) status by 2020.

To achieve the above mentioned goals and visions, the NSED7 put forwards four overall goals:

1. Ensure rapid and sustainable economic growth at no less than 8% per year. GDP per capita estimation for 2015 is about \$1,700 per person per year at current prices.
2. Achieve MDGs (including poverty reduction) by 2015, acquire modern technologies and infrastructure, and establish a diverse economic foundation to move the country out of its Least Developed Country status in 2020.

3. Ensure sustainable development by integrating economic development with socio-cultural development and environment protection to the nation’s advantage.
4. Ensure political stability, fairness, and order in the society and maintain public security.

The main macroeconomic targets for 2015 can be summarized as follows:

- GDP growth not less than 8% per annum
- GDP per capita by 2015 to be realized about \$1,700
- Inflation must be less than one digit
- Exchange rate fluctuates between + and - 5 %
- Foreign currency reserve to be maintained for more than 6 months of imports
- Government revenues to be achieved about 18%-19% of GDP
- Budget deficit is about 3%-5% of GDP
- Investment requirement: Total Investment about 32% of GDP
 - Public Investment: 8%-10 % of total investment
 - ODA 26%-28 % of total investment

2.2 Thresholds for LDC Graduation

In order to meet the development goal by 2020, in particular to free from the status of LDC, Lao PDR needs to achieve 2 of 3 criteria to qualify for the graduation, in particular:

1. Gross National Income (GNI) per capita. 2011, the threshold for graduation is \$1,086, Lao PDR’s GNI per capita is about \$1,156.
2. Human Asset Index (HAI). 2011, threshold for graduation is more than 86, Lao PDR’s HAI is about 62.3.
3. Economic Vulnerability Index (EVI). In 2011, the threshold for graduation is less than 32. However, Lao PDR’s EVI is about 59.9 and the trends of EVI for Lao PDR in the last 10 years has gone more far away from the EVI threshold.

Based on the progress of the 3 criteria so far as mentioned above, Lao PDR could qualify for the thresholds of GNI per capita and HAI. For criteria 3, it is extremely difficult to be achieved. Hence, Lao PDR may concentrate on criteria 1 and 2. However, more efforts is also to be made to improve the EVI by promoting more development projects for improving the EVI.

2.3 Some Main Opportunities and Challenges

2.3.1 Main Potentials and Opportunities

Some main opportunities are:

- Political stability:

In Lao PDR, there is only one party system, the communist party, which has ensured political stability since the foundation of Lao PDR in 1975.

- Macroeconomic stability:

After the financial East Asian crisis in 1997, and its impacts until early 2000's Lao PDR has enjoyed relatively macro-economic stability.

- Strategic location and natural resources endowment:

The country of Lao PDR has relatively huge potentials on strategic location for developing the country as a land-linked country, untapped natural resources such as mineral resources, water resources for hydro power projects, and tourism destinations, forestry, etc.

- Relative low labor cost and low land concession: Labor cost and land rent cost in Lao PDR is lower than in Thailand
- Investment incentives for FDI.

2.3.2 Main Challenges for 2020

Together with the opportunities discussed above, Lao PDR is, however, facing a number of challenges as follows:

1. How to sustainable economic growth and equity?

The relative rapid economic growth over the last two decades has been based mainly on natural resources based sector in particular mining and hydropower projects as driver of growth. In addition, economic growth has been relied and until 2020

will still rely heavily on external sources in particular ODA (about 25%) and FDI (about 55%) of the total investment. Domestic sources are only about 20%.

2. How to foster human resources ?

Human development, one of the 3 pillars of socio-economic development is a crucial issue in the Lao PDR. Lao PDR's Human Development Index is still behind many countries in the world. In 2010, Lao PDR ranked 122 in the world, and poverty incidence is 26%.

3. How to strengthen firm competitiveness?

The most recent World Bank indicators on 'Doing Business 2010' rank Lao PDR 167 out of the 183 countries that were assessed, the worst rank in the region (table1).

4. How to ensure environmental sustainability?

As a result of population growth and economic development including infrastructure development, urbanization, industrialization, agriculture development, deforestation, trade etc., all natural resources will be affected gradually.

5. How to ensure equity and social safety net?

As a result of economic growth, population growth, the improvement of the living standards of the Lao people, the increase in life expectancy, reduction of child mortality rate, there will be more students, more workers, more old people, more social problems, which need more health care and safety.

2.4 Recommendations for the Development Strategy to 2020

In order to achieve the 2020 goal as well as to deal with the challenges above, policy recommendations are proposed as follows:

Table 1: Lao PDR: "Doing Business" compared with other countries

	Laos	Singapore	Thailand	Taiwan	Viet Nam	Cambodia
Ease of doing business Rank	167	1	12	46	93	145
Starting a business	89	4	55	29	116	173
Dealing with Construction permit	115	2	13	97	69	145
Employing workers	107	1	52	153	103	134
Registering Property	161	16	6	30	40	116
Getting Credit	150	4	71	71	30	87
Protecting investors	182	2	12	73	172	73
Paying Taxes	113	5	88	92	147	53
Trading Across Borders	168	1	12	33	74	127
Enforcing contracts	111	13	24	90	32	141
Closing a business	183	2	48	11	127	183

Source: Doing Business, World Bank (2010).

2.4.1 Some Main Socio-Economic Development Targets:

- A. Main macroeconomic targets:
- GDP growth no less than 8%
 - GDP per capita \$3,154 (GNI per capita about \$2,807)
 - Shares of GDP:
 - Agriculture: 19.2%
 - Industry: 49.0%
 - Services: 31.5%
 - Import duties: 0.3%
 - Investment capital requirement: 30-32% of GDP
- B. Social development targets:
- Population: Population will be 7.6 million by a population growth rate of 2.2%
 - Poverty reduction: Reduce poverty rate from about 26% in 2010 to 5% by 2020 of total population (below 19% by 2015)
 - Education and human development:
 - Increase universal primary school enrolment rate to 100% by 2020, and ensure that girls have equal access (98 % in 2015)
 - Increase secondary school enrolment rate to 90% in 2020 (85% in 2015).
 - Increase adult literacy to 100% in 2020 (99% by 2015).
 - Health and nutrition:
 - Increase life expectancy to 70 years
 - Reduce percentage of under weight children under 5 to 10% by 2020 (20% by 2015)
 - Reduce under 5 mortality rate (<5) to 40/1,000 by 2020 (70/1,000 live births by 2015)
 - Reduce infant mortality rate (<1) to 20 /1,000% by 2020 (45/1,000 live births by 2015)
- C. Environment targets:
- Ensure forest covers about 65% of the total land areas.

2.4.2 Policy Recommendation for Development Strategy

On the development strategy for 2020 to achieve

the development goals, Lao PDR may focus on the following:

1. Lao PDR needs to increase productivity and diversify the economy for growth with equity:

In order to ensure sustainable growth and diversify the economy for the long term by 2030, some recommendations are proposed:

(1) Increase labor and production productivity

Lao PDR needs to increase labor and production productivity in particular by focusing on agriculture sectors because the majority of Lao labor forces at the present time, more than 70% of the total labor forces are still engaged in agriculture sector, however, agriculture sector's share to GDP is only about 30%. This indicates the lowest productivity sector in the Lao economy. Industrialization in agriculture sector with eco-friendly manner should be strongly promoted in particular by focusing on modernization of irrigation system and introduction of modern production techniques and concentrate on production of market demand-driven commercial goods.

In addition, human resources development in general should be strongly promoted by focusing on developing more vocational schools and more technical trainings for workers in all sectors. The national education system should focus on upgrading the education's quality to international standards. Further more, Research and Development (R&D) should be promoted by taking appropriate shares of Government budget into account.

Moreover, imports of appropriate modern production techniques, technology and machines from advanced countries should be promoted.

(2) Diversify the economy:

In parallel with the development of the natural resources based sector, Lao PDR may develop more manufacturing industries to produce more value added products, develop transit services by developing the country as a land-linked country comprehensively including logistics development, trade facilitation, transport facilitation, promote SME, tourism etc. with sound market functioning mechanism and environment, in order to maximize the benefits from its strategic location as a land-linked country.

(3) Improve macro-economic management:

As a result of increasing foreign currency inflows from the windfall of the natural resource sectors (mining and hydropower), ODA and FDI, leading to Dutch Diseases, and in particular its impacts on the real exchange rate and

weakening competitiveness of domestic export firms, Lao PDR may have to mitigate these phenomena by focusing on stabilizing exchange rate and allocating government's expenditures resulting from the resources booming sector, ODA including foreign borrowing and FDI on promoting tradable goods and human resource development, infrastructure and health care.

Fiscal policy: (a) Continue to concentrate on the current reform in public financial management with the aim to increase fiscal discipline including transparency and accountability; (b) Establish a well functioning financial management mechanism for the revenue from natural resources, of which appropriate shares for saving and investment for the long term is to be taken into account; (c) Maintain an appropriate budget deficit (no more than 5% of GDP) in particular to avoid a debt trap.

Monetary policy: (a) Well manage money supply in accordance with the need for economic growth and ensure macroeconomic stability in particular inflation rate must be less than GDP growth rate, exchange rate fluctuates between +/-5%; (b) Continue to develop the monetary framework in consistency with regional in particular ASEAN monetary integration framework; (c) Develop a prudent exchange rate policy for the purpose of stimulating export.

2. Foster Human Capital:

Foster human capital is one of the main targets of Lao Government's development strategy, which is included in the MDG's and the goals for graduation from LDC status. In order to meet the MDG's by 2015 and to graduate from LDC status by 2020, Human Resource Development is one of the key priorities in particular, Lao PDR needs to increase its Human Development Index (HDI) and Human Asset Index (HAI for more than 68) to qualify for the threshold for the graduation by 2020.

Together with HDI and HAI, fostering human capital may focus on promoting more skilled labors, technicians, engineers and researchers. Lao Government may take more share of its budget allocation for education, health care and social security into account. Private investors should be strongly encouraged to contribute to human resources development at all levels of education. Education development at all levels should be labor market demand driven development and the real need for socio-economic development in the sense of learning for doing and doing by learning .

3. Ensure Environmental Sustainability:

Some recommendations to ensure environmental sustainability are proposed as follows:

(1) A clear road map or strategy for the long term development until 2030 should be formulated and adopted for the purpose of an appropriate balance between the tree pillars of development: economic development, social development and environmental preservation. Environmental preservation should be one of the top priorities by defining clear areas, development projects, policy and institutional frameworks.

(2) All the laws and regulations related to environmental issues, environmental assessment regulations for all socio-economic development projects should be more strictly monitored and enforced. Before implementing all development projects of both government and private sectors, environment assessment should be conducted deeply.

(3) The capacity of institutions related to natural resource and environment management should be strengthen .

4. Develop Economic Infrastructure:

Lao PDR as a land-locked country among GMS countries aspiring to become a land-linked country, a significant beneficiary of GMS by improving trade and transport facilitation to reduce the costs of its global as well as its regional trade. Some proposed recommendations for developing the infrastructure to facilitate transport and reduce cost are :

(1) Enhance the regional cooperation in particular GMS cooperation, and ASEAN cooperation on the long term regional infrastructure development projects linking GMS and ASEAN member countries trough Lao PDR and to link with the sea port in Thailand and Viet Nam, of which many parts are built and to be built in Lao PDR such as East-West Corridor (Rout 9), North-South Corridor (Road 3A), The Railway Boten/Bohan (Louangnamtha Province)-Vientiane to link Kunming-Singapore and others projects. However, Lao PDR may consider to maximize the benefits from these corridors in particular to develop the country as a land-linked country trough developing the transit corridors into economic corridors by improving the transit road, improving logistics, improving transport facilitation, trade facilitation, developing logistic parks, developing hotels, restaurants, resorts, tourism destination, garage, gas and rest stations, shopping center, etc.

(2) Improve and expand the domestic road networks between urban and rural areas to facilitate and increase transport in particular in rainy season more efficiently to reduce transport cost. It is important to increase the percentage of paved roads (the current paved road is only about 12 %).

(3) Develop and modernize international airport in Vientiane that big air craft such as Boeing 747 can land, develop and upgrade medium international airports in Louangprabang, Pakse (Champasack), Savanakhet and Xiengkhouang to attract international tourists and expand trade network.

(4) Due to the limited budget of the Lao Government for infrastructure development, Public- Private Partnership (PPP) could be promoted. Private investors can contribute to infrastructure development.

5. Increase Firm Competitiveness:

To deal with the challenges of firm competitiveness within the context of Lao PDR's economic integration in to the regional and global economy in particular AEC, EAFTA and WTO by 2030, it is important to increase firm competitiveness. Some policy recommendation might be taken into account as follows:

(1) Reduce transportation cost: Lao Government might make great efforts to develop and modernize road infrastructure, modernize transport logistics for transport facilitation, improve trade and investment facilitation.

(2) Produce high quality products for niche market: firms from Lao PDR need to qualify themselves to produce highly quality and competitive products in particular products for niche markets such as Lao handicraft (silk, hard wood products), eco-agriculture products, mineral processing products (gold, silver, and copper), and garments.

(3) Improve investment climate: Lao Government might focus on improving the one stop services for investment approval and problem solution. All laws and regulations related to investment climate might be revised periodically for a better investment climate under the new circumstances. Lao Business Forum should be organized regularly as a platform for discussion between the government and the private sector on how to improve investment climate as well as how to strengthen Public Private Partnership (PPP).

(4) Capacity building: Lao firms should develop their workers to be skilled workers.

(5) Research and Development (R&D): Lao firms should invest also in R&D to improve their product's quality and to study market assess.

6. Develop a Sustainable Social Safety Net:

A better social safety net should be developed in particular to increase the coverage of social protection for all Lao people by promoting economic growth with fair income distribution, establishing social assistance funds for the poor, promoting establishment of community social protection funds, promote the Lao traditional and cultural value etc.

Appendix

Table 1: Main Macroeconomic Indicators (2001-2010)

Items	2001-2005	2006-2010	2001-2010
	Average	Average	Average
Population (1000 people)		6,256	
GDP Growth	6.3%	7.9%	7.1%
- Agriculture	1.8%	4.0%	2.9%
- Industry	8.4%	12.6%	10.5%
- Services	10.2%	8.4%	9.3%
Shares of GDP			
- Agriculture		30.4	
- Industry		26.1	
- Services		37.2	
GDP per capita (\$)	491	1,069	1,069
Export Growth (%)	9.8%	34.2%	22%
Import Growth	4.1%	21.9%	13%
Inflation	10.4%	5%	7.7%
Exchange rate (Kip/\$)	depreciated 6.5% against \$	Appreciated 4.66% against \$	depreciated 2.5% against \$
M2 (billion kip)***		49,949	
Ratio of Government revenue to GDP in %	13.6%	14.5%	14.05%
Ratio of Budget deficit to GDP in%	7.4%	4.3%	5.58%
Ratio of total Investment to GDP in%	27.8%	28.5%	28.15%

Source: Ministry of Planning and Investment, 2010.

Table 2: Some Main Targets for 2020

No.	Items	Targets
1.	Population in 2020 (million people)	7.6
2.	Average GDP Growth	> 8.5%
	- Agriculture	3.5%
	- Industry	15%
	- Services	6.5%
3.	Shares of GDP	100%
	- Agriculture	18.5%
	- Industry	47%
	- Services	32%
4.	GDP per capita (\$)	3,303
5.	Inflation	< GDP growth
6.	Exchange rate (kip/\$)	8,022 (+/-5%)
7.	Government Budget	
	- Revenue to GDP	24-26%
	- Budget deficit to GDP	3-5%
8.	Ratio of Investment to GDP	32-34.5%
9.	Composition of total investment	100%
	- Public investment	10-12%
	- ODA	24-26%
	- Domestic and foreign private investment	55-60%
	- Bank credit and local people	10-12%

Source: Author's estimation.

ECONOMIC GROWTH AND DEVELOPMENT IN MYANMAR, 2001 - 2010, AND STRATEGIES AND PLANS FOR 2011 - 2020

Tin Htoo Naing¹

1. Introduction

Asia, including the Greater Mekong Subregion (GMS), has become the world's fastest growing region during the last few decades and the key player in restructuring the world's economic setting in the 21st century, which is often branded as the Asian century. The economies in the region are facing a number of challenges in environmental conservation because all developmental activities involve some amount of environmental degradation. While there are a number of different challenges in each economy, the environmental issue is a common challenge for all member economies of the region. However, the nature and extent of impact vary from country to country depending on the human, institutional, technological, and financial capability of the country concerned. Therefore, the critical point to be considered in policy making is to take into account the damage to environment as a result of development, and strike a balance between development and environmental protection (Field and Field, 2002).

Although the GMS is rapidly growing on average, its countries and peoples are at different development and income levels. Since most members of the GMS are developing economies with low levels of income and, in many cases, with weak human and institutional capacity, balancing economic growth and environmental sustainability has become crucial. This study attempts to review Myanmar's economic development performance during the last decade and consider emerging issues and challenges on the path to developing the country's economic sector without causing irreparable damage to the environment in the next decade.

2. Political Economy and Policy Regimes

Myanmar was one of the wealthiest nations within the region and its high potential for development was widely recognized when it gained independence from the British

in 1948. However, from 1962 to 1988, Myanmar's fortunes underwent a dramatic turn-around for the worse, as a result of its poor marriage to a self-styled socialism.

The socialist system was dismantled and a market-oriented economic system was revived in the 1990s after the military assumed State power. With the consistent efforts made by the government and the extensive participation of private sector, the economy rapidly entered a recovery phase. Under the economic reforms, which provided an impetus to both public and private sector development, the economy underwent changes in many sectors such as infrastructure as well as the institutional and business environment and officially recorded high growth over the period. However, the restructured economic system of the post-1988 period was unable to achieve macroeconomic stability and Myanmar has remained one of the poorest countries in the world, with a per capita gross domestic product (GDP) in 2011 of about \$821, according to an IMF estimate. This figure is lower than that of other Association of Southeast Asian Nations (ASEAN) countries, including the neighboring Lao People's Democratic Republic (PDR).

The State Constitution of the Republic of the Union of Myanmar was ratified and promulgated by the National Referendum in 2008, which declares Myanmar to be a market economy.

There are indications that together with the changes in the political system and the administrative structures following the 2010 national elections, attempts are being made to learn from the weaknesses and the flaws in policy, strategy and implementation of the previous periods. Legislation enacted in 2008 and the Special Economic Zones Acts of 2011 give incentives to investors while guaranteeing the people's interests. However, many other changes in terms of policy and strategies have yet to be made to achieve macroeconomic stability and targeted outcomes, and to ensure institutional cohesiveness and private-public collaboration that are vital for the realization of development goals.

3. Economic Structure

The structure of the economy in terms of the share of GDP by major sectors has remained substantially unchanged over several decades. For example, the share of agriculture in GDP in the fiscal year 1938/1939 is estimated to be 47.9% (U Myint, 2009), which remained unchanged after 50 years in 1988/1989. It continued more or less the same

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in the first decade of the new millennium, with a declining trend in the last few years only (Table 1).

Myanmar remains an agricultural country, with 70% of its population living in rural areas. The Government must seek all possible ways and means to achieve significant development in the agricultural sector. The most productive sectors are extractive industries, especially oil and gas, mining, and forest products, which makes the country vulnerable to the resource curse, including serious environmental degradation. Industrialization has shown little development, contributing 21.7% to the GDP with 11.0% of the labor force in 2008/2009. The share of manufacturing industry as a whole is about half that in higher-income ASEAN economies. The sector is dominated by private enterprises, which produced 92% of the total industrial output. The manufacturing and other modern facilitating sectors, which are the sectors that Myanmar must exploit if it is to follow the success-paths of its neighbors, are growing slowly against expected growth rates (Tin *et al.*, 2011).

The stagnation or very slow growth of manufacturing, transportation, communications, power generation, and financial institutions is, to some extent, indicative of flawed or inconsistent and incompetent policies in promoting industrialization (Myat Thein, 2004). The energy sector has experienced high rates of growth, while fluctuating substantially year by year depending on new capacity coming on stream. The construction sector also expanded rapidly in the second half of the decade with the construction of the new capital Nay Pyi Taw in central Myanmar and the implementation of various large infrastructure projects, including the Yangon-Mandalay motorway, Dawei and Kyaukphyu deep-sea port, and hydropower projects.

3.1 Foreign Direct Investment

The Foreign Investment Law enacted in November 1988 aimed at bringing foreign capital into the country. Although incentives were given to attract foreign investors, Myanmar was not a large recipient of foreign direct investment (FDI) as it was regarded as a highly risky destination due to the uncooperative policies, inconsistent regulations, poor infrastructure, unstable financial markets, multiple exchange rates, and later, economic sanctions.

Due to the economic sanctions imposed by the United States and some European Union countries since the late 1990s and early 2000s, the Asian region is the main source of FDI inflows into Myanmar. The huge differential between the official exchange rate and the market rate also continues to negatively affect FDI inflows and the competitive environment for the private sector. The State Economic Enterprises (SEEs) for instance, can import at the official rate and hence are at a huge competitive advantage over the private sector (Verbiest and Tin, 2011).

Myanmar's top two sources of FDI, the People's Republic of China (PRC) (inclusive of Hong Kong) and Thailand accounted for 71% of the total, followed by the Republic of Korea at 8% and the United Kingdom (inclusive of enterprises incorporated in the British Virgin Islands, the Bermuda Islands, and the Cayman Islands) at 7%. The FDI levels increased dramatically in 2006/2007 and remained stable until 2009, with the total permitted foreign investment amounting to \$15,722 million as of 31 January 2009 and doubling to \$35,518.440 million as of 31 January 2011 (Table 2).

Table 1: Share of Agriculture, Industry, and Services Sectors in Myanmar's GDP, 2000/2001–2008/09 (%)

GDP, 2000/2001–2008/09 (%)	%		
	Year	Agriculture Sector	Industrial Sector
2000/2001	42.7	17.8	39.5
2001/2002	55.9	10.6	33.5
2002/2003	52.9	12.8	34.3
2003/2004	51.9	13.6	34.5
2004/2005	50.7	14.5	34.8
2005/2006	50.1	15.3	34.6
2006/2007	45.3	18.6	36.1
2007/2008	43.7	19.8	36.5
2008/2009	41.7	21.2	37.1

Source: CSO, Ministry of National Planning and Economic Development, Myanmar.

Table 2: Foreign Investment in Permitted Enterprises by Sector (\$ million)

Sector	As of	As of	As of	As of	As of	As of
	31.3.2000	31.3.2003	31.3.2005	31.3.2007	31.3.2009	31.1.2011
	Approved Amount					
Power				6,311.222	6,311.222	14,529.742
Oil and Gas	2,308.373	2,403.173	2,600.023	3,073.478	3,357.478	13,815.375
Mining	524.115	526.740	534.190	534.890	1,395.886	2,395.386
Manufacturing	1,468.979	1,604.068	1,610.408	1,610.408	1,628.896	1,668.126
Hotel and Tourism	818.059	1,059.661	1,034.561	1,034.561	1,049.561	1,064.811
Real Estate	997.140	1,025.140	1,056.453	1,056.453	1,056.453	1,056.453
Livestock and Fisheries	283.617	309.758	312.358	312.358	324.358	324.358
Transport and Communication	275.687	283.272	313.272	313.272	313.272	313.272
Industrial Estate	193.113	193.113	193.113	193.113	193.113	193.113
Agriculture	14.351	34.351	34.351	34.351	34.351	96.351
Construction	17.267	37.767	37.767	37.767	37.767	37.767
Other Services	13.386	23.686	23.686	23.686	23.686	23.686
Total	6,914.087	7,500.729	7,750.182	14,535.559	15,726.043	35,518.440

Source: Statistical Yearbook, Central Statistical Organization, Ministry of National Planning and Economic Development, Myanmar. Various years.

The bulk of the FDI that Myanmar has attracted so far is concentrated in sectors related to natural resources extraction, such as power, oil and gas, and gem mining. Some 80% of total FDI is channeled to the power industry (41%), and oil and gas industry (39%). Such figures are a strong indication that the foreign investors are interested most in extracting natural resources of Myanmar. FDI levels remain low in economic sectors that require little resource use but promise high returns, with the manufacturing sector attracting 4.7%, livestock breeding 0.9%, transport and communication 0.9%, and agriculture 0.3% of FDI. The export-oriented garment industry had relatively less attraction to foreign investors, especially after economic sanctions were imposed in the early 2000s. The food and beverages industry produced 75% of total industrial output, mostly for the domestic market. Transport and communication, the most important sector to be developed in order to catch up with global market changes, received only 0.9% (\$313.27 million) of FDI (Table 2). The sectors vital for import substitution, export promotion, and job creation while having very little impact on the environment, are exactly those that received the lowest proportions of FDI.

Barriers to FDI inflow, such as economic instability, fluctuations in the value of the local currency, and the use of multiple exchange rates, need to be addressed while modernizing the banking system, issuing currency legislation for transparent regulatory framework and avoiding frequent and/or arbitrary regulatory changes. Strategies will also be required to provide more incentives for investment in agriculture, livestock breeding, consumer equipment manufacturing, industrial manufacturing, and technology, rather than in natural resources extraction and use.

The environmental problems related to natural resource extraction and use are transboundary in nature and need to be considered regional issues rather than internal affairs of particular countries. The FDI structure in Myanmar is obviously not environmentally friendly and is definitely not headed in the direction of a green economy. Moreover, the investments in natural resources extraction have physical constraints that significantly restrict prospects for long-term development. Even the export of natural resources is carried out in raw form without value-added production or processing.

In order to maximize benefits from natural resources and reduce negative impacts, short-term measures, such as careful scrutiny of proposals, attracting investment for high value-added manufacturing, production based on existing industries, and enforcing accountability for side-effects through specific legislation, may be considered. Part of the revenue from natural resource extraction may also be channeled into public investments as productive expenditure to achieve the transformation of natural resources into human resources for long-term development.

Such human capital formation and domestic knowledge accumulation have the potential to attract other forms of investments, such as market-seeking and efficiency-seeking investments, providing a pathway out of the resource curse. Beginning with the period of economic transition, Myanmar has the opportunity to take advantage of other countries' experience and incorporate environmental conservation and sustainable long-term utilization of natural resources into its economic policies and strategies.

3.2 External Trade

Since Myanmar has pursued an export-led growth policy, the Government has encouraged exports promotion through relaxation and liberalization of trade policy. However, trade strategies, very often associated with free trade and government intervention concepts, were practiced. To be in line with the changing economic system, the Ministry of Commerce amended export and import policies and procedures with a view to developing external markets and adopted trade strategies to export all exportable surpluses, to import all the country's required goods, and to utilize human and natural resources effectively. It also promoted external trade not only in traditional exports but also more value-added commodities. Border trade was regularized in order to develop and strengthen bilateral trade relations with the five neighboring countries (MOC, 2010). Trade value increased from about \$400 million in 1988/1989 to \$11.77 billion in 2009/2010, an increase of more than 25 times (Table 3). ASEAN, the PRC, and India are major destinations for Myanmar's exports, accounting for more than 70% of total exports and about 90% of total imports.

The export structure of Myanmar has changed in line with the market-oriented system since 1999/2000. The garment sector grew rapidly and became a major foreign-exchange earner and job creation industry. Garment exports reached their peak in 2000/2001 and amounted to 30% of total exports, followed by agricultural products and natural gas (nearly 9%), which was a new export product at the time.

By 2008/2009, the major export items were natural resources, including natural gas (35.1% of total exports); precious and semi-precious minerals; and agricultural products (15.5%), mainly rice and rice products, pulses, maize, raw rubber, marine products, and forestry products (Table 4). Imports were almost equally shared among capital goods at 30%, intermediate goods at 33% and consumer goods at 37% .

Under such circumstances, diversifying export products, increasing export volumes, and improving the quality of the exports products should be among the main objectives of the export promotion policy. The import policy of Myanmar is to give priority to capital goods, industrial raw materials, and spare parts and other essential items. The Government needs to encourage public and private entrepreneurs to import commodities that will contribute to infrastructure development and production sectors.

4. Economic Growth and Development

In 1992/93, a 20-year plan consisting of 4 five-year short-term plans began. The first five-year plan spanning 1992 to 1996 achieved an average annual growth of 7.5%. The main drivers for the growth were the opening of trade as a result of the government liberalisation measures, the growth in tourism industry, and a short-term construction boom together with agricultural development based on successful rice harvests. However, during the second 5-year plan from 1996 to 2001, growth slowed as a result of repercussions from the 1997–1998 Asian financial crisis and economic pressure begun in the year 2000. But official statistics claimed 10.9 % and 13.7 % growth for 1999/2000 and 2000/2001, respectively, with an average annual growth of 6%. In this period, American and European economic pressure began, in connection with the political situation in Myanmar.

In the 2001–2006 plan, the Government claimed a better than expected economic growth performance of 12.9%. The principal aims of this plan were to build a more stable and diversified formulation for sustained growth of the economy, to attain the rank of agro-based industrialized nation, and to strive for balanced economy among the regions. Against the economic sanctions imposed by Europe and the United States, Myanmar was restructured and brought firmly into the orbit of the GMS and ASEAN. In order to transform itself to an agro-based industrializing nation, 18 industrial zones were established. The Myanmar Industrial Development Committee was formed to assist private entrepreneurs to acquire capital, raw materials, machinery and equipment, modern technology, and infrastructural facilities.

The fourth 5-year plan spanned 2006/2007 to 2010/2011, and aimed to achieve an average growth rate of 12.0%, maintain rapid economic growth, reduce poverty and implement the Millennium Development Goals (MDGs). Better-than-targeted annual growth rates were again claimed (Table 5), which on paper made Myanmar the fastest growing economy in the subregion. The main drivers for such growth were claimed to be more efficient land use, higher production, industrial sector development, and increased exports.

Claims of sustained double-digit economic growth for over a decade prompted studies by experts at home and abroad, raising questions over the growth rates claimed by

Table 3: Myanmar Foreign Trade

Particulars	2001/2002	2002/2003	2003/2004	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009
Export	2,544.25	3,062.85	2,356.81	2,927.83	3,558.00	5,232.70	6,401.70	6,779.10
Normal	2,253.80	2,546.01	2,077.97	2,580.42	3,127.70	4,585.50	5,655.00	6,121.50
Border	290.45	516.84	278.84	347.41	430.30	647.20	746.70	657.60
Import	2,735.59	2,299.63	2,239.97	1,973.28	1,984.40	2,936.70	3,353.40	4,543.30
Normal	2,618.08	2,084.12	1,971.27	1,682.87	1,692.80	2,491.30	2,770.60	3,852.30
Border	117.51	215.51	268.70	290.41	291.60	445.40	582.80	691.00
Trade Total	5,280.84	5,362.48	4,596.78	4,901.11	5,542.40	8,169.40	9,755.10	11,322.40
Normal	4,872.88	4,630.13	4,049.24	4,263.29	4,820.50	7,076.80	8,425.60	9,973.80
Border	407.96	732.35	547.54	637.82	721.90	1,092.60	1,329.50	1,348.60
Trade balance	(191.34)	763.22	116.84	954.55	1,573.60	2,296.00	3,048.30	2,235.80
Normal	(364.28)	461.89	106.70	897.55	1,434.90	2,094.20	2,884.40	2,269.20
Border	172.94	301.33	10.14	57.00	138.70	201.80	163.90	(33.40)

Source: Ministry of Commerce, Myanmar.

Table 4: Myanmar Exports by Commodity (%)

Commodity	2000/2001	2001/2002	2002/2003	2003/2004	2004/2005	2005/2006	2006/2007	2007/2008	2008/2009
Agricultural Products	18.15	17.63	14.07	16.59	10.95	12.28	13.31	13.26	15.53
Animal Products	0.29	0.25	0.11	0.09	0.10	0.10	0.06	0.06	0.07
Marine Products	7.33	5.03	5.59	6.84	6.20	5.56	4.52	4.68	4.06
Timber	6.30	10.97	9.38	14.51	13.43	13.32	9.79	8.40	5.97
Base Metal and Ores	2.54	1.68	1.41	2.41	3.28	3.13	2.13	1.35	0.48
Precious and Semi-precious Minerals	2.85	0.74	1.25	2.53	3.69	6.58	7.43	10.08	9.72
Gas	8.72	24.79	29.66	24.63	34.81	30.20	38.89	39.49	35.10
Garment	29.72	17.42	14.91	13.92	7.41	7.68	5.34	4.41	4.30
Other Commodities	24.09	21.48	23.61	18.47	20.13	21.15	18.55	18.28	24.77
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Ministry of Commerce, Myanmar.

the Government, especially those in the post 1999/2000 period. In the six decades of independence since 1948, the country achieved an annual double-digit growth twice in the 1950s (in 1950 and 1956) and 3 times in the 1960s (in 1962, 1964, and 1967). Those years were all immediately preceded or followed by a negative growth year. But the double-digit growth rate beginning in 1999/2000 was claimed to have continued for over a decade. Such sustained double-digit growth represents a sharp break with the country's development experience in the entire post-independence era (U Myint, 2009).

The International Monetary Fund (IMF) and World Bank noted that no developing country anywhere in the world has ever achieved such growth and that given the regional and international situation, the robust growth claimed by Myanmar was highly controversial. While real GDP growth was about 6%–7% in the 1990s and appeared to be in line with other indicators, double-digit growth claimed for 1999–2000 and continued over the last decade, together with many other indicators, suggests a substantial overvaluation of GDP. The IMF estimates average growth at around 4.5%–5% over the past decade, significantly

lower than that of Cambodia, the PRC, the Lao PDR, and Viet Nam (Table 6).

There are several reasons why Myanmar GDP growth is controversial among national and international observers. One of the reasons would be the weakness of the System of National Accounts (SNA). Compiling GDP estimates is just the first step of a comprehensive analysis of the economic development trajectory. The SNA has many weaknesses and has been revised from time to time. Two estimators using two different versions of SNA will give different GDP estimates at the same time. Although the compilation of macroeconomic variables requires special skills and extraordinary efforts, the best estimate is no more than an approximation (Studenski, 1958). However, errors are more often due to gaps and inaccuracies in the data. Also, coverage of the economy in terms of formal and informal economic activities will make GDP estimates different; the use of different methods of deflation and inflation (single/double) is another factor to be considered. In the case of Myanmar, the most questionable factor is the use of exchange rates in constructing GDP estimates (Table 7).

Table 5: Economic Growth Trajectory, Myanmar, 1981/1982–2008/2009

Fiscal Year	GDP growth rate (%)	Fiscal Year	GDP growth rate (%)	Fiscal Year	GDP growth rate (%)
1981/1982	6.4	1991/1992	-0.7	2001/2002	11.3
1982/1983	5.4	1992/1993	9.7	2002/2003	12.0
1983/1984	4.3	1993/1994	6	2003/2004	13.8
1984/1985	4.9	1994/1995	7.5	2004/2005	13.6
1985/1986	2.9	1995/1996	6.9	2005/2006	13.6
1986/1987	-1.1	1996/1997	6.4	2006/2007	13.1
1987/1988	-4	1997/1998	5.7	2007/2008	11.9
1988/1989	-11.4	1998/1999	5.8	2008/2009	10.7
1989/1990	3.7	1999/2000	10.9	2009/2010	10.4
1990/1991	2.8	2000/2001	13.7		

Source: CSO, Ministry of National Planning and Economic Development, Myanmar.

Table 6: Growth Rate of Myanmar's GDP (% per year)

	2005	2006	2007	2008	2009	2010
Cambodia	13.3	10.8	10.2	6.7	0.1	6.3
PRC	10.4	12.7	14.2	9.6	9.2	10.3
Lao PDR	7.3	8.1	7.9	7.2	7.3	7.5
Myanmar ^a	13.6	13.1	12	10.2	10.4	10.8
Myanmar ^b	4.5	7.0	5.5	3.6	5.1	5.3
Thailand	4.5	5.1	5.0	2.5	-2.3	7.8
Viet Nam	8.4	8.2	8.5	6.3	5.3	6.8

Notes: a Official GDP

b Adjusted based on weighted exchange rate, IMF

Source: ADB. 2011. *Asian Development Outlook 2011*. Manila. Table A1.

Table 7: Economic Growth and Macroeconomic Indicators, Myanmar

	Economic Growth	Inflation	Exchange Rate (Official)	Exchange Rate (Market)
1999/2000	10.9	15.2	6.2	
2000/2001	13.7	-1.7	6.5	627
2001/2002	11.3	34.5	6.7	936
2002/2003	12.0	58.1	6.5	979
2003/2004	13.8	24.9	6.0	912
2004/2005	13.6	3.8	5.7	1,067
2005/2006	13.6	10.7	5.8	1,281
2006/2007	12.7	26.1	5.7	1,302
2007/2008	10.2	32.9	5.5	1,206
2008/2009	10.4	22.5	5.5	1,081
2009/2010	10.8	8.2	5.4	973

Source: CSO, Ministry of National Planning and Economic Development, Myanmar.

Under these circumstances, a single indicator, such as GDP growth, cannot measure the economic success of a nation, which encompasses much broader areas of the economy and the people's welfare as well as the physical environment. In other words, GDP growth in Myanmar can only serve as one of the indicators and a proper overview of the country's socioeconomic life will require the consideration of other macroeconomic and social indicators.

According to the classic economic theory, investment levels play a vital role and have a strong positive correlation with GDP growth, making investment ratios a highly pertinent macroeconomic indicator. The investment ratio in Myanmar over the past decade was 12–15. Viet Nam had an investment ratio between 35 and 40 and an average growth of about 8% during the same period. Similarly, the PRC

had much higher investment ratios than Myanmar and an average growth rate of about 10% over the decade. Among the GMS countries for which investment data are available, the investment ratio in Myanmar is the lowest (Table 8).

5. Human Resources Development

The role played by human capital in the development of the country is as important as that of physical capital, if not more important, as economic growth and human resource development are mutually reinforcing. In evolutionary economics, the best investment for the future of a country is considered to be human capital formation. Myanmar's rating in the Human Development Index (HDI), a social indicator, has fallen behind that of other GMS countries (Table 9).

Table 8: Gross Domestic Investment (% of GDP)

	2000	2005	2009	2010	2011
Cambodia	17.5	18.5	16.0	18.5	19.0
PRC			48.2	23.8	
Myanmar	12.4	13.2	14.6	15.2	14.2
Thailand	22.8	31.4	21.2	26.0	27.9
Viet Nam	39.6	35.6	38.1	38.0	36.4

Source: International Monetary Fund. 2011. *World Economic Outlook Database*. April 2011 Edition. Washington, DC.

Table 9: Human Development Index in GMS Countries (country ranks and scores)

Economies	2005		2010		2005–2010 Change	
	Rank	Score	Rank	Score	Rank	Score
Cambodia	125	0.466	124	0.494	1	0.028
PRC	81	0.616	89	0.663	8	0.047
Lao PDR	126	0.460	122	0.497	4	0.037
Myanmar	138	0.406	132	0.451	6	0.045
Thailand	93	0.631	92	0.654	1	0.023
Viet Nam	114	0.540	113	0.572	1	0.032

Source: <http://hdr.undp.org/en/media/HDI-trends-1980-2010.xls> (accessed on 7 May 2011).

Table 10: Components of Human Development Index

Economies	Life Expectancy at Birth (years)		Mean Years of Schooling (adults aged 25 years and above)		Expected Years of Schooling of Children (years)		GNI Per Capita (2008 US\$ at PPP)	
	2005	2010	2005	2010	2005	2010	2005	2010
	Cambodia	59.4	62.2	5.7	5.8	9.7	9.8	1,511
PRC	72.6	73.5	7.1	7.6	10.7	11.4	4,434	7,258
Lao PDR	63.6	65.9	3.9	4.6	9.0	9.2	1,693	2,321
Myanmar	60.6	62.7	3.5	4.0	8.9	9.2	1,102	1,596
Thailand	68.4	69.3	5.9	6.6	13.5	13.5	6,955	8,001
Viet Nam	73.8	74.9	4.9	5.5	10.4	10.4	2,274	2,995

Source: Human Development Report 2010 - 20th Anniversary Edition.

As can be expected of a least developed country (LCD), the HDI ranking for Myanmar is 132 out of 169 countries, significantly lower than that of other GMS countries. However, the overall HDI ranking changed faster than other member countries, showing an increase of 11% or average annual increase of about 2.1% between 2005 and 2010. Similarly, the components of HDI (Table 10) reveal progress in Myanmar over the period. In terms of gross national income (GNI) per capita, Myanmar increased 45%, below that of the PRC (64%) but higher than that of other GMS countries: Cambodia (24%), Lao PDR (37%), Viet Nam (32%) and Thailand (15%). Although most of the components are lower than those of all members, mean years of schooling and expected years of schooling increased by about 0.5 and 0.3 years, respectively, while life expectancy at birth increased slightly by over 2 years.

A quality basic education system is a prerequisite for human resources development, as is a healthy and knowledgeable workforce. For longer-term development and growth, investments in health and education sectors leading to human resources development will be essential. Myanmar's low HDI ranking is due mainly to the government's low levels of spending on health and education - 0.2 % and 0.8% of GDP in 2010 (ADO 2011), a lack of coherent and continuous education policy, failure to create knowledge-

based employment opportunities, and lack of incentives for academic pursuits. In the case of education, the frequent suspensions of tertiary education classes and changes in the education system severely affected the quality of education in Myanmar over the last two decades. Public sector expenditure on education decreased from about 1.9% of GDP in 1990 to 0.6% in 2010. Consequently, education indicators for Myanmar are well below those of its neighbors and peers. However, there has been a series of reforms introduced to improve quality and accessibility of education across the country and a substantial expansion of private sector education in the past decade.

Water quality and quantity are of economic, social, and environmental importance. The proportion of population with sustainable access to an improved water source was 66% in 2000 and increased to 71% in 2008, which is much higher than two other GMS countries, Cambodia and the Lao PDR. Similarly, the proportion of population with access to improved sanitation facilities in Myanmar increased from 65% in 2000 to 81% in 2008, while in Cambodia and the Lao PDR, the corresponding proportions were 29% and 53%, respectively (Table 11). However, Myanmar's freshwater resources are threatened by overexploitation and pollution both from industrial and domestic waste. Also, several damming projects such as the Ayeyarwady Myitsone

Table 11: GMS Social Indicators

Economies	Improved water source (% of population with access)		Improved sanitation facilities (% of population with access)	
	2000	2008	2000	2008
	Cambodia	46	61	17
PRC	80	89	49	55
Lao PDR	48	57	26	53
Myanmar	66	71	65	81
Thailand	96	98	93	96
Viet Nam	79	94	57	75

Source: World Development Indicator, World Bank, available at <http://databank.worldbank.org/ddp/home.do> (accessed on 19 May 2011)

Hydropower project, are threatening sustainable freshwater resources and the whole ecosystem of the country.

6. Environment and Biodiversity

Different economic systems practiced in Myanmar throughout its post-independence period have shaped the Myanmar economy and will continue to shape it in the future. For several decades, Myanmar had implemented the National Development Plan with the aim of accelerating growth, achieving sustainable development, and reducing socioeconomic disparities between rural and urban areas of the country. While rapid growth is being pursued as the top priority in the short term, the long-term strategy must be to strive for sustained and stable growth of the economy guided by a philosophy of environmentally sound development that improves the quality of life of the people, makes proper use of natural resources, and protects essential ecological processes and biodiversity (MNPED, 2010). In practice, it seems easier to set the economic policy priorities in favor of rapid growth rather than balanced growth with economic sustainability. The mechanism of realizing sustainable development is usually slow in yielding concrete benefits, making it more difficult to justify the sacrifices in economic growth for future environmental sustainability.

Myanmar is indeed very rich in forest resources, with approximately half the total land area under forest cover. The variety of climatic zones from temperate to arid and tropical allows different forest types to exist: temperate forests in the north, deciduous and dry forests in the central regions, and semitropical rain forests in the south. They are home to over 7,000 different plant species, including 2,100 tree species, 840 kinds of orchid, 96 varieties of bamboo, and 32 different types of cane. Myanmar's forest cover declined from 61% in 1975 to 59% in 1989, to 52%

in 1998, and to 47% in 2010. The annual deforestation rate is about 0.3% of total country's area (MOF, 2001) while another source stated that the rate is about 1.4%, which is one of the highest among ASEAN countries (MOF, 2004).

Environmental preservation activities in Myanmar have gathered some momentum. Under the Myanmar Forest Policy (1995), 30% of the total land area is designated as reserved forests, and 5% as Protected Area System (PAS). Currently, there are 43 PAS areas, of which 34 have been notified, 9 proposed, and 121,911 km² reserved (MOF, 2009). In 2001, 19% of the country's area was legally classified as Reserved and Protected Public Forests (16.48% and 2.67% respectively). By adopting the MDGs and implementing the 1995 Myanmar Forest Policy, the total area of both types of forests increased to 23.2% of total land area in 2006 (MOF, 2009). Similarly, the private sector is now allowed to grow teak on a commercial basis. Establishment of forest plantations is making progress, albeit rather slowly.

Myanmar is also rich in biodiversity; however, loss of biodiversity due primarily to socioeconomic pressure is unavoidable in a developing country like Myanmar. The general trend toward a decrease in the wild animal population became apparent over the past 20 to 30 years, due partly to habitat destruction, and partly to small populations failing to sustain a viable rate of reproduction in the wild (FD, 2009). In particular, the downward trend is apparent with large mammals, such as tigers and elephants, because of their altered sex ratio and home range reduction by human activities.

As much as 95% of Myanmar households use solid fuels, such as firewood, for cooking. Nevertheless, Myanmar, has the lowest carbon dioxide emissions in the GMS (MOF, 2009). Also, fewer people than elsewhere in the subregion are affected on average by natural disasters (Table 12).

Table 12: Carbon Emissions and Disasters

Economies	Carbon Dioxide Emission Per Capita (ton)		Population Affected by Natural Disasters (average per year, per million people)
	1999	2006	2000–2009
Cambodia	0.1	0.3	62,992
PRC	2.3	4.6	96,359
GMS	1.1	1.8	43,613
Lao PDR	0.1	0.2	24,535
Myanmar	0.2	0.2	5,989
Thailand	3.3	4.3	46,173
Viet Nam	0.6	1.2	25,632

Source: Human Development Report 2010, Table 7, p: 170-171

Myanmar has acknowledged the need to integrate environmental considerations into its economic policies and poverty alleviation programs. It has established a National Sustainable Development Strategy (NSDS, 2009) with the vision of “Well-being and Happiness for Myanmar People” and similar plans to strengthen institutions, monitor and enhance environmental quality, provide environmental education, and raise public awareness. The most critical constraint for improving environmental management is the absence of clear institutional responsibility and the lack of effective enforcement associated with limited technological and organizational capabilities. In order to promote environmental conservation, the Government, private entities, and donors should employ both moral and profit motive approaches for the business sector and communities in rural and urban areas to take into account the damage to environment as a result of development and strike a balance between development and environmental protection.

7. Regional Connectivity

Myanmar is of geopolitical importance for regional connectivity with its location at the junction of East Asia, Southeast Asia, and South Asia, and a potential central hub for exchange of goods, services and technology. The country is a full member of several regional and subregional organizations apart from the GMS. Underdeveloped infrastructure and an unfavorable institutional and business environment seriously limit Myanmar’s economic participation in regional and global networks. Cross-border connectivity plays a very important role in this scenario. Establishing better connectivity will allow Myanmar and other GMS countries to create possibilities for collaboration between them and to expand economic synergies for development in the broad Asian region.

7.1 Physical Connectivity: Transport

There are three main economic corridors that have so far been defined in the GMS Program, namely, the East-West Economic Corridor (EWEC), running from the Da Nang Port in Viet Nam, through Lao PDR, Thailand, and to the Mawlamyine Port in Myanmar; the North-South Economic Corridor (NSEC), which covers the major routes running from Kunming to Chiang Rai to Bangkok via Lao PDR and via Myanmar, and from Kunming to Hanoi to Haiphong (and most recently, from Nanning to Hanoi); and the Southern Economic Corridor (SEC), which runs through southern Thailand, Cambodia, and southern Viet Nam. The PRC

and India have suggested to the Myanmar Government that the 1,726 kilometer Stilwell Road, which could serve as an important road link between the world’s two most populous nations, be reopened.

With the assistance of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), Asian Development Bank (ADB), and Mekong River Commission, the East-West Economic Corridor project is being implemented not only to improve freight transportation and to facilitate trade in the subregion but also for the development of a transportation network across the GMS, mainly in Cambodia, Lao PDR, Myanmar, and Viet Nam (Cho, 2008). The EWEC is designed to be the direct and continuous land route between the Indian Ocean and the South China Sea. The highly efficient transport system will strengthen economic cooperation between the Lao PDR, Myanmar, Thailand, and Viet Nam by linking two port cities: Mawlamyine in Myanmar and Da Nang in Viet Nam. Although the EWEC connects eastern ASEAN countries, the Western Economic Corridor (Mawlamyine to Tamu) and SEC are the key base to establish a Mekong-India Economic Corridor (MIEC) by extending the link to Dawei in Myanmar.

The Dawei project will cover an area of approximately 250 km² (on shore) and consist of three major components: deep sea port; industrial estate; and cross-border road, rail, and pipeline link with connecting electrical transmission lines to the Myanmar/Thai border. The total project investment cost of infrastructure and supporting facilities is estimated to be \$8.6 billion, and the required investment from potential industrial investors in the industrial estate is estimated to exceed \$50 billion (ITD, 2010). The project will reduce logistical and labor costs for GMS members while creating job opportunities in Myanmar. It will bring good opportunities for the region as a whole since Dawei port will serve as a new commercial gateway providing an alternative sea route to the PRC, India, Middle East, Europe, and Africa that will reduce dependence on the congested Straits of Malacca and yield significant savings in transportation time and logistic costs (MPA, 2010).

Connecting the GMS and India was more or less initiated by the establishment of Mekong-Ganga Cooperation (MGC) in 2000 in the Lao PDR. After completion of EWEC transport network, it will be possible to travel by road from India to Viet Nam passing through Myanmar, Thailand, and the Lao PDR. India has also proposed an India-Myanmar-Thailand trilateral highway to extend to Cambodia and the Lao PDR with the aim of fostering greater cooperation within the

Mekong region (ADB, 2010). The MGC is advantageous for Myanmar as it will enable direct trade, transit trade, and the development of special economic or industrial zones along the corridors (e.g., Yangon, Mandalay, Monywa, Myingyan, Mawlamyine, Dawei, and Kyautphyu) as well as trade posts in the border areas (e.g., Myawaddy, Tamu, Rhi, and Muse). Development of economic corridors and transportation networks will reduce not only transport costs but also growth differentials among the countries in the subregion (Tin *et al.*, 2011).

The PRC is developing another project for building a deep sea port at Kyaukphyu in western Rakhine State. The main harbor at Kyaukphyu will link to a new 1,950 kilometer highway to be built from Kyaukpyu of Myanmar directly to Kunming, the capital city of Yunnan Province. The project will shorten the overall distance by thousands of kilometers and will save money and time for the PRC by sending their products to the west and Middle East through Myanmar instead of passing through the Malacca Strait (MPA, 2010). As both the Dawei and Kyaukphyu projects are designed to develop the deep sea port with industrial zones and transportation links, they will promote not only trade volume but also FDI in the GMS.

Myanmar is located at a strategic geographical location in the GMS. Development programs in the subregion will depend to a significant extent on subregional connectivity. As it is costly for GMS countries to reach the Indian Ocean through the Malacca Straits, Myanmar can serve as a gateway via the EWEC and SWEC corridors. However, the current economic projects being implemented in Myanmar are faced with delays due to economic sanctions and the effects of the international financial crisis.

Some political and security issues require bilateral and multilateral attention, especially territorial and border issues between neighboring countries. The territorial issues and armed ethnic groups along the border areas of Cambodia, the Lao PDR, Myanmar, Thailand, and Vietnam have impeded the implementation of regional cooperation programs. Illicit trade (of timber and precious stones from Myanmar to Thailand, for example), trafficking in persons and transnational crime are also challenges that require resolution before the regional cooperation programs can proceed fully.

While the infrastructure projects are implemented in order to improve regional connectivity, capacity for proper management in conservation of the natural environment needs to be built. Environmental friendly practices, such

as proper waste management, low carbon emission techniques, and systematic treatment, are to be set up in the industries of special economic zones, but some environmental degradation and pollution of soil, air, and water will occur. International organizations may give special consideration to environmental conservation in Myanmar in providing financial and technical assistance.

7.2 Institutional Connectivity: Trade

Myanmar has shown an interest in cooperating more closely with the ASEAN member countries and has joined the ASEAN Free Trade Area (AFTA) to be implemented from 2015, covering nearly 3 billion people. With the expansion of markets for ASEAN countries, competition for market share is also likely to intensify. Import prices in the region will be lower leading to greater domestic consumption and increased trade. However, the private sector in Myanmar, as well as in Cambodia, the Lao PDR, and Vietnam, have raised concerns about the consequences of imminent economic freedom.

Myanmar has little experience in market economic practices and poor access to the necessary technology and financial resources. Under such circumstances, plunging into direct competition with more experienced countries under AFTA is likely to have more harmful than beneficial effects. Within the new setting of a regional market, Myanmar will need to attain market competitiveness, quality competitiveness, and product competitiveness for its survival and growth.

The Myanmar economy is based on primary sectors and relies on exports of raw material rather than value-added products. While there are advantages, such as rich natural resources and low labor costs, much work remains to be done before the advantages can be translated into a competitive edge in trade. Export promotion is closely linked to increasing productivity. In other words, greater competitiveness in any economic sector requires greater productivity, which in turn calls for either improvements in efficiency or an increase in capital intensity, or both. There is a great potential in Myanmar to create a highly skilled labor force, strong technology, and knowledge base, high-tech infrastructure, and corporate governance through dynamic and coherent economic strategies (Rasiah, 2007; Rasiah and Myo, 2011). But at present, Myanmar's efforts to achieve market competitiveness have fallen far behind the required levels in almost every aspect. Clearly, Myanmar requires a preparatory period before it can hope to compete with countries in the region on what can be considered an equal basis.

During such a period, Myanmar needs to be considered a complementary trade partner rather than a market competitor. It can serve as a regional food basket, a logistic hub, an energy supplier, or a host to supportive manufacturing industries, while preparing for survival and growth with good long-term prospects for a strong economic position in the regional market.

8. Development Prospects for the Economy

An indicator for successful policy making by a government would be the achievement of its development objectives to the greatest extent possible with the minimum use of its natural resources. In Myanmar, a mixed economic system that originated in the colonial period was practiced after the gaining of independence until 1962. It gave way to the centrally-planned “Burmese way to socialism” between 1962 and 1988. After that, the State Peace and Development Council adopted a market-oriented economy with some success. However, according to macroeconomic indicators, Myanmar has fallen behind its neighboring countries.

An overview of the 60-year economic trajectory of Myanmar reveals a lack of balanced and accurate judgment of the realities within the country in the formulation and implementation of national economic policy, lack of competence and experience in economic management, impractical policies, high levels of corruption, and a general lack of good governance.

The new Government that came to power in April 2011 seems to be steering the country in the direction of reform, with the President U Thein Sein calling for clean government, good governance, and poverty alleviation to lift the country out of the least developed country (LCD) status. There have been efforts toward tripartite cooperation and collaboration among the Government, businesses, and professionals for national development through evaluation of the realities in the country and through reforms. For short-term economic stability and growth, the Government claims to be working to revise export-import licensing and taxation; control the extraction, utilization, and export of natural resources; control foreign exchange market fluctuations; obtain assistance from international organizations for financial sector reform and exchange rate unification; improve functioning of the banking sector and the rationalize interest rates; regularly publish accurate economic statistics; and ensure efficient good governance through transparency, accountability, and credibility.

An important issue that the new Government is facing is the rapid appreciation of the local currency, leading to widespread instability in all sectors of the economy, with significant impact on export activities such as agriculture, fisheries, and garment industry that directly impact the rural population and the labor force. While the immediate impact falls on businesses, brokers, and business owners, the price instability in the forthcoming growing and harvest seasons threatens to undermine the rural economy extensively. Damage control measures that have been put in place include reduction in tax rates (with export tax rates being reduced from 10% to 2%, while the withholding tax of 2.5% has been revoked), reduced taxes or tax holidays for agricultural exports, speedy processing of export-import procedures, and setting up of monitoring units to respond to market conditions in real time. Currently, the interest rates in Myanmar, set at 12% for deposits and at 17% for loans, are the highest in the subregion and ASEAN. This is a clear symptom of an underdeveloped banking system impeding the development of small and medium enterprises.

At the same time, agricultural development is being undertaken as part of poverty alleviation, using a multidisciplinary approach. Capital and technology investment is necessary for large-scale farming that can achieve economies of scale and boost productivity. Currently, farmers will be provided with access to microfinance and farm-related technology. To counter the effects of declining prices for agricultural produce and the local currency appreciation, government interventions for government-led economic stabilization and growth are being implemented.

Past experience suggests that the formulation and implementation of economic policies for national development can prove challenging due to weaknesses in implementation and strategy development combined with inflexibility or lack of timely response in the face of market shifts. While there has been insufficient time for a meaningful evaluation of the progress made by the new Government, the new economic measures are considered to be responsive to the needs of the market and on the right track toward economic stability.

At the same time, the principle of unity in diversity is being practiced to maintain political stability in the country, with nascent positive cooperation among political parties. To ensure social stability, measures are being planned to narrow inequalities among nationalities, regions, and the towns and villages. Policies and procedures for the

delegation of authority from the Union Government to the Regional/State government bodies is also hoped to contribute to the resolution of ethnic problems.

Projections of a nation's likely course in the future require the compilation of reliable macroeconomic variables, special skills, and extraordinary efforts as well as making various assumptions. While the best estimates cannot hope to be anything more than an approximation, the task becomes even more formidable for an underdeveloped nation that is attempting and economic transition, such as Myanmar. This exercise would be more helpful in terms of providing answers to what-if questions that policy makers and analysts may take into consideration in formulating short- and medium-term development policies and strategies, rather than in predicting economic statistics of the country at some point in the future. In this sense, the predictions in this document are no more than simple guesstimates based on the past experience of the country, similar experiences of other neighboring countries, and insights from the development literature and extant studies.

The three major assumptions for this scenario are: (1) the political and economic circumstances at the prospects of the world in general, and of Asia and the GMS in particular, remain stable in the current general form; (2) political and economic transitions in the GMS and ASEAN remain under control; and (3) there are no major climate change impacts and natural disasters. Another country-specific assumption is that significant improvements will be achieved in the following factors: (1) political will and commitments, (2) strengthening institutions and human capital formation, (3) stability in all areas, (4) economic specialization and diversification, (5) regional integration and connectivity, (6) managing natural resources and sustaining environment, and (7) an efficient monitoring and evaluating system.

In Table 13, a score of 7 is given if all factors are achieved fully to give the ideal situation; a score of 3.5 reflects an average situation; while little or no progress in most of the factors is shown by a score of 0.

9. Policy Implications

9.1 Political Will and Commitment

(1) Political will and commitment

By nature, the government's policy making is not independent from the political security interests and, therefore, does not always act in the national economic interest. Under the circumstances, although the spirit of the economic policy very often well reflected Myanmar economy's needs, its implementation caused obstacles for the set-objectives to be achieved. Adverse impact of these economic and political imbalances was linked to other dimensions of flaws, which in turn contributed to overall distortion of the economy in the past. Therefore, the policy making should be primarily motivated by the need to bolster the deteriorating national economy and to achieve growth to keep up with the other countries development and address the interests of the people.

(2) Stability by all means

Political, social and economic stability is essential. Political and social stability should be resolved by seeking unity in the diversity concept. Macroeconomic instability has remained at the core of Myanmar's economic problems and has never been tackled firmly even in recent years. Macroeconomic stability must be a priority for Myanmar policymakers looking forward. Macroeconomic stability associated with policy predictability and transparency is the cornerstone of economic policy and a precondition for accelerated economy growth and economic takeoff in Myanmar.

(3) Strengthening institutions and human capital formation

For Myanmar to be able to join the middle-income countries group, policy making institutions need considerable strengthening and to be given independence of decision making in their area of competency. Greater decentralization and reduced micromanagement are also essential (Verbiest and Tin 2011). Transparency of

Table 13: Economic Development in the Next 10 Years

Score	Per capita gross domestic product (\$)	Poverty Rate (% population)	Human Development Index	Reserved and Protected Public Forests (% of total country's area)
7.00	821 to 1,668	26 to 13	4.5 to 5.7	27.9 to 36.9
3.50	821 to 1,241	26 to 20	4.5 to 4.9	27.9 to 32.6
0.0	821 to 998	Slight change (+/-)	Slight change (+/-)	27.9 to (-)

Source: Author's guesstimates.

decision-making needs to be given due attention as should accountability. Several new institutions will also have to be set up as the economy develops and becomes more sophisticated. Similarly, policy makers need to give serious consideration to develop a strategy to address the issue of human-resource development.

(4) Economic specialization and diversification

There is a big danger that relatively high growth could be reached from rapid growth in the oil, gas and mining industry. It would put growth on a non-sustainable and non-inclusive long-term path, often leading to social unrest. Major policy reforms to revive the agriculture sector including land reform, give incentives to improve agriculture support services. A realistic industrial sector strategy should be developed in order to support the diversification of the economy mainly through private sector development, and linking investment incentives and infrastructure development to the strategic priorities.

(5) Regional integration and International supports

To support higher growth and also to become a major strategic regional player, Myanmar needs to invest massively in upgrading its infrastructure and improve institutional and regulatory framework.

(6) Managing natural resources and sustaining environment

Environmental sustainability is a major concern in Myanmar not only for high growth to be sustainable but also and mainly to preserve quality of life of its people. The pressure on natural resources including fresh water, forests and sea/coastal resources is very high and needs to be managed tightly to keep the country on a sustainable growth path. Precise targets such as carbon dioxide emissions, protected land areas, seawater quality area can be set. In exploiting its natural resources, Myanmar has still the opportunity to do it in a sustainable way, relying on the latest technology and best practices.

(7) Monitoring and evaluating system

An independent monitoring and evaluation mechanism must be set up to overview the reforms and policy implementations.

10. Conclusion

Myanmar is aiming to transform itself from a primary economy to an industrializing economy and to advance

core livelihoods from a “traditional pattern” to full integration into “capitalist modernity” during the coming decades. Its abundant natural resources will be the major factor underpinning its economic success. A stable political climate and a set of outward-oriented economic policies will help Myanmar gain reclassification as a rapidly growing developing economy in the GMS.

In retrospect, government policy regimes have consistently played a key role throughout Myanmar’s recent past in regulating markets and determined whether the economy is State-regulated or self-regulatory or somewhere in between. In other words, government performance has taken the form of either active support or active intervention. Flexibility in policy making in response to internal and external circumstances will be one of the most important determinants if the expected success story is to come true. Moreover, this policy nexus has generally succeeded in maintaining a constructive interaction between the State and the private sector by adopting proactive business policies and liberal market mechanisms. Moreover, improving regional integration will also boost growth of the country, while it strives to strike a balance between economic growth and environmental sustainability strategies.

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ECONOMIC GROWTH AND DEVELOPMENT IN VIET NAM, 2001 - 2010 AND STRATEGIES AND PLANS TO 2020

Duong Duc Ung

Abstract

Viet Nam successfully implemented a 10-year Social-Economic development Strategy 2001–2010 (SEDS) that resulted in important achievements in growth and social progress. By its own efforts and with support from development partners, Viet Nam has become a middle income country (MIC) and has greatly reduced poverty. These achievements are due to high economic growth during two 5-year plans covering the decade. A few economic sectors, such as agriculture and the textile and garment industry used the advantage of Viet Nam’s former least-developed-country status to make strong contributions to meet the needs of domestic consumption and export and create more jobs for poor people.

Viet Nam has developed a Social-economic Strategy for 2011–2020 with the overall goal of transforming Viet Nam into a modern industrialized country by 2020 in a context of various opportunities and challenges. For achievement of this overall goal, the country needs to focus on three issues in its 5-year plans: developing an institutional framework for the market economy, training human resources, and modernizing infrastructure.

1. What has been achieved in Viet Nam during 2001–2010?

The main achievement by Viet Nam in the past 10 years is upgrading its status from the group of “underdeveloped countries with low income (LIC)” to that of “developing countries with middle income (MIC)”. The MIC classification by the World Bank includes countries with GDP per capita \$950–3,500. In 2010, GDP per capita of Viet Nam reached \$1,168.

The above-mentioned general development achievement was a combination of economic growth and social progress. Economic growth was maintained at high speed during two 5-year plans covering 2001–2010 (Figure 1). However, in the last years of the second 5-year plan (2006–2010), growth decreased slightly due to the impact of the global economic crisis and domestic macroeconomic instability, high inflation, large national currency depreciation, natural disasters, and animal disease outbreaks. As a result, average growth of the economy in 2006–2010 was about 7%, lower than the 7.5% in 2001–2005. Despite that, in comparison with many countries in the region, economic growth of Viet Nam was positive.

Early in 2011, the Government approved a package to stabilize the macroeconomy and contain inflation (Resolution No 11), including measures of monetary policy, financial, investment, and public expenditure savings. Efforts to stabilize the situation have brought some results; inflation, though still high, has tended to decline. The Asian Development Bank (ADB) predicted that inflation will fall from 18% in September 2011 to 11% in 2012. Foreign exchange reserves have increased; the International Monetary Fund estimated reserves at \$13.5 billion in May 2011, and exchange rate stability is being restored.

The relative high rate of development across sectors has been crucial in the economic growth of the economy during the past decade (Table 1).

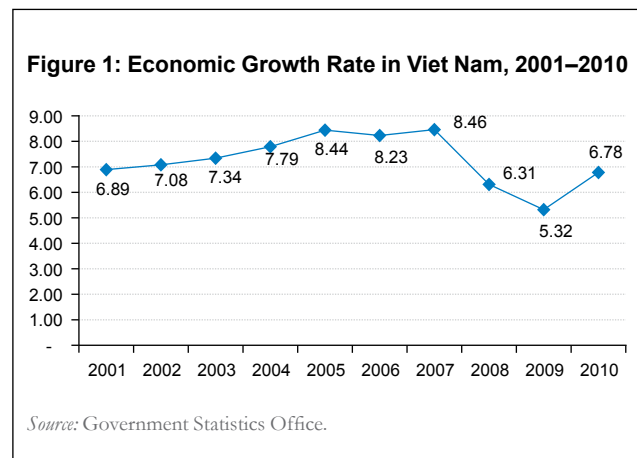


Table 1: Sector Growth during 2006–2010 (%)

Sector	Target	2006	2007	2008	2009	2010	2006-2010
Agriculture	3.83	3.69	3.76	4.68	1.82	2.78	3.3
Industry and Construction	9.5-10.2	10.38	10.32	5.98	5.52	7.70	7.9
Services	7.7-8.2	8.29	8.85	7.37	6.63	7.52	7.7

Source: Ministry of Planning and Investment.

The structure of gross domestic product (GDP) has shifted; the proportion of agriculture is declining and the proportion of industry and services is increasing, although not sufficiently to meet the targets outlined in the 2006–2010 5-year plan (Table 2).

Table 2: Economic structure of GDP in 2006–2010

Sector	Planned (%)	Implemented (%)
Agriculture, Forestry, Fishery	15–16	20.6
Industry and Construction	43–44	41.1
Services	40–41	38.3

Source: Ministry of Planning and Investment.

During 2001–2010, agriculture (including agriculture production, fisheries and forestry), industry (including garments and textiles) and construction, and services achieved encouraging results and contributed significantly to economic growth of the country, especially through trade. These sectors not only contribute to the economic growth but also create jobs for poor people in rural and urban areas, contributing to poverty reduction.

Agriculture lays the foundation for Viet Nam's social-economic stability and maintained a relative high growth rate with a decisive impact on poverty reduction by ensuring food security and generating employment and income in the rural sector, which accounts for 70% of the population. With regard to trade, rice exports increased from 3.7 million tons in 2001 to 5.8 million tons in 2010, making Viet Nam and Thailand first and second largest rice exporters, respectively, in the world. Viet Nam is not only able to ensure domestic food security but also contributes to global food security.

During the development process, some land has been transformed from agricultural use to industry and infrastructure development, including construction of roads, ports, airports, industrial parks, export processing zones, and real estate. Farmers, who lost their land have migrated to urban areas seeking work, thus creating pressures on urban areas.

The development of the textile and garment industry has contributed not only to economic growth and export, but also created more jobs in urban areas. Textile and garment exports increased strongly from \$1.9 billion in 2001 to more than \$11 billion in 2010.

Exports have contributed significantly to economic growth of Viet Nam, increasing from about \$14.5 billion in 2000

to nearly \$32.5 billion in 2005, and likely to reach \$72.2 billion in 2010. The proportion of exports in GDP increased from 46.5% in 2000 to 70% in 2010. Export value per capita increased from about \$187 in 2000 to about \$830 in 2010.

The acceleration of Viet Nam's exports is due to many reasons. Before renovation,¹ Viet Nam mainly had trade relations with countries in the socialist system. Since then, especially since Congress IX, which promulgated the Foreign Investment Law, the number of countries and territories investing in Viet Nam as well as importing goods from Viet Nam, began to expand. Since 1995, after the elimination of a United States (US) embargo, when the US and Viet Nam established normal relations, Viet Nam joined the Association of Southeast Asian Nations (ASEAN) and the number of countries and territories importing goods from Viet Nam increased rapidly. After the US-Viet Nam Trade Agreement was signed in 2000 and Viet Nam became member of the World Trade Organization (WTO) in 2007, almost all countries and territories around the world began to import goods from Viet Nam. Currently, Viet Nam has trade and investments relations with more than 200 countries and territories.

2. More Sustainable Growth and Less Poverty

Viet Nam has achieved very impressive progress with regard to poverty reduction. Viet Nam has implemented innovative policies to develop and to integrate into the world from being a poor country with a poverty rate more than 50% in 1993 to about 10% in 2010, thanks to the support from many countries and international organizations. Thus, Viet Nam has met the Millennium Development (MDG) poverty goal of halving the poverty rate by 2015.

One of the factors that ensured success in poverty reduction was its integration into the national development strategy and policies and development plans of the Government at all levels. Poverty reduction is a target in the 5-year and annual socio-economic plans and the Government balances resources for the implementation of poverty reduction target, and for monitoring and evaluation of the implementation process. In addition, the Government has targeted national programs on poverty elimination, such as the Program 135 to support poverty reduction in the especially difficult communes.

¹ Renovation or Doi Moi, refers to economic reforms initiated in Viet Nam in 1986 with the goal of creating a socialist-oriented market economy.

One of the issues widely discussed by the Government and donors in the beginning of the of the 2000s was the relationship between infrastructure development and poverty reduction. Viet Nam found that infrastructure was an important prerequisite for growth. Donors supported to the Comprehensive Poverty Reduction and Growth Strategy (CPRGS), announced by the Government in 2003, in which there was a special chapter on policies and solutions for large-scale infrastructure development.

In terms of International development assistance, there are 50 bilateral and multilateral donors that provided about \$21 billion in official development assistance (ODA) (disbursed funds) in 2001–2010, and several international nongovernment organizations (INGOs) that provided more than \$200 million per year in social-economic development in the same period. ADB, Japan, and the World Bank are the leading donors in Viet Nam. The value of international assistance is not just money but more importantly knowledge, expertise, advanced technologies, and modern management skills. Aid is considered to be “a fishing rod rather than a fish”.

Along with support from bilateral and multilateral agencies, regional cooperation has an important role. The Greater Mekong Sub region (GMS) program, established in 1992, provides a venue for cooperation among all the member countries. GMS priority sectors in cooperation are infrastructure development, energy, telecommunications, tourism, trade and investment, human resource development, and the environment. Viet Nam participates in all these areas.

3. What is the Development Orientation of Viet Nam for the Next 10 Years?

Viet Nam has developed a Socio-Economic Development Strategy for 2011–2020 with the overall goal transforming Viet Nam into a modern industrialized country by 2020. The main indicators of the Strategy are:

- Economic indicators:
 - Average annual GDP growth: 7%–8 %
 - Proportion of industry in GDP: 85%
- Social indicators:
 - GDP per capita in 2020: \$3,000
 - Life expectancy: 75 years
 - Total student population reached 450 peons per 10,000 People
 - Poverty rate reduction: 1.5%–2% annually

- Environmental indicators:
 - Forest coverage in 2020: 45% (from 38.7 % in 2008)
 - Proportion of industrial plants to meet environmental standards: 80%

To implement the Strategy, a 5-year plan has been developed with two scenarios. In the first scenario, there is no change in the indicators of social, economic, and environmental development in the Development Strategy 2011–2020, including the expected annual GDP growth of 7.0%–7.5%. Annual economic growth in 2011 is estimated at 6% and is expected to reach 6.5% in 2012. Therefore, in order to achieve an average growth rate of 7.0%–7.5% in 2011–2015, higher growth rates than in 2006–2010 would be necessary, which is hardly feasible in the context of Viet Nam’s economy, now facing many difficulties due to the unstable macroeconomic situation and high inflation.

The second scenario is designed to ensure macroeconomic stability, rather than fast growth, and to hold inflation down. The expected economic growth rate in 2011–2012 period will be lower than proposed figure in the development strategy and it is hoped that the economy will recover from 2013.

The 2011–2015 five-year plan includes a total investment capital of society at current prices of about \$290 billion, accounting for about 40% of GDP during 2011–2015, an average increase of 16% per year over 2006–2010.

Regarding total development investment capital, the five-year plan 2011–2015 expects that domestic capital will make up 70%, and the foreign capital the remainder. Foreign capital sources include official development financing, investment by the foreign private sector, remittances, and some other foreign capital. Total foreign capital is expected to be about \$87 billion during the plan period.

4. Opportunities, Difficulties, and Challenges

Although Viet Nam has become a MIC, laying an important foundation for future development, the country faces considerable difficulties and challenges, mainly (i) poor infrastructure, (ii) weak national competitiveness, (iii) obstacles in human capacity, (iv) unsustainable poverty reduction, and (v) severe consequences of climate change.

The world economy has shown signs of instability recently, causing some unexpected problems. The prices of energy and raw material inputs continue rising unpredictably, which is leading to many difficulties for an economy like Viet Nam relying heavily on imports. In addition, some development partners providing development aid to Viet Nam are facing financial difficulties or are facing severe consequences of natural disasters. In addition, foreign aid for Viet Nam from development partners in coming years will have changed terms, scale, and lending conditions because of Viet Nam's upgrading to MIC status—grant aid and concessional loans will tend to decrease. The Government needs to develop aid mobilization and utilization policies to adapt to the changing situation and is preparing the ODA Strategic Framework (Policy paper) for 2011–2015.

Three breakthroughs for future success

To overcome the difficulties and challenges mentioned above the strategy sets out three breakthroughs:

(1) Developing and improving the institutions of the market economy, with a focus on creating an environment for fair competition, and implementation of administrative reform.

This breakthrough has the following priorities:

– To formulate all the elements of market economy and to develop other markets with high transparency, better management, and monitoring. Thus, the market will establish a dynamic balance, allocating resources for manufacturing and services based on market signals to ensure economic efficiency and effectiveness.

– To improve the mechanisms and policies in markets of both commodities and services, including finance, securities, real property, labor, science, and technology; to create consistent and smooth operations based on high competitiveness and better connection with world markets; and to effectively manage and monitor business to minimize monopolies in the manufacturing and service sectors in order to create an environment of fair competition.

– To strongly reform the national administration system—institutional and organizational structure, relevant administrative and public financial work in accordance with decentralization in order to improve efficiency and quality of governance; to enhance transparency and policy predictability in order to reduce uncertainty and risks for investors; to avoid speculation and corruption; and to reduce business transactions costs.

(2) High-quality human resource development, especially that associated with the development and application of science and technology.

The comparative advantage of Viet Nam's economy over the past decade, based on cheap labor, no longer meets the requirements of economic restructuring. In the new context of development, Viet Nam's economy must be based on efficiency, productivity, and competitiveness, which are driven by human capacity. Therefore, human capital is an important driving force to promote development in order to avoid "MIC trap."

The second principle includes the following prioritized activities:

– To develop strong management leadership, professional experts, good corporate managers, professional and skilled labor, and talented scientific and technological staff; to train human resources to meet diverse requirements of technology and development in different fields and industries; to implement training programs/projects for people working in key economic and public sectors; and to detect, foster, and to promote talent for a knowledge-based economy.

– To overhaul the education system in accordance with the direction of standardization, modernization, socialization, democratization and international integration, in which innovation of educational management mechanisms, training teachers and administrators are critical to serve for restructuring the economic and the growth model.

– To strongly and comprehensively renovate the organization, management mechanism, and the operating activities of science and technology. To orientate science and technology for industrialization, modernization and conversion of growth model, contributing to increasing productivity, quality, efficiency and competitiveness of the economy. To promulgate policies to encourage enterprises in technological innovation, priority utilization of material-saving technologies, energy, environmentally friendly and green economic development.

(3) Development of comprehensive modern infrastructure.

The socioeconomic infrastructure of Viet Nam is currently an obstacle for development. To develop this sector, the following prioritized activities are proposed:

– To focus on developing transportation to ensure rapid and sustainable growth (highways, ports, international airports, railway), especially the transportation network linking Viet Nam with other GMS countries.

- To develop modern infrastructure in the biggest cities in accordance with a master plan; to rapidly develop urban transport systems, especially public transport; and to address congestion and flooding in Ha Noi and Ho Chi Minh City.

- To rapidly develop power systems, power transmission, and renewable energy, using advanced technology to save energy and ensure sufficient power for development needs of the country and the people.

- To develop and modernize agriculture and irrigation systems, construct disaster prevention works, and develop modern information and telecommunication systems to meet requirements and contribute to improving productivity.

Although future development will be difficult and challenging, Viet Nam's experience in the last decade of relying on its internal strengths in combination with international support and cooperation will help the country achieve its goal of becoming an industrialized country by 2020.

THE FUTURE OF WATER IN THE GMS: IS IT HISTORY?

Arjun Thapan¹

Colleagues, friends, ladies and gentlemen:

I don't think that any of us gathered here this morning can claim to be definitive gazers of the crystal ball. We weren't when the GMS² countries embarked upon a program of economic cooperation in 1992, and we aren't now when the GMS looks forward to higher and more sustained growth over the next 20 years. But it is hard to dispute the enormous change that has been wrought upon the subregion during this period. The economies have grown, poverty has declined, incomes have risen, and an air of wellbeing and hope now envelops the Mekong peninsula. But it would do us well to remember that this rising prosperity has not been without costs in terms of the subregion's environment, and its natural resources.

I don't know what these costs are—I don't think anybody does. But there are costs and we need to determine them. Because these costs will inform us of the handicaps that we are now served with in shaping the subregion's future especially if we are going to perpetuate our business-as-usual ways much like economies in East and South Asia have done.

As I said a moment ago, I am not a clairvoyant and will not pretend to forecast the subregion's future. I will raise more questions than provide answers. And I will share with you a possible framework to look at some key issues that will guide the destiny of the GMS.

I think we are all agreed that water, energy, and food will be central to the continuing transformation of the subregion. And if we further agree that Water is an essential and principal ingredient of both energy and food, then let's take a look at the basic water endowment of the GMS countries.

I'm afraid I don't have discrete figures for Yunnan Province and Guangxi Zhuang Autonomous Region, and it would

Slide: 1

GMS: Water Resources and Usage

Country	Water Resources Total Renewable Per Capita (m ³)		Agriculture Water Withdrawal (as % of Total)	Industrial Water Withdrawal (as % of Total)	Municipal Water Withdrawal (as % of Total)
	1962	2009			
Cambodia	83,500	34,000	94.0 (2006)	1.5 (2006)	4.5 (2006)
PR China	4,113	2,080	64.6 (2005)	23.2 (2005)	12.1 (2009)
Lao PDR	149,552	54,565	92.9 (2005)	4.0 (2005)	3.1 (2005)
Myanmar	53,416	24,537	89.0 (2000)	1.0 (2000)	10.0 (2000)
Thailand	15,115	6,384	90.3 (2007)	4.8 (2007)	4.8 (2007)
Viet Nam	23,910	10,174	94.7 (2005)	3.7 (2005)	1.5 (2005)

Source: FAO Aquastat Database

¹ Chairman, WaterLinks

² Greater Mekong Subregion, comprising Cambodia, Guangxi Zhuang Autonomous Region and Yunnan Province of the People's Republic of China, the Lao People's Democratic Republic, Myanmar, Thailand, and Viet Nam.

not be fair to extrapolate from them to the overall People's Republic of China figures because Guangxi and Yunnan are not really representative of water availability and use across the country. But, with this exception, we see a precipitous decline in per capita water endowments across the subregion over the approximately 5 decades since 1962. Should we be alarmed? After all, the rates of decline have been more or less the same as in other parts of Asia, including India, the People's Republic of China, and Pakistan. But what should concern us is that (i) these numbers relate to renewable water resources, not accessible freshwater—and it is this latter category that is finally important, and (ii) the rate of decline (between 1.7% and 2.2% per annum) is higher than the rate of efficiency gains (less than 1% per annum) in water use. The People's Republic of China's case is also worrisome but since I don't have data for Guangxi and Yunnan, we will postpone a discussion on this element.

The share of water withdrawals for agriculture, industry, and municipal use are unsurprising. They broadly reflect usage patterns all over Asia. But if we look at the numbers in Slide 2, in conjunction with those in Slide 1, we note a couple of points. One, that although agriculture's value in

Gross Domestic Product (GDP) has dropped markedly (11.6% in Thailand's case in 2009, and 48% in Myanmar's case in 2004), the ratio of water withdrawals for agriculture relative to other major users has not changed. In the case of the People's Republic of China, however, it has changed. Two, that industry and municipal use share a much smaller slice of the pie but in an uneven way. Some of these figures are dated and more recent figures should reveal a clearer picture of trends in line with growth in the industrial and urban sectors.

Overall, therefore, there is an inescapable conclusion. Water endowments are under pressure. These pressures will increase as food demands grow in the GMS based on growing population, change in dietary habits toward food that is water-intensive, and an increase in tourist traffic (the GMS continues to be one of the fastest growing tourism destinations in the world). They will also increase, as we shall see, with the growth in energy production, expansion of industry, and expanded urban consumption. Water pollution, given the increase in manufacturing and intensity of chemical use in agriculture and low investments in industrial and urban wastewater treatment, will also increase and put pressure on the finite accessible freshwater resources.

Slide: 2

GMS: Agriculture Value Added to GDP (%)

Country	Base Year	End Year
Cambodia	55.6 (1990)	35.3 (2009)
PR China	39.3 (1962)	10.35 (2009)
Lao PDR	61.8 (1992)	34.7 (2009)
Myanmar	60.5 (1992)	48.3 (2004)
Thailand	34.0 (1962)	11.6 (2009)
Viet Nam	40.5 (1987)	20.9 (2009)

Source: FAO Aquastat Database

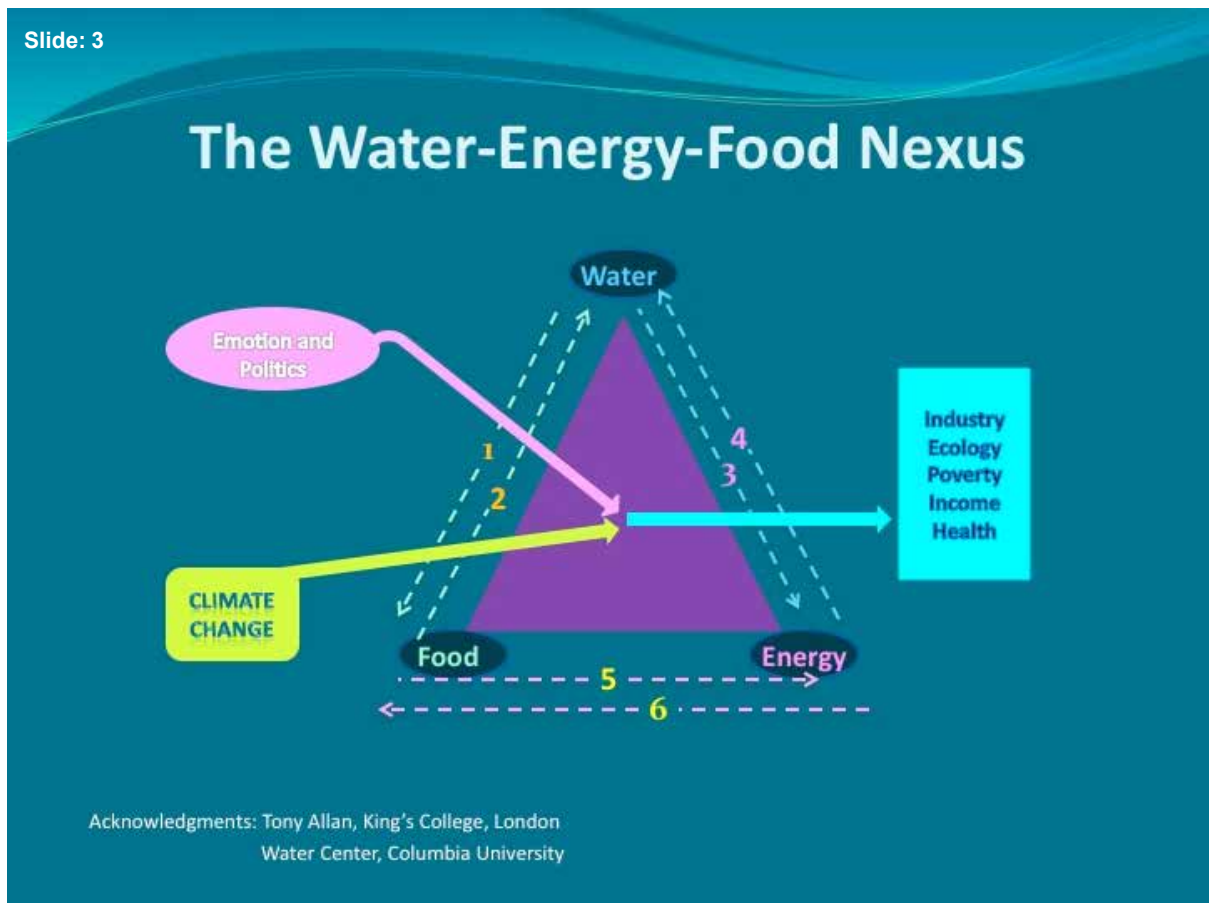
In this sense, the GMS is unlikely to be any different from the economies of East and South Asia. Their per capita water endowments declined earlier in time (both the People's Republic of China and India are water stressed countries; large parts within each are water scarce). The World Resources Institute has estimated (2010) that the Chao Phraya basin in Thailand and the Hong River basin in Viet Nam are almost water scarce today and will be absolutely water scarce by 2025. This tells us that the Mekong Basin will not be an exception to water stress and scarcity being witnessed in developing Asia.

But, again, I have a question: Can this be avoided? Of course it can, but the solution will lie in two areas. One, in rationally allocating water resources on the basis of economic costs and benefits, i.e., real integrated water resources management, or IWRM, and, two, serious gains in water use efficiency brought about through true-value pricing, technology adoption, and tough legal and administrative frameworks.

I said that I would suggest a framework within which we could substantively examine issues in shaping the future of the GMS. Let us, therefore, look at the water-energy-

food relationship, a number of sub-relationships, and how some of them operate in the GMS. Here is an illustration in Slide 3.

Each side of the triangle represents two basic relationships with several impacts. Water impacts on food—production and yields, trade in food, location, vulnerability, poverty, etc. Food, and here we are only talking of production, impacts on water through land use changes, groundwater depletion, biodiversity loss, and so on. Water's impact on energy is manifest principally through hydropower production, processing water and wastewater, and irrigated agriculture (both surface and groundwater). Energy and water are related through biofuels, cooling water for thermal energy, and the considerable thirst of renewable energy sources. Food and energy are related through food for fuel, biodiversity, and fertilizer use. Finally, energy and food are linked through the energy intensity of food production, impact of renewable energy on land use, and pricing (essentially subsidies). These relationships and impacts, of course, have numerous issues embedded in each. Addressing these comprehensively will be part of the design for tomorrow. Let me come back to this later.



I will now dwell on the energy-water relationship. Energy demand is growing between 9% and 16% annually in the GMS. Thailand and Viet Nam had planned to add 7 and 13 gigawatts (GW), respectively, over 2009–2013. Thailand's fuel mix would change from a 73% share for natural gas to 60%, an increase for hydropower from 6% to 10%, and an increase for renewables from 1% to 10%. In Viet Nam's case, hydropower would constitute 40% (up from 10%), and thermal power (coal and gas) 60%. These are sizeable expansions to capacity over and above the plans for Cambodia and the Lao PDR that we briefly discussed. In addition, there are expansion plans for Myanmar, as well as for Yunnan and Guangxi.

Both thermal and hydropower are large consumers of water. Thermal electric plants use between 720 (natural gas, combined cycle) and 2,700 liters (nuclear power) of water per megawatt hour for closed-loop cooling (in itself 40% more expensive than open cooling systems). However, the evaporative loss in hydropower is estimated at 17,000 liters per megawatt hour. While these numbers³ are significant in themselves, they mask the impacts of climate change.

These impacts, triggered by higher temperatures ranging from 1.0–1.8°C, translate into

- higher rates of evaporation,
- increased glacial and snowpack melt,
- changes in precipitation patterns, and
- saline intrusion in coastal freshwater resources.

Recent research has shown that more than 95% of the glaciers (over 40,000) in the Himalayan (including Tibet, where the Mekong rises) cryosphere⁴ are in retreat, 40% are likely to disappear by 2050, and 70% by 2100. The mass balance has critically, and negatively, altered⁵.

Higher temperatures will also affect precipitation patterns. During the 40 years to 2000, most of Southeast Asia, including the GMS, experienced a decline in rainfall and the number of rainy days. This is estimated to continue till 2060 but precipitation is expected to increase toward the end of the century with strong variations between March

and May. Essentially, the wet season is likely to become wetter, and the dry season drier.⁶

Water renewals in the Mekong River are also likely to change. In Viet Nam, for instance, the maximum monthly flow is expected to increase between 35%–41% and the minimum monthly flow decline by 17%–24% compared to levels seen during 1960–1990. Toward the end of this century, up to 25% of the Mekong's annual flow is expected to decline. But given that the Mekong no longer flushes the delta in Viet Nam for most of the year, and that saline ingress has progressed over 100 kilometers inland, this might be a generous forecast.

I would now like to look at the hydropower question. The development of hydropower has grown exponentially in the GMS. In Cambodia, power production is expected to grow 10 times from less than 1,000 megawatt (MW) in 2011, to more than 10,000 MW, mainly through the construction of at least 20 hydropower stations. In the Lao PDR, 10 hydropower stations are under construction, and another 25 are planned. Most power produced by the Lao PDR is, and will, be sold to Thailand. The People's Republic of China's construction of hydropower-related and multipurpose storages on the upper reaches of the Mekong River has been extensively documented and reported on. In 2008, Viet Nam had an installed capacity of 12 GW of which 10% was hydro-based. This is expected to expand to 40% of a total installed capacity of 25 GW by 2013. Of course, these projects translate into substantial hydropower investments based on the assumption that the GMS is water-rich. This might well be a questionable assumption in the context of the pressure on accessible freshwater sources that I referred to a short while ago. Nothing short of a full, basin-by-basin, and overall basin optimization study will guide us definitively.

What is the relationship between hydropower development and food? According to the Mekong River Commission, the annual economic value of the Mekong's fish production exceeded \$2 billion in 2005; more recent estimates⁷ indicate an annual value of \$3 billion. Cambodia leads the world in terms of its 14 million population totally reliant

³ US Department of Energy, National Energy Technology Laboratory. 2008. Water Requirements for Existing and Emerging Thermoelectric Plant Technologies.

⁴ Extensive ice and glacial fields.

⁵ Mass balance is the ability of a glacier, or a glacial field, to accumulate ice at a rate equal to or greater than its melt, or ablation, rate.

⁶ Asian Development Bank. 2009. *The Economics of Climate Change in Southeast Asia: A Regional Review*. Manila.

⁷ Dugan, P. 2008. *Examining the Barrier Effect of Mainstream Dams to Fish Migration in the Mekong, with an Integrated Perspective to the Design of Mitigation Measures. Conclusions from an Independent Expert Group Meeting*. Vientiane. 22–23 September 2008.

on fish protein. In Viet Nam, the Mekong Delta produces 80% of the country's total fish catch. Overall, more than 70% of the total fish catch in the Lower Mekong Basin is dependent on long-distance migrant species. Dams are barriers to migration and their impacts will be destructive. According to a recent report of the International Center for Environmental Management in Melbourne, if all hydropower projects are constructed as planned, fish production is likely to drop by 42% annually. I do not know of any definitive, recent analysis of the qualitative and volume impacts of hydropower and other storage-related construction on fisheries in the basin. But since fisheries are uniquely a key source of protein and livelihoods in the GMS, this is an analysis worth doing. We will then have a basis for determining one of the several energy-food relationships.

You might well query the significance of these dire forebodings on water for thermal and hydropower generation. The growth of consumptive use of water for energy is itself an issue in the GMS in terms of total withdrawals relative to other applications. However, the risk to thermal and hydropower plants from water shortages, especially during extreme weather events, and overdraws by other users as in agriculture or industry, is considerable. Thailand's eastern seaboard is a good example of thermal electric plants in a heavily industrialized but rainfall-short region being dependent on small reservoirs for cooling water needs, and coming into conflict with farmers for irrigated agriculture. There have been numerous cases of hydropower plants in the GMS being either switched off entirely, or functioning with low capacity, because of prolonged dry spells.

As a consequence, we have, for the first time, environmentalists and investment bankers coming together to determine risks to investments in energy in Southeast Asia because of water scarcity.⁸ The majority of existing and new power generating capacity for publicly listed companies in Southeast Asia is located in areas classified as water scarce and water stressed. The impacts of these investments will probably translate into serious business continuity risks, a higher risk premium, and a higher cost economy. Question: how much of this can the GMS afford?

⁸ Sauer, Amanda, Piet Klop, and Sumeet Agrawal. 2010. *Overheating: Financial Risks from Water Constraints on Power Generation in Asia*. Washington, DC: World Resources Institute.

Before I leave the energy-water relationship, let me dwell on two other sub-relationships. One concerns energy used in the provision of water and wastewater services, a subject that acquires some significance in light of the rapid industrial and urban growth in some parts of the GMS. Electricity accounts for about 80% of the costs of municipal water processing and distribution costs. Groundwater supply requires an additional 30% energy on a per unit basis. Wastewater treatment requires about 660 kilowatt hours (kWh) per million liters. Finally, desalination of brackishwater, or seawater, common in coastal cities, requires between 1,400 and 4,500 kWh per million liters.⁹ When coastal cities, and industrial centers, in Thailand, Viet Nam, and southern Cambodia begin to consider desalination options (as have coastal cities in the People's Republic of China and India), the energy costs will emerge as a key factor. The question for the GMS to consider here is: do we invest in efficiency to reduce energy costs and energy footprints per unit of production in industry, or do we invest in expanded energy production and, if so, in what mix?

A second sub-relationship is between biofuels and water. Later in this conference we will examine the question of biofuels as a proposition for the GMS. But let me start by sharing with you what my colleague, Peter Brabeck, Chairman of Nestlé, says¹⁰ very nicely: "On average, it takes half a liter of water to grow one calorie of grain. So, a thousand liters of water could grow enough calories to feed one person per day. Or, it could fuel the drive to your local bakery to buy croissants." He goes further to say: "The skeptics would say, but that's "only" a thousand liters of water and you are comparing it to 2,000 calories. But look at the relative size of the global food and energy markets. When measured in calories, the energy market is 20 times the size of the food market. So, if governments were to replace only 10% of global energy consumption with first generation biofuels, they would also be doubling agricultural water withdrawals." Currently, such withdrawals are at 70% of total water withdrawals and, therefore, a 140% withdrawal would only happen on some other planet.

Then there is the question of biofuels being emission free. It would be disingenuous to say that the urban centers of the GMS will be positively impacted by greater use of biofuels. Recent calculations have shown that the most commonly

⁹ Source: Cambridge Energy Research Associates, US.

¹⁰ Brabeck-Letmathe, Peter 2011. *Burning Up Food as Fuel: The Role of Water, Water Security: The Water, Food-Energy Climate Nexus*, The World Economic Forum Water Initiative.

produced biofuel crops release twice the amount of nitrous oxide than previously thought. In the case of rapeseed biodiesel (80% of biofuel production in Europe), the relative warming from nitrous oxide generation is 1 to 1.7 times higher than the quasi-cooling effect of saved carbon dioxide emissions. It is the same with corn bioethanol (mostly in the United States)—0.9 to 1.5 times higher. Only cane sugar-based bioethanol makes sense—until, that is, you figure out the water intensity of sugar cane production!! Overall, therefore, if biofuels are measured in terms of a lifecycle analysis of agricultural production (a complex process that generates methane and nitrous oxide), most biofuels perform worse than fossil fuels.

One often hears that second-generation biofuels will be better. After all, what's better than picking up waste from plants in fields and fallen wood in the forests and converting this cellulosic material into biofuels? But if you read the fine print of these claims, it says that the main and most efficient source of such waste would be specifically grown plants, e.g., a new variety of energy corn, grown twice as high as normal corn. These varieties will, it has been determined, draw even more water than current origins of biofuel production.

So, against this background, it is difficult to appreciate a conclusion of the Intergovernmental Panel on Climate Change (IPCC). It said that 25%–80% of today's total energy consumption by 2050 should come from biofuels. The economics of biofuel production at this level simply do not make sense even in the context of evolving research on biofuels.

To wrap up this discussion, the questions to be asked are: what will biofuels in the GMS mean in terms of the water-energy-food conundrum? And why will GMS biofuels not be affected by climate change? Why shouldn't GMS transport energy come from a whole range of instruments (including demand management instruments) instead of a formulaic dependence on some fixed element of biofuels? Finally, what constitutes "self sufficiency" in biofuels, and why must the GMS be "self-sufficient"; is some, or all, import not an economic option?

Let me now take you through some facets of the water-food relationship, one that concerns irrigated agriculture particularly. We know that agriculture, regardless of its share in the total GDP pie, is a key driver of national economic development in the Mekong countries, but particularly Myanmar and the lower four riparian countries. It provides the livelihood for 75% of the population of

the Lower Mekong Basin. The area under irrigation has expanded significantly across the GMS largely as a consequence of substantial public investments. But given the dominant share of agriculture in withdrawal of accessible freshwater, the question is: how efficient is irrigated agriculture in the GMS?

Rice, as we know, is the staple crop in the region. Its dominance in the crop hierarchy, however, has been so significant that a large majority of public irrigation systems have been designed for rice production that has made it difficult to diversify into non-rice crops. There are serious issues with water productivity, yields, and quality of service delivery. Participatory irrigation management has made very little progress and system productivity has remained weak. Cost recovery for operation and maintenance of the systems has been extremely low and, together with the reduction in financial benefits from agriculture between 1980 and 2000, put governments under considerable pressure to reduce irrigation management costs.¹¹ Irrigation investment costs in Southeast Asia were estimated to be almost the lowest in the world.¹²

A case in point is Viet Nam. It is the world's sixth largest rice producer and second largest exporter. About 85% of its exports come from the Mekong delta where 10,000 km of irrigation canals sustain 2 crops a year, sometimes 3.¹³ But saline intrusion and land shortages do not permit an expansion of production. Postharvest losses of up to 16% put further pressure on securing gains.¹⁴ The rice bowl of Southeast Asia is seriously under threat mainly because of flood irrigation practices, the absence of science and technology, and inadequate river flows in the delta.

With the underwhelming performance of most public irrigation systems (given the usual problems of inadequate design, insufficient revenues for operation and maintenance, and little or no cost recovery), atomistic irrigation has emerged as the leaner, more nimble alternative to profitable farming. Farmers scavenge water from whatever sources they can, especially groundwater.¹⁵

¹¹ Molle, Francois, Tira Foran, and Mira Kakonen, eds. 2009. *Contested Waterscapes in the Mekong Region: Hydropower, Livelihoods and Governance*. Earthscan Publications Ltd., Chiang Mai University.

¹² Inocencio et al., cited in Molden, 2007.

¹³ Rainfed rice is virtually absent in the delta.

¹⁴ Dao Trong Tu, Kim Geheb, Uchiimi Susumu, and Vitoon. 2004. Mekong Rice Conference. Mekong River Commission Secretariat

¹⁵ International Water Management Institute. 2009. *Trends and Transitions in Asian Irrigation: What are the Prospects for the Future?* Sri Lanka.

But this phenomenon, increasingly widespread in the deltaic regions of Viet Nam and Thailand (Red, Mekong, and Chao Phraya rivers) is not free from worries. Saline intrusion, the decline of aquifers, and high costs of energy, especially for diesel-based pumps, are beginning to emerge as serious issues. One must not forget that due to groundwater mining, water tables are plunging in the food belts of India, Pakistan, and northern People's Republic of China, as well as in California's Central Valley and the southern portions of the High Plains' Ogallala Aquifer.¹⁶ Of course, 60% of India's irrigation is based on groundwater compared to 30% in Viet Nam, but the warning signs deserve attention nonetheless.

Let me go beyond the water-energy-food nexus that I have discussed so far, and turn to a major issue in the GMS, that of environmental flows in its rivers. We know that these flows are necessary both from an ecological perspective and from an economic one. We have seen what has happened to more than 70 major rivers in the world including the Nile, Indus, Yellow, Jordan, and Colorado rivers—they have shriveled up, and barely trickle through their respective deltas. Can this happen to the Mekong? Yes, most certainly. The fact that much less of the Mekong reaches the sea is already evident in the significant deltaic saline intrusion. And as abstraction increases, and flows decline, we will most likely witness more of this phenomenon, and not less.

So how do we respond to this peril? I am an unabashed admirer of the water reforms undertaken in Australia over the last decade. Their impact on the Murray-Darling Basin that constitutes 41% of mainland Australia, and is responsible for 40% of its agricultural output by value, has been dramatic. Ten years after the reforms commenced, Australia's economy and agriculture sector does better with 30% less water, specifically in the Murray-Darling Basin. The reforms put a premium on environmental flows, set a sustainable diversion limit, provided water rights to land holders that could be freely traded, created a \$2 billion per annum water market, and empowered the government to buy back water allocations to maintain environmental flows. Significant investments have been made in irrigation efficiency through provision of infrastructure, new technology, and monitoring networks. Water-use efficiency in irrigated agriculture is now estimated at 85%.¹⁷ In sum,

the environment has improved, the Murray and Darling rivers have regained 'life', agriculture has become adaptive to variable water allocations, and a water market ensures that demand and supply are matched through an economic price. Question: is it time for the GMS to start looking at the Murray-Darling model as a possible IWRM intervention in the Mekong Basin? In Australia's case, 4 states and 23 major river catchments need to work together. Can the GMS extend its strengths and experience in subregional cooperation to commence this task?

We know that the GMS occupies a strategic position between the large economies of India and the People's Republic of China. Water is a barrier to growth in both countries. In India, water for energy and industry is forecast to drop from 492 billion cubic meters in 2010 to 197 billion cubic meters in 2025.¹⁸ Unless the water footprints of both sectors shrink to a point where efficiency gains outweigh water scarcity, economic growth will clearly slow down, perhaps unacceptably. In the People's Republic of China, the blistering pace of industrial and urban growth has polluted up to 90% of its waterways and unless clean-ups and investments in treatment technologies and infrastructure are made and the pressure on freshwater is reduced, the collision of water, energy, and food will get worse. Can the GMS remain an unaffected island? We see water-deficit regions investing in contract farming in the GMS. We see the GMS trading virtual water with its neighbors both through food and energy. Is there a lesson that the GMS can draw from all of these developments?

I believe that the GMS would be well served by commencing some serious data capture and analytical work that will be a foundation to design a shared program of economic growth and social development that optimizes the use of water and other natural resources in the Mekong Basin. This should, at a minimum, comprise (i) the development of a comprehensive database that is spatially distributed, (ii) the identification and attribution of spatial and temporal trends among a range of key variables, (iii) a thorough analysis of climate variability and change, (iv) a comprehensive analysis of the water-energy-food nexus especially as driven by climate change impacts and extant policy, and (v) an analysis of the broader social, environmental, and political impacts. I have complete confidence that this exercise will be time and money well spent. And it will accord totally with the spirit of cooperation that the GMS has so carefully developed and nurtured.

¹⁶ Solomon, Steven. 2010. *Water: The Epic Struggle for Wealth, Power, and Civilization*. New York: Harper Collins.

¹⁷ See Irrigation Association of Australia for definition of Irrigation Efficiency at www.irrigation.org.au/

¹⁸ Infrastructure Development and Finance Company. 2011. *India Infrastructure Report 2011: Water: Policy and Performance for Sustainable Development*. Chennai.

Before I close, let me refer you to some recent headlines:

*India Faces Water Famine*¹⁹

*Choke Point: China – Confronting Water Scarcity and Energy Demand in the World's Largest Country*²⁰

*Indian Agriculture Unsustainable due to Water Crisis – Sachs*²¹

*Climate Change in Africa's Major River Basins could Impede Continent's Farm Transformation*²²

*Dhaka's Groundwater Drops 6 meters in 7 years*²³

Ladies and Gentlemen, I have spoken far too long. We could, conceivably, see a headline such as these in respect of the GMS unless, and this is a big unless, we join hands and determine to avoid the water-starved future that has now arrived in so many regions of Asia and the world beyond. I said that I am not a clairvoyant, but neither am I a prophet of doom. It is well within the capacities of this subregion to learn from history, and to shape its future.

Thank you for your attention. You have been most patient.

¹⁹ Infrastructure Development and Finance Company. 2011. *India Infrastructure Report 2011: Water: Policy and Performance for Sustainable Development*. Chennai.

²⁰ Circle of Blue. 2011. www.circleofblue.org/

²¹ Sachs, Jeffrey D. 2012. Delhi Sustainable Development Summit

²² Third International Forum on Food and Water, Tshwane, South Africa, November 2011.

²³ Bangladesh Agricultural Development Corporation. 2011. Report. 2011. Dhaka.

ENVIRONMENTAL IMPACTS: CURRENT AND FUTURE CHALLENGES IN THE GREATER MEKONG SUBREGION

Jeffrey A. McNeely¹

Abstract

The Greater Mekong Subregion (GMS) has had a decade of strong economic growth, drawing especially on its natural resources – forests, waters, fisheries, minerals, and soils. But this development has had costs as well as benefits, and the GMS is now facing environmental degradation that affects virtually all sectors of the economy and especially threatens the well-being of the forest-dwelling poor. The major environmental problems include declining ecosystem services, accelerating loss of biodiversity, increasing competition for limited land resources, continuing forest fragmentation, increasing pollution, and growing demand for limited water resources. These trends are all parts of a system of rapid change that affects human wellbeing, and their magnitude is likely to increase in the coming decade unless serious efforts are made toward more sustainable forms of development. The appropriate responses to these problems are also part of a system of responses that would support sustainable development. The proposed system begins with conserving the biological basis of resource management; it then adds improved technology for conserving biodiversity and ecosystem services, improved means of mobilizing energy and providing water resources, and generating the economic and financial support required; and finally converts these policies and technologies into reality on the ground through mobilizing an abundant renewable resource: human ingenuity. This paper concludes with some policy options that governments may wish to consider as the countries of the GMS seek to continue to prosper in the coming decade, and beyond.

Introduction

The Greater Mekong Subregion (GMS), stretching from Yunnan in the north to the southern tip of Thailand, and from western Myanmar to eastern Guangxi and Vietnam, is world-renowned for its wealth of plants, animals, and ecosystems. Yunnan, for example, has more than half of the world's species of bamboo, is a global center of diversity for rhododendrons, and supports more than half

the plant species in the People's Republic of China (PRC). Other parts of the GMS add their own unique biodiversity to the mix. This natural bounty enabled some of the world's earliest development of agriculture, led to sophisticated civilizations based on irrigation, and supported a great diversity of cultures occupying the complex ecosystems that characterize the GMS.

For centuries, people in this region lived in a sort of balance with nature, harvesting timber, medicinal plants, wildlife, and other natural resources on a reasonably sustainable basis. Forests were cleared for shifting cultivation, but relatively quickly recovered as the hill farmers moved on when crop yields began to decline after a few years. The abandoned fields resulting from the traditional forms of shifting cultivation attracted many species of wildlife, especially birds, pigs, deer, wild cattle, elephants, and their predators. Virtually all of the forests of the GMS have been cleared at various times over the centuries, but in a cyclical fashion that generally maintained significant forest cover (Spencer, 1966).

With the development of irrigation beginning as early as 1500 years ago in Puyu, Myanmar (Stargardt, 1990), primarily to grow rice, many of the lowland areas in the GMS were transformed from wetlands to croplands over the following centuries, though the resulting complex civilizations in the riverine lowlands still depended on the upland forests and their peoples for goods (such as construction materials and medicinal plants) and services (such as flood control and provision of clean water). When forests were over-exploited by civilizations, such as that centered at Angkor Wat, irrigation systems were disrupted and the civilizations collapsed (Audric, 1972).

The ecosystems of the GMS continue to provide numerous goods and services to people, including food, water, energy, clean air, and recreation. The domesticated species that provide most of the food people eat have been produced through selection from wild ancestors (many of which are native to the GMS) and are grown in fields, pastures, and ponds that once supported much more diverse ecosystems. This trade-off between species-rich natural ecosystems and species-poor managed ecosystems is generally accepted to have worked in the favor of people, judging from the expanding human population and improved welfare throughout the GMS over the past 200 years or so, accelerating in recent decades.

But globalization, population growth, and increasing pressure on land and water to drive economic development are also posing major environmental challenges to modern

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societies. The floods that affected much of the region in the latter part of 2011 provide just one dramatic example of how environmental mismanagement can have costly consequences for people in the lowlands, but deforestation has also deprived the forest-dwelling rural poor of critical resources (see RRDTTC, 2009, for details on Lao PDR). Increasing demand for land, water, and energy have put additional pressure on the natural resources that had long sustained the natural and cultural wealth of the GMS.

It is now generally accepted that the global human population will continue to increase from its current 7 billion to at least 9 billion by 2050 (UN median variant), with the 2010 GMS population being about 315 million (4.5% of global population). The global population is growing at a rate of about 1.17% per year (which produces about 78 million more people annually, more than the current total population of Thailand). Among the GMS countries, the populations of two (Lao PDR at 2.32% per year and Cambodia at 1.77%) are growing faster than average, while the other four are growing at a rate below average (Viet Nam at 1.14%, Myanmar at 0.78%, PRC at 0.66%, and Thailand at 0.63%). The countries with low population growth rates have an aging population, or soon will have, and this may pose some social problems (Tinker, 2002).

Assuring a sustainable and prosperous future will require addressing environmental issues as part of the overall development process of the region, depending on a clear definition of the problems to generate appropriate responses in policy and practice. Successfully addressing the key environmental problems over the next decade will help ensure a sustainable future for the GMS.

1. Key Environmental Issues in the GMS

This section will present a brief synthesis of several key environmental issues facing the GMS, recognizing that the individual countries have considerable differences that are likely to continue into the future. Perspectives on environmental issues also vary with scale and location. For rural communities, local ecosystem concerns, such as soil fertility, land rights, forest resources, and watershed protection, will tend to dominate their perspectives, and these will vary considerably on the basis of rainfall, history, demographics, and many other factors. For people living in cities, environmental concerns more often focus on factors like pollution, floods, water quality, recreation, land prices and global trade in commodities. The environmental problems tend to overlap, which calls for systemic solutions.

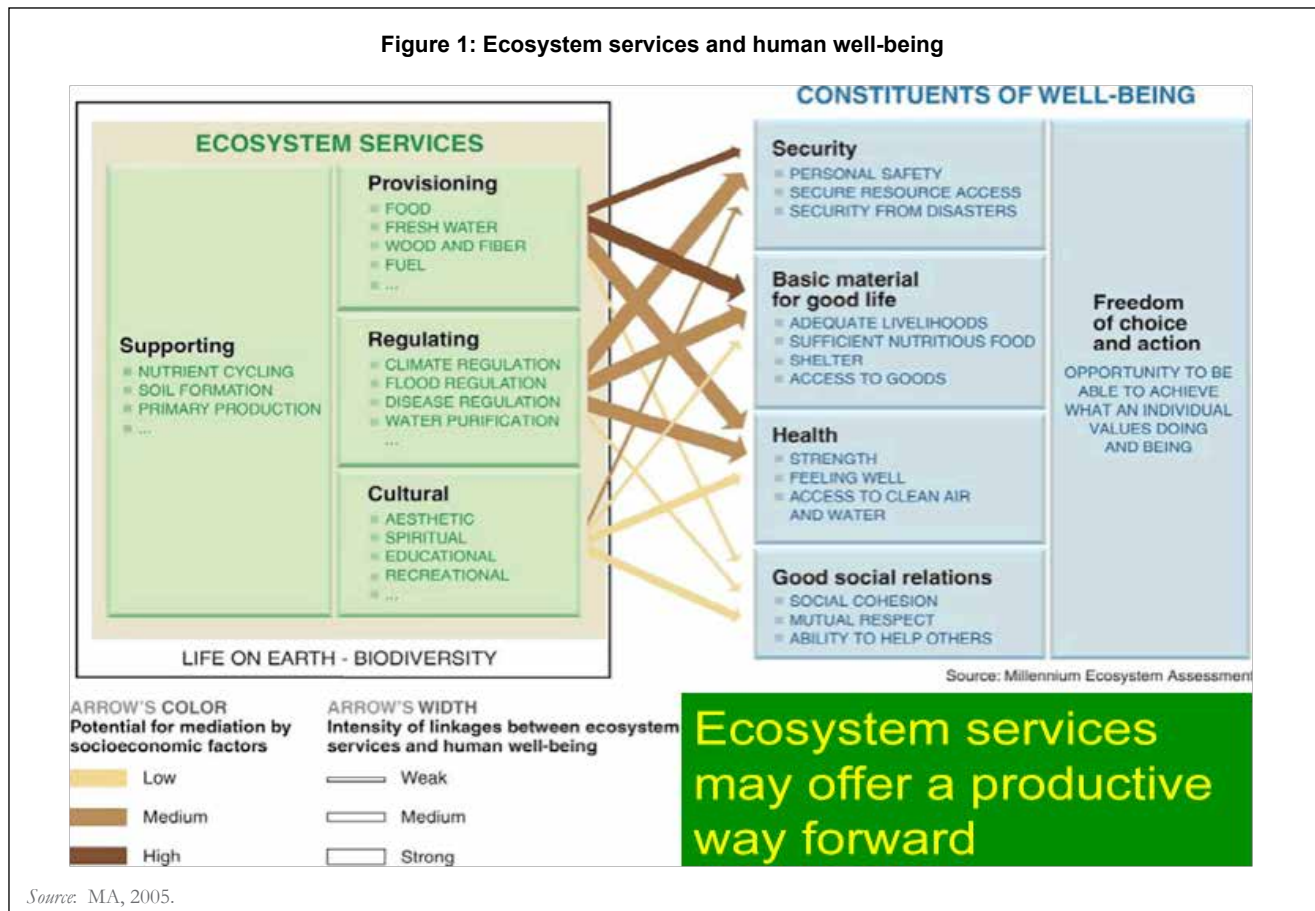
1.1 The Foundation: Maintaining Ecosystem Services

Economists have long recognized that ecosystems provide important benefits to society, and that prices can be assigned to many of them (such as land, water, and timber). The full range of benefits recently has been given the umbrella label of “ecosystem services” (Daily, 1997). As it entered the mainstream of environmental thinking, the concept of ecosystem services was given a significant boost by the Millennium Ecosystem Assessment (MA, 2005), which assessed 26 of these ecosystem services, defined simply as the benefits people receive from nature. These were divided into four broad categories: provisioning services, such as food and water; regulating services, such as flood and disease control; supporting services, such as nutrient cycling; and cultural services, such as spiritual, recreational, and cultural benefits (Figure 1).

In the GMS, some ecosystem services continue to deliver considerable benefits, especially from provisioning services such as food production or harvesting of forest products. Others are degraded to the point where they no longer provide the benefits people need. For example, deforestation and loss of wetlands contribute to flooding, a problem that is becoming more expensive by the year; deforestation also leads to greater soil erosion, which in turn can lead to sedimentation of reservoirs and shorten the productive life of water resources development projects. Thus human exploitation of ecosystems has resulted in at least short-term increased production from a small number of provisioning services, at the substantial long-term cost of other services.

More generally, the continuing degradation of ecosystem services increases the likelihood of serious negative impacts on human wellbeing, including the emergence of new infectious diseases, decline in water quality, problems from pollution, the collapse of fisheries, and shifts in regional climate (MA, 2005).

The concept of ecosystem services also has important policy implications for governments determining how to invest their scarce resources. It provides a framework for deciding the relative priority for the services that support consumptive uses, such as food, fuel, and construction materials, as opposed to those that support non-consumptive uses, such as watershed protection, disaster prevention, cultural values, pollination, health, and so forth. It also clarifies the tradeoffs that are often implicit in decision-making, especially about the distribution of



benefits from ecosystems. Finally, decision-makers need to be reminded that environmental conditions are changing rapidly in much of the GMS (and indeed throughout the world), which makes it all the more important to maintain healthy ecosystems that will be able to provide their functions (such as carbon sequestration, evolution, nutrient recycling, and watershed protection) as part of adapting to changing conditions. This is likely to require conserving the maximum possible biological diversity.

1.2 Biodiversity Loss

Although biological diversity (here shortened to “biodiversity”) has many definitions, the one used here is from the Convention on Biological Diversity (CBD): “the variability among living organisms from all sources, including, inter alia, terrestrial, marine, and other aquatic ecosystem, and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.” While biodiversity thus defined cannot easily be measured and is difficult to translate into policy terms, the concept has proven to be extremely useful, judging from its numerous applications in the GMS (see, for example Persson *et al.*, 2010). All GMS

countries are Party to the CBD and other biodiversity-related conventions that provide international support to national conservation initiatives.

The conservation of biological diversity is a fundamental principle of environmental management, since diversity at gene, species, and ecosystem levels provides the greatest range of options for adapting to changing conditions, and is the very basis of evolution. Reviews have shown that high plant diversity is needed to maintain ecosystem services (Isbell *et al.*, 2011). Other recent research has found that the loss of species negatively affects overall ecosystem resilience; restoration of biodiversity greatly enhances ecosystem productivity; and regions identified as having high priority for biodiversity also have very high ecosystem-service value (Butchart *et al.*, 2010). On all of these criteria, the conservation of the biological wealth within the GMS earns very high priority. Perhaps most important for the GMS, biodiversity is an essential element for fighting poverty and ensuring sustainable development.

Barrett *et al.* (2011) identified four distinct trends that threaten links between biodiversity and poverty: dependence on inherently limited natural resources;

shared vulnerabilities; failure of social institutions; and unintended consequences and lack of informed adaptive management. Ways of addressing these threats have been further elaborated in a series of activities in the GMS that will be discussed further below.

For rural people, biodiversity can be a matter of life or death because they are totally dependent on the ecosystem services supported by biodiversity. The protection of ecosystems is so important that it is included in the Constitution of Cambodia (Article 59), and is being addressed by all GMS countries through their National Biodiversity Strategies and Action Plans as well as through their collaboration in the GMS Core Environment Program.

The GMS is blessed with some of the richest biodiversity in the world, at all levels from genes to ecosystems. Many of its species are unique to the region (“endemic”), especially primates, birds, reptiles, amphibians, insects, and plants; if these species become extinct in the GMS, they are lost to the world (the kouprey, a wild species of cattle native to Cambodia that was thought to be resistant to rinderpest, and Schomburgk’s deer, a swamp deer found only in Thailand and which had the most magnificent antlers of any deer, are two dramatic recent extinctions). Other more widespread species are now lost to the region, such as the Javan and Sumatran rhinoceroses; and even more are so rare as to be considered Endangered, such as tigers and many species of primates. But an estimated 1200 new species were discovered in the GMS between 1997 and 2008, including new species of monkeys, a new family of rodents from Lao PDR, and a unique species of forest ox from the Annamite Mountains known as “saola”, indicating limits to knowledge about the species of the GMS.

A particular challenge for the Mekong is its tremendous diversity of fish species, which contribute to the well-being of 60 million people in the GMS (Vaidyanathan, 2011). The Mekong is one of the most species-rich rivers in the world, with at least 781 species, including four of the world’s largest freshwater fish. All of the giant fish are highly threatened by fishing pressure, and will be further threatened, and possibly driven to extinction, by the construction of mainstream dams.

The combination of habitat loss, poaching, illegal trade, pollution, and the impact of invasive alien species are driving numerous species in the GMS toward extinction (Baillie, *et al.*, 2004). These species have long been an integral part of the cultures of the GMS and have provided multiple benefits in the form of food, medicines, ecological

balance, genetic resources, folklore, and esthetic pleasure. The source of some of the planet’s richest biodiversity is in danger of becoming a biological desert, unless corrective measures are urgently taken.

Agricultural scientists quite rightly focus on plants, as the GMS is often considered one of the origins of horticulture, and is the original home of species now of global importance, such as sugarcane, coconut, banana, eggplant, rice, and many fruits and tubers. More recently, researchers have tended to focus especially at the genetic level of plant biodiversity, seeking to conserve the widest possible range of genetic material that is relevant to crop production. The International Treaty on Plant Genetic Resources for Food and Agriculture, for example, concentrates on 64 of the most important food and forage species. Even so, the genetic diversity of most crops is declining significantly, with GMS countries that once grew thousands of varieties of rice now growing just a few hundred. Many protected areas in GMS countries contain important genetic resources for food and agriculture, especially the wild relatives of domestic species of plants and animals, and should be considered living gene banks where evolution continues under natural conditions.

While many GMS ecosystems are losing native species, they may also be adding non-native species that are now moving more freely around the world as an externality of global trade. Non-native species help feed the world, with most agricultural species now having a global spread following the great genetic interchange that followed the 1492 contact between the eastern and western hemispheres (Mann, 2011). Imagine the GMS without chili peppers, rubber, cassava, oil palm, tomatoes, oranges, maize, potatoes, eucalyptus, and grapes – all non-native species that have enriched the productivity of agriculture in the GMS.

Most of these species introductions are beneficial to ecosystems and human well-being. But when imported into new habitats, some non-native species are highly destructive to native species, thereby fundamentally changing ecosystems. A significant, but often ignored, biodiversity problem in the GMS is the serious harm from invasive species, and the damage appears to be growing. Grasslands of *Imperata* (native to east Africa) cover many of the hills of the GMS, following shifting cultivation that has been mismanaged due largely to population pressure, are difficult to cultivate and are not attractive to herbivores (either wild or domestic). The golden apple snail (*Pomacea* sp.) was imported into Viet Nam in 1988 as a source of rich

protein for fish, ducks, and people, but it quickly became invasive and spread throughout the country, infesting over 132,000 ha of ricefields and other wetlands by 1997 and causing severe economic damage to rice (Tu and Hong, 2003). Thailand has at least 24 species of serious insect pests that are invasive and at least 190 species of alien plants (including several that are highly destructive to native ecosystems, including water hyacinth *Eichhornia crassipes*, giant water fern *Salvinia molesta*, and Siam weed *Chromolaena odorata*) (Napompeth, 2003). Similar problems affect the other GMS countries, with costs in the billions of dollars per year. Most GMS countries have established biosafety committees, but the booming international trade that carries invasive alien species as an externality is overwhelming the capacity of border controls to implement the import regulations that are designed to protect native ecosystems and agriculture.

The concept of biodiversity, in all its complexity, has provided a fairly simple way to address the living wealth of planet Earth. The genes, species, and ecosystems that comprise biodiversity provide the capacity to support life, thereby deserving the full attention of decision-makers at all levels.

1.3 Obtaining the best return from limited land resources

Land use change remains the most serious threat to the provision of ecosystem services in the GMS, a view supported by the Millennium Ecosystem Assessment (MA, 2005) and the International Assessment of Agricultural Science and Technology for Development (McIntyre *et al.*, 2009). Managing the land resources of the GMS is a major challenge, with demand for agricultural production certain to increase, along with more land needed for mining, manufacturing, urban expansion, forests, and other uses (including to be converted into reservoirs as part of water resources development). Making choices about how land is best allocated requires trade-offs and careful consideration of opportunity costs, with decision-making made more difficult by dynamic external conditions.

The growing human population in the GMS has been accompanied by the spread of human settlements into areas that previously were sparsely populated. This has resulted in converting substantial amounts of forest to agricultural land, for both arable crops and pastures (as well as wasteland). Impacts on ecosystems have been profound, including reduction of the populations of large vertebrates, disruption of watersheds, and declines of

biodiversity; for the people who live in and around forests, these impacts have worsened poverty.

At a regional level, the GMS is currently self-sufficient in food and is an active trader on the international market. Thailand exports about US\$7 billion of agricultural products per year, Viet Nam \$1.7 billion, and Myanmar almost \$300 million. Cambodia imports \$15 million of agricultural products per year and Lao PDR \$3 million. The PRC is a major importer of agricultural products, at over \$14 billion per year, but most of this is consumed outside the PRC's Mekong region (Yunnan and Guangxi provinces) (Ng and Aksoy, 2008). Still, this high demand for food by the PRC at the national level affects the GMS as a whole.

More food production will be required in the GMS in the coming years, but determining the appropriate balance between intensifying production on the most suitable lands for agricultural production and expanding production into more marginal lands is a major policy concern. As demand for agricultural land increases, people are moving into protected areas or other areas that are legally protected for biodiversity and ecosystem services (including forests and wetlands). One result is increasing forest fragmentation, with the remaining patches of natural vegetation being too small to support most of the larger species of wildlife or even trees (Primack and Lovejoy, 1995; Primack, 2010).

The GMS countries have brought deforestation under some control by greatly expanding plantations; the PRC may plant more trees per year than the rest of the world combined (FAO, 2003), but the plantations tend to be of a single species and even-aged, making them vulnerable to pests and not very attractive to native birds and mammals. Despite efforts to halt deforestation, Viet Nam is still losing about 1.08 percent of its forests per year, Myanmar 1.4 percent, Thailand 0.7%, Cambodia 0.6%, and Lao PDR 0.4 %. These figures may be underestimates, but even so, they demonstrate that forests continue to decline in the GMS at a time when more forests are needed to provide a healthy environment and important ecosystem services.

In short, land use and its ramifications for ecosystem services, human well-being, livelihoods, forests, agriculture, water, transportation, energy, and many other essential dimensions of sustainable development, are likely to remain at the top of the agenda for many sectors of society in the GMS.

1.4 The impacts of pollution on soil, air, and water

Pollution is the introduction and spread of harmful substances or other contaminants into air, water or soil. It comes in many forms, such as chemicals, radioactivity, waste products, dust, noise, or even light. It may be a natural by-product of an ecological process, such as the emission of carbon dioxide or methane by plants or animals, or the production of by-products from digestion of food that may cause disease to other species when deposited in drinking water. Pollution from modern systems of production is usually an externality of an activity that is intended to benefit people, such as farming, transportation, mining, energy generation, or construction. But pollution may sometimes be intentional and designed simply to earn a larger profit (for example, illegal additives to food) or intentionally to damage ecosystems (such as the use of defoliants, some of which may have long-term health effects on people). Different forms of pollution may affect different sectors of society or different parts of a country, but the discussion here will focus generally on environmental impacts of modern forms of pollution in the GMS.

One major source of environmental pollution in the region is chemical fertilizers, which are widely used to enhance production. The major producers of agricultural products are also the major users of fertilizer. Viet Nam, for example, uses about 1.9 million metric tons of chemical fertilizer per year, followed closely by Thailand at 1.7 million metric tons. The other GMS countries lag far behind, with Myanmar at 132,000 metric tons, Cambodia at 7,620 metric tons, and Lao PDR at 7,019 metric tons (the PRC is the world's leader, at over 39 million metric tons, with most applied outside the GMS)(2002 statistics). Used appropriately, chemical fertilizers are unquestionably beneficial to production, but excess use is damaging to soils, waters, and ecosystems more generally.

Such use can cause environmental problems such as the process of eutrophication, when nitrates and phosphates from fertilizers runoff into rivers, wetlands, and oceans lead to excess nutrients that increase phytoplankton that depletes the oxygen content of the water body, causing die-offs of many fish species. This has led to substantial "dead zones" in many parts of the GMS, including lakes, rivers, and coastal waters (Molle, *et al.*, 2009).

Pesticides are often considered essential by farmers anxious to protect their crops against insect predators. But

the pesticides also carry substantial costs, posing health problems for farmers (including increased cancer risks and disruption of endocrine systems), killing non-target species such as pollinators, earthworms, and fish, and disrupting natural control of insect pests (an ecosystem service that can form part of integrated pest management). The target species eventually build up resistance to the pesticide, requiring constant upgrading to more powerful chemicals, and the natural predators of insect pests – especially birds – often accumulate pesticides in their bodies, which can affect their reproduction (Carson, 1962).

All of the GMS countries are seeking to reduce pollution because of its damage to human health, manufacturing, energy generation, infrastructure, and so forth, which carry substantial costs. For example, the World Bank (2007b), working with the State Environment Protection Administration of China, estimated that air and water pollution cost 2.68% of the country's GDP in 2003, about \$88 billion; this did not include soil pollution, the impacts of pesticides, climate change, or the costs of eutrophication, which would have increased the costs considerably. The other industrializing countries of the GMS, Thailand and Viet Nam, are likely to have similar levels of pollution, requiring significant expenditures to address the problems; Viet Nam, for example, spent about \$2.3 billion on pollution control and abatement in 2001-2005 (Dore, *et al.*, 2008), and the impacts of atmospheric pollutants from the production of thermal power in the country could reach \$9 billion per year by 2030 unless serious efforts are taken to reduce the effluents from coal-fired power plants (Soussan and Nilsson, 2009).

But by far the most expensive and damaging result of pollution is climate change (ADB, 2007). The strong consensus is that the accumulation of anthropogenic greenhouse gasses (especially carbon dioxide from burning forests and fossil fuels and methane from livestock and ricefields) in the atmosphere is leading to accelerated climate change, which in turn is leading to changing patterns of rainfall, driving a change in the distribution of many species, creating novel ecosystems, increasing acidification of oceans, rising sea levels, and having many other impacts on ecosystems (IPCC, 2007). While no single weather event can be ascribed to climate change, the recent extremes in temperature, cyclones, rainfall and rainfall patterns are consistent with the projected impacts of global climate change. The GMS is already feeling many of these changes, including increasing salinity in the Mekong Delta (affecting rice production), catastrophic floods in Thailand, Cambodia, and Viet Nam,

ecological changes in the Gulf of Thailand as a result of the influx of freshwater from the Chao Phraya river, and coral bleaching as the ocean becomes warmer and more acidic. The costs of climate change have been estimated to be at least 5% of global GDP per year (Stern, 2006), and governments are already spending billions of dollars per year on climate mitigation and adaptation under the UN Framework Convention on Climate Change.

Much uncertainty remains about the impacts of climate change. Most agree that rainfall patterns, an essential dimension of rainfed agricultural production in the GMS, will change, adding uncertainty to crop yields. It also seems likely that some areas will benefit while others will suffer, and that dry seasons will be longer and wet seasons will be shorter and wetter (Kirby *et al.*, 2009). The flow of water in the Mekong and its tributaries is likely to become more unpredictable, requiring more sophisticated management of the dams and their reservoirs, and indeed the entire Mekong watershed.

Pollution has accompanied human development from the time fire was discovered by people half a million years ago and started producing smoke and particulates inhaled by the cave-dwelling ancestors of modern humanity. With the industrial revolution and accompanying advances in chemistry and manufacturing, the range of pollutants greatly increased and has now reached a critical level that is damaging many ecosystem services, with climate change being the most dramatic symptom.

2. Some Productive Responses to Environmental Problems in the GMS

While the problems briefly described above are daunting, and the list could be extended considerably, the governments, private sector, and civil society at local, national, and international level are becoming more aware of the problems. Solutions are not simple, and some may take years to solve. Others – such as climate change or invasive species – may never be “solved”, and instead will need to be managed at a level where damage is kept within acceptable levels. The measures described below are already being put in place and may show significant progress over the coming decade. Other papers in this volume will suggest other responses, including some that will show their impacts over the longer term.

But just as environmental problems are part of a system where the symptoms that cause human suffering are inter-

related, so are the solutions part of a package of mutually-reinforcing policies and practices that are designed to enhance human well-being by improving the health and productivity of ecosystems. They start with the biological basis of all life, then discuss new technologies, briefly touch on the critical role of water and energy, outline means of providing the necessary financial resources, and conclude with a quick review of building the human capacities to support sustainable development. All of these are sheltered under the umbrella of ADB’s Core Environment Program, though they are treated separately below.

2.1 Conserving biodiversity and ecosystem services

The most effective policy instrument for conserving native biodiversity is the establishment and effective management of protected areas, defined by IUCN (2011) as clearly delineated geographical spaces “recognized, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values”. Protected areas thus defined incorporate the traditional association between people and the rest of nature, and can be managed to provide benefits to local people.

Many international agreements also support protected areas. The Convention on Biological Diversity has a detailed Programme of Work on Protected Areas that provides principles and guidelines for all parties. UNESCO’s World Heritage Convention has established a list of natural and cultural sites that are considered to be of “outstanding universal value” and therefore worthy of international support. UNESCO’s Man and Biosphere Program (MAB) also supports the establishment of Biosphere Reserves, which have a core protected area surrounded by buffer zones and research areas; international support is primarily in the form of training and information exchange. The Convention on Wetlands of International Importance also maintains a list of these habitats, with all GMS countries (and provinces in the case of the PRC) having sites on the list (Table 1). The latter convention provides support in terms of training, policy advice, international cooperation and demonstration projects. At the country level, the government resource management agencies are supported by dozens of NGOs that are contributing to protected areas, in everything from research to ecotourism (see, for example, King *et al.*, 2009 for Cambodia).

Given the high value of biodiversity and ecosystem services in the region, it is not surprising that the GMS

Table 1: Protected Areas in GMS Countries

Country/Province	Protected Areas	World Heritage Sites	Ramsar Sites	Biosphere Reserves
Cambodia	40	*	3	1
PRC				
Yunnan	29	2	4	1
Guangxi (China)	5	1	2	1
Lao PDR	25		*	2
Myanmar	51	-	1	-
Thailand	207	2	11	4
Viet Nam	190	2	3	8

* Cambodia and Lao PDR each have 2 World Heritage Cultural Sites.

countries all have strong protected areas programs. While they are all designed with the broad objectives contained in the IUCN definition of protected areas, the national programs differ in many details. The PRC, for example, has many local protected areas that often are rather small; Myanmar does not have any World Heritage sites and Lao PDR and Cambodia have only cultural World Heritage Sites; and Thailand has by far the most sites listed under the Convention on Wetlands of International Importance. The PRC has 28 Biosphere reserves, but only one each in the GMS provinces; Lao PDR and Myanmar have not yet taken advantage of the MAB Program. These international programs all give considerable attention to the full range of benefits of protected areas, from tourism to poverty alleviation through employment opportunities for local people. The protected area agencies in most countries still give more attention to income-earning tourism than to resource management problems such as invasive alien species, but the provision of ecosystem services and forest protection is gaining more attention as these gain economic support (see 2.4 for more details).

Despite the many benefits of protected areas, the vast majority of them are too small to maintain viable populations of wide-ranging species such as elephants, tigers or vultures, or even some species of rare trees. In order to expand the effective size of protected areas, some countries depend on buffer zones, where some human uses are permitted when they are consistent with the overall objectives of the protected areas.

Far more ambitious is the effort to link protected areas with other land uses that support conservation and the provision of ecosystem services through the establishment of conservation corridors. Examples at the international level include the Yellowstone to Yukon Corridor in North America, the Mesoamerican Biodiversity Corridor, the Andean Corridor in South America, and the Southern Africa Peace Park (from Mozambique to South Africa). Many countries are establishing conservation corridors

within their own boundaries, most including community managed forests; these often have lower and less variable annual deforestation rates than formally protected forests (Porter-Bolland *et al.*, 2011). The benefits of conservation corridors are many, but the most important ones are that they build cooperation between local people and protected areas, provide sufficient habitat to conserve the key species, and are sufficiently large to enable ecosystems to adapt to climate change (especially those that have a north-south axis and altitudinal variation that enable species to move to new habitats as their existing ones are affected by changes in temperature or rainfall regimes).

The GMS has drawn on this experience to establish one of the world's most ambitious such efforts, the Biodiversity Conservation Corridors Initiative (BCI), which was launched in 2006 and now has nine pilot Biodiversity Conservation Landscapes (BCL) that cover mixed landscapes that include over 17 million hectares of forest and a total area of over 50 million ha (Moinuddin *et al.*, 2011). The Ton Le Sap Inundation Zone BCL is entirely within Cambodia, but the other BCLs cross boundaries, and thereby help promote cooperation among neighboring countries. These transboundary areas include:

- the Western Forest Complex (Thailand and Myanmar) (forest area 3,804,688 ha);
- the Cardmom and Elephant Mountains (Thailand and Cambodia) (forest area 1,218,971 ha);
- the Eastern Plains Dry Forest (Viet Nam and Cambodia) (forest area 1,704,698 ha);
- the Northern Plains Dry Forest (Cambodia, Lao PDR, and Viet Nam) (forest area 1,192,259 ha);
- the Tri-border Forests (Cambodia, Lao PDR Viet Nam) (forest area 1,422,755 ha);
- the Central Annamites (Lao PDR and Viet Nam) (forest area 2,192,903 ha);
- the Northern Annamites (Lao PDR and Viet Nam) (forest area 2,043,435);
- the Mekong Headwaters (Yunnan, Lao PDR, Myanmar, and Thailand) (forest area 3,230,579 ha).

These areas are sufficiently large to support viable populations of all species in the GMS, with some giving particular attention to conservation of tigers, elephants, or the rarest species of gibbons. They each have their own governance structure and action priorities, and many lessons are already being learned and applied more widely within the GMS and internationally (Carew-Reid *et al.*, 2007).

Most of the BCI areas include protected areas of various sorts, but they are designed to achieve more than restoring and maintaining ecosystem connectivity. They also incorporate components dealing with poverty alleviation through sustainable use of natural resources and development of livelihoods; clear definition of optimal land use and harmonized land management regimes; capacity building in local communities and among the relevant government staff; and sustainable financing mechanisms that will enable the corridors to become self-reliant in the fairly near future. They also promote collaboration among diverse agencies. The Western Forest Complex BCL, for example, is focusing on a study area within Thailand that includes two National Parks, a Wildlife Sanctuary, a National Reserved Forest, a Natural History Park, and an area supervised by the Royal Thai Army; research support is provided by Wildlife Conservation Society Thailand.

The nine Biodiversity Conservation Landscapes all include some agricultural land, but agriculture throughout the GMS depends on ecosystem services provided largely by native species, though domesticated biodiversity characterizes these systems. As indicated earlier, greater pressure is likely to be put on the agricultural lands of the GMS, but it is possible to halt agricultural expansion by closing “yield gaps” on underperforming lands, increasing cropping efficiency, changing diets, and reducing waste. Such strategies could significantly increase agricultural production while simultaneously reducing the environmental impacts of agriculture (Foley *et al.*, 2011).

Expansion of land devoted to agriculture in the GMS region has only limited potential, though yields may continue to grow as agricultural technologies continue to improve. An optimistic perspective is that the GMS by 2020 could produce more food with fewer inputs per unit of output, and less land conversion. But pressure on the agricultural system will surely increase, stimulating innovation and calling on modern research to provide solutions. The BCLs are testing some of these agricultural innovations.

2.2 Mobilizing modern technologies

Technology is the branch of knowledge that deals with the creation and use of technical means and their relation with society and the environment. Technologies come in many forms, including “soft technologies” that deal with improved regulations and means of decision-making, such as government regulations to support sustainable management, Environmental Impact Assessment, Strategic Impact Assessment, Spatial Multi-Criteria Assessment, Cost-Benefit Analysis, the concept of ecosystem services, and the renewed use of old soft technologies such as Community-based Forest Management and sustainable forestry; “appropriate technologies” that draw on a mix of the old and the new, with the latter being typically low-tech, energy-efficient, and capable of being developed and applied at the local level and at low cost (Schumacher, 1973); and modern sophisticated technologies such as computers and genomics. Virtually all forms of technology are being used in the GMS, often in combinations (such as the marriage between local knowledge and Geographic Information Systems for improving spatial management – Linde, 2009) but further development will require more effective application of them.

Mobilizing local knowledge and applying it to modern resource management has become a fundamental part of the package of technologies being applied in the GMS, especially for addressing poverty-related issues such as the management of non-timber forest products (Ingles *et al.*, 2007). Modern sophisticated technologies are drawing on local knowledge to develop a web-based interactive atlas of the GMS that is expected to be upgraded in the coming years to become even more useful for land-use planning, and perhaps other applications as yet unforeseen (Linde, 2009). Already, modern cellphones have reached into even the most remote parts of the region, enabling farmers to gain up-to-the-minute information on crop prices, weather, and various social dimensions of development. Tools such as Google Earth enable close monitoring of land uses, computers enable vast amounts of information to be collected and analyzed to support better decision-making, and photo-monitoring provides more detailed information about wildlife populations than ever before (see Lassoie and Moseley, 2007, for an example in Yunnan). Hand-held field guides to birds and other species are now becoming available, as are sophisticated GPS-based information management systems for forest rangers and other resource managers. These latter tools are already being used elsewhere, but the GMS is now ready to adapt them to local needs, perhaps using the Biodiversity Conservation Corridors as pilots for their application.

Increasing the productivity of land in the GMS is beginning to draw on the remarkable scientific and technological advances that in the past few decades have opened up a wide range of new approaches for enhancing the production of plants and animals that are useful to people. These technologies include genomics, genetic engineering, synthetic biology, and many others (Chaturvedi and Rao, 2004). Genetic engineering may well be the most controversial issue, with many people totally rejecting the technology because of its perceived threats to ecosystems and human health. Within the GMS, the PRC is by far the leader in the development of GM crops, and Myanmar is also growing some. Other countries are conducting research on GM plants but have not yet released them; many are developing their capacity for risk assessment and management of GMOs (see, for example, Mohamed and Hien, 2011 for an evaluation of Viet Nam).

But genetic engineering is far from the only kind of biotechnology, and many other biotechnologies can play a positive role for food security and sustainable development in the GMS. In forestry, it is now possible to use DNA to track logs of valuable timber trees, thereby ensuring that only legally-harvested trees are traded (Lowe *et al.*, 2010). In agriculture, the mapping of the genomes of crops, pollinators, and pests will provide agronomists with a new tool for producing crop varieties that can respond to the new conditions that seem sure to come.

This brief overview of the contribution of technologies has indicated their potential, and continuing research and development will make new such advances available in the coming years. The challenge in the GMS will be to assess these new technologies as they become available and adapt them to local needs while avoiding any negative impacts that may limit their benefits.

2.3 Improving the delivery of energy and water

This paper primarily addresses living natural resources, but water is an essential part of all ecosystem functions and the development of additional energy is essential to the economic development of the GMS but poses a serious threat to many ecosystem services. Water and energy are addressed in more detail elsewhere in these proceedings, but several points are of particular relevance here.

One of the major development objectives of the GMS countries is the mobilization of the waters of the Mekong Basin. These waters support agriculture, hydropower, and various industrial and domestic uses. The ambitious

development of infrastructure to manage these waters is therefore quite properly seen as essential to the further development of the GMS. Hydropower, for example, is seen as a clean alternative to geothermal forms of energy that are based on fossil fuels and generate considerable pollution, including greenhouse gasses that are causing climate change. However, while hydropower is a relatively clean form of energy, it comes at an environmental cost. A Strategic Environmental Assessment for Viet Nam's power development plans reported that if all 21 hydropower schemes were implemented, the value of lost farmland would be \$2.9 million annually, the resource value of forest area lost would be \$72.4 million, and over 61,000 people (mostly ethnic minorities highly dependent on access to natural resources) would be displaced (Soussan and Nilsson, 2009). Similar assessments are available for the rest of the GMS, calling for careful consideration and wide consultation about the costs and benefits of the various uses of the rich, but limited, water resources of the Mekong River and its tributaries. Lessons learned from this international river can also be applied at the national level.

While hydropower is a key concern, other modern forms of energy are also being explored, including solar, wind, and others. But a new threat to forests is coming from an ancient form of energy generation in the GMS: biofuels. In the form of firewood, biofuels reach as far back as the mid-Pleistocene in Asia (James, 1989). In many parts of the GMS, wood and charcoal still provide the primary source of energy for rural people. While biofuels are not new, enthusiasm for them recently has grown as a result of concerns about security of oil and gas supplies, interests in promoting alternative markets for agricultural producers, and a desire for lower-carbon transportation fuels that will help alleviate climate change. Such developments are likely to change production systems and affect food security, ecosystems, and livelihoods throughout the GMS.

This has led to concerns about direct impacts on forested land and food production. These concerns are shared by food companies worried that demand for at least first generation biofuels (from crops that could otherwise be used as food) will increase the cost of crops such as maize and palm oil, and thereby increase the production costs of their commercial products and the price of food (a major problem for the urban poor). Produced without consideration for the environment, biofuels could result in further deforestation, habitat fragmentation, invasive species, declining soil fertility, and even a net carbon increase (particularly where forested land is cleared for intensive biofuel feedstock production).

This brief discussion of energy and water underlines the importance of carrying out strategic environmental assessments so that the full trade-offs of the various options can be quantified, thereby providing decision-makers with the information they require.

2.4 Using economic instruments to promote sustainability

The extremely high conservation values of the biodiversity of the GMS has generated substantial funding from international agencies, such as the World Bank, the United Nations Development Program, the United Nations Environment Programme, the Global Environment Facility, the United Nations Food and Agriculture Organization, the Asian Development Bank, and many others. Major investments in conservation have also been supported by bilateral donors, including virtually all of the OECD countries.

Many international non-governmental organizations are also active in supporting conservation in the GMS, notably the Wildlife Conservation Society, The Nature Conservancy, Worldwide Fund for Nature (WWF), Conservation International, Fauna and Flora International, Birdlife International, the International Crane Foundation, Botanical Gardens Conservation International, and the International Union for Conservation of Nature. They have provided financial support, developed local capacity, and supported critically important research.

It is likely that such external support will continue in the coming decade, though the financial problems being faced by many OECD countries could well reduce the funds available and redirect investments toward the least developed countries. Therefore, the countries of the GMS are exploring other options for ensuring that the financial resources remain available for maintaining the environmental health of the region. This is sensible public policy. A recent major international effort, known as The Economics of Biodiversity and Ecosystem Services (TEEB) has concluded that the value of ecosystem services is substantially greater than the costs of maintaining their productivity (TEEB, 2010). In other words, environmental degradation is costly on both social and economic grounds, like Stern (2006) showed for climate change.

The problem is that only some ecosystem services, mostly the provisioning services such as food production or harvesting of timber, are amenable to traditional economic analysis, which tends to “externalize” (that is, ignore) the

other ecosystem services that may be sacrificed. But the concept of ecosystem services has provided a new tool that is now being more widely applied, including in the GMS.

For example, the PRC sees payment for ecosystem services (PES) as a tool for stimulating development in rural ecosystems of the country (Scherr and Bennett, 2011). Viet Nam and Cambodia, too, are promoting PES and have provided a legal basis for them. All of the GMS countries are involved in a form of PES that pays for the service of carbon sequestration. This climate mitigation program is known as Reduced Emissions from Deforestation and Forest Degradation (REDD), under which countries that emit excess carbon dioxide compensate by supporting the planting of new forests or the conservation of existing ones. An improved version goes beyond the carbon storing service to include other services such as maintaining watersheds and conserving genetic resources; this is known as REDD+.

One of the most effective ecosystem services for delivering benefits to the rural poor is the protection of forested watersheds (Warner, 2009), often as part of REDD+. Farmers in some parts of the world are growing coffee and cocoa as part of complex agroforests, earning a premium on their “Forest Friendly” labels; they are using a market mechanism to enhance earnings from helping to conserve biodiversity, an approach that could be more widely used in the GMS.

Some protected areas are also cashing in on ecosystem services, especially those that provide ecosystem services to a reservoir; a notable pioneer in this effort is the Nam Theun 2 dam in Lao PDR, which has established a special Watershed Management Protection Agency that receives \$1 million per year to conserve the watershed and support local development. Many other protected areas provide cultural services in the form of tourism, and local communities often are able to participate through establishing ecotourism facilities around the protected areas (see, for example, King *et al.*, 2009, for examples in Cambodia).

While developing markets for ecosystem services shows considerable potential, it is constrained by factors such as poorly-developed property rights, inadequate recognition of liability for environmental damages, lack of a culture of rewarding contributions to ecosystem health, and weak regulatory capacity (Bishop *et al.*, 2009). These constraints will require attention from the GMS countries in the coming years.

2.5 Building stronger capacity for conservation

Public policy decisions that affect the environment are by their nature political. While sound science is helpful in decision-making, it is not necessarily decisive. For example, solid science clearly demonstrates that primary forests are essential for sustaining biodiversity in the tropics (Gibson *et al.*, 2011), but policy makers may nonetheless be convinced that an oil palm plantation is preferable to a tropical forest. Such decisions are often made on the basis of economics (see above) and on the relative power of those who gain the greatest benefit from the decision. But much depends on how benefits are defined and who defines them. And this in turn depends on the strength of the constituency that affects such definitions. If the expected benefits are to be delivered to the rural poor from improved management of ecosystem services, then their constituency needs to be strengthened.

Delivering on the promise of the Biodiversity Conservation Corridors Initiative will require action at many levels, from the international to the local. Managing transboundary cooperation requires new forms of institutions, with new mandates and new sets of skills from the many different interest groups. Training in specific fields, from basic computer skills to GIS mapping to productive negotiation needs to be supported by improved outreach and communications. A particularly important group that may need support in developing new crops, new products, and new marketing skills are rural women, especially for minority peoples who are often ignored.

At the other end of the scale, the complexity of managing transboundary resources will call on well-trained government officials with numerous skills, from designing appropriate legal frameworks to ensuring that national interests are well represented in international negotiations. Protected area managers will need new skills too, and they will be expected to work productively with people in the surrounding lands, their own staff, and the tourists who expect to visit a well-managed protected area.

3. Conclusions and Recommendations

This brief overview has highlighted some of the most important environmental issues facing the GMS. The serious challenges that face humanity in the coming decade could greatly benefit from a stronger partnership among government agencies, the private sector, environmental organizations, scientists, and the agricultural community,

perhaps based on some of the principles outlined in this paper. Areas of controversy should be seen as stimuli for developing better approaches and stimulating further research. Easy answers should not be expected, nor should approaches that will work everywhere. Diverse systems will require diverse responses, but new insights from science and other forms of knowledge may stimulate a broad range of applications.

The following points pose some options for productive policy debate, drawing from the preceding discussion.

1. The concepts and practices developed by the Biodiversity Conservation Corridors Initiative should be applied more widely, and even promoted to other regions. Results to date indicate that looking at the scale of an individual farm or plantation, or even a protected area, will lead to only limited progress (though of course it is crucial to the individual farmer or protected area manager). Experience from the BCI has shown that working at a watershed scale is often effective, particularly when development of water resources is so central to sustainability and the equitable distribution of benefits in the GMS. While the establishment of hundreds of protected areas throughout the GMS is a notable achievement, these areas need to be connected by corridors if they are expected to conserve their full complement of species, and adapt to climate change.

2. The environmental problems facing the GMS that have been outlined in this paper would greatly benefit from interdisciplinary approaches. The more sophisticated approaches that are now being taken to environmental management will require expertise from natural resource managers, business people, experts in energy and water, geographers, the military, social scientists, and many others, working together.

3. Results from studies of the economic benefits of ecosystem services have shown that investments in their conservation are well justified. Sustainable financing mechanisms, such as Payment for Ecosystem Services and REDD+, are likely to become increasingly important, and new applications of these concepts should be explored. For example, many protected areas earn considerable income through gate fees, and regulations (where they do not already exist) should be adopted that enable the protected areas to retain the income they earn and apply the profits to improved management and benefits to communities around the protected areas.

4. New approaches to addressing the issues identified in this paper should be addressed through multiple ways of knowing. Scientific knowledge can be enriched by local knowledge, traditional experience, and other forms of knowing. For example, farmers can contribute local ecological knowledge about forests beyond the experience of professional forest scientists, through means such as assessing the percentage of leaves damaged by insects or fungi and the density of new shoot stems (Fortmann and Ballard, 2011).

5. Investments in capacity building for resource management need further expansion, at all levels but with a particular focus on the poor, ethnic minorities, and women. The future is uncertain, but building the capacity of local people to adapt to change will be an important means toward a prosperous 2020. Resource managers also need regular refreshing of the skills to address sustainable forms of management, requiring improved skills in community relations, business management, ecotourism, collaborative management, and species protection.

6. Capacity building is also needed by scientists and other researchers. Having seen amazing changes in technology in the past few decades, the GMS countries should collaborate with other countries to seek key breakthroughs that by the year 2020 would best contribute to sustainable management of biodiversity and ecosystem services. Speeding adoption of new technologies while ensuring that they are safe will be crucial elements of mobilizing the new technology, and this will require the countries of the GMS to develop an independent and self-reliant scientific capacity. Regional cooperation may also contribute to more rapid adoption of new technology, while also ensuring that any risks are carefully addressed.

7. Countries that import food, timber, medicinal plants, biofuels, and other genetic resources have responsibilities to the exporting countries, and these have been incorporated in international law such as the Convention on Biological Diversity. But this "soft law" has not yet been sufficient, and the GMS countries should consider jointly requesting the World Trade Organization to incorporate these issues as its members seek to reach a satisfactory conclusion to the Doha Round. The exporting countries should also accept their own responsibilities, using tools like Strategic Environmental Assessment and Environmental Impact Assessment to ensure that the income earned from exports does not come at the expense of environmental degradation that will impose costs on rural people, especially the poor.

8. Agricultural researchers should work with farmers to maintain the maximum possible diversity in cropping systems, genetics, and technology. The best way to adapt to change is to maintain the widest possible range of options, which in the case of agriculture include biodiversity (genes, species, and ecosystems), constantly-evolving technologies, and the cultural diversity that builds on local wisdom among the farmers, foresters, pastoralists, and fishers who are actually managing the living resources humanity needs to sustain society.

9. Biofuels should be carefully assessed for their impacts on biodiversity and ecosystem services in the GMS. Produced sustainably, biofuels could provide economic incentives for restoring and enhancing ecosystems – through, for instance, conservation farming practices such as no-till or organic farming, and forest landscape restoration. Much will depend on how the biofuel market develops in the coming years, a topic that well deserves greater attention. Substantial investments are being made in the GMS (especially the PRC) to develop advanced biofuels into a commercially-feasible option, though high costs of production remain a significant constraint. The many unknowns surrounding biofuels calls for the countries of the GMS to take a precautionary approach to their further development, especially if they are to be grown on land that currently supports the mature forests on which so much of the region's biodiversity depends.

10. The GMS is rich in options for building dams, and deciding which ones to build, and in what order, is a complicated process with numerous factors to be considered. The World Commission on Dams (2000) provides useful guidance. Three main points will be emphasized here: choose sites that will have the least negative impacts on biodiversity and ecosystem services; for hydroelectric dams, choose reservoir sites that provide the most energy per unit of land to be flooded; and include payments for ecosystem services within the financial arrangements of any dam.

The GMS has developed a strong foundation of environmental management upon which to build. The coming decade is sure to bring major changes to the region, and the direction of these changes will be dependent upon policy decisions that recognize the value of ecosystem services to the people of the region.

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THE IMPACT OF TRADE LIBERALIZATION ON THE ENVIRONMENT IN GMS AND SOUTHEAST ASIAN COUNTRIES: AN EMPIRICAL STUDY

Loi Nguyen Duy¹

Abstract

The relationship between trade liberalization and environmental degradation was studied using a parametric econometric model with a cross-country dataset of 3 countries in the Greater Mekong Subregion (People's Republic of China, Thailand, and Viet Nam) and 3 other (Association of Southeast Asian Nations [ASEAN]) countries (Indonesia, Malaysia, and the Philippines)² for the period 1980–2006. Two environmental indicators were used for analysis: carbon dioxide emissions from the consumption of energy and primary energy consumption. The presence of an environment Kuznets curve (EKC) was investigated to describe the interrelation between per capita income and environment quality.

No evidence for the existence of an EKC was found for the relation between per capita income and the environmental indicators. There was evidence to support the pollution heaven hypothesis (the shift of polluting industries from the North to the South), and evidence for a monotonically increasing linear trend between per capita income and both carbon dioxide emissions and primary energy consumption.

1. Trade Liberalization and the Environment: A Theoretical Overview

Since the early 1990s, many empirical studies have examined the relationship between income, trade liberalization, and pollution in different country development stages, using cross-country and time series data. An inverted U-shaped relationship between income and pollution called an environmental Kuznets curve

(EKC) is said to exist, and has attracted much attention.³ Some authors argued that the EKC should be interpreted with care because of its fragility and the weakness of the concept (Arrow *et al.*, 1995; Ekins, 1997; Stern and Common, 2001).

The skepticism about most empirical studies is due to their concentration on a few pollutants, such as sulfur dioxide (SO₂), nitrogen oxides (NO_x), carbon monoxide (CO), and energy consumption. Other pollutants have different relationships with income. The empirical results can be influenced significantly by research methods, time of studies, samples, and data quality. The impacts of economic growth on pollution depend on the source of economic growth. Evidence for the impact of trade liberalization on pollution is mixed. Antweiler *et al.* (2001) found that trade liberalization reduced pollution, whereas Dasgupta *et al.* (2002) found that trade liberalization did not have a positive effect on the environment in developing countries.

A pollution heaven hypothesis (PHH), which was supported by some studies (Mani and Wheeler 1998; Suri and Chapman, 1998), is based on the differences in environmental regulations between the North and the South;⁴ the South has a comparative advantage in pollution-intensive production while the North specializes in clean production. The South provides pollution-intensive products for the North via trade. This is the channel by which pollution is transferred from the North to the South. Some authors, such as Grossman and Krueger (1993) and Gale and Mendez (1998), found evidence against the PHH, and supported a factor endowment hypothesis (FEH).

The evidence for the PHH is also quite mixed. A number of studies have investigated the environmental consequences of trade liberalization, or the impacts of income and economic growth on the environment (Janicke *et al.*, 1997; Mani and Wheeler, 1998; Cole, 2004). However, few studies have assessed the net trade effects on environment or on an indicator of sustainable development. The United Nations Environment Programme (UNEP) (1999) found

³ Many authors have found the existence of an EKC, including Grossman and Krueger (1995), Shafik and Bandyopadhyay (1992), Shafik (1994), Selden and Song (1994), Suri and Chapman (1998), Agras and Chapman (1999), Cole (2004); Azomahou, Laisney, and Phu Nguyen Van (2006), and Phu Nguyen Van and Azomahou (2007).

⁴ The North implies developed countries while the South refers to developing countries.

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² Cambodia, the Lao PDR, and Myanmar were excluded due to lack of data.

evidence of negative impact of trade liberalization on sustainable development in several developing countries. However, another UNEP study (UNEP, 2001) showed that trade had a positive effect on sustainable development in some developing countries.

Several authors have investigated potential interactions between international trade and environment quality.⁵ Trade liberalization makes countries cope with greater competitive pressures; thus, they will use resources more efficiently and, as a result, pollution emissions decrease. Trade liberalization through free trade agreements (FTAs) and the World Trade Organization (WTO) promote technical and environmental standards so that countries may restrain imports of environment damaging goods.

Grossman and Krueger (1995) and Copeland and Taylor (1994, 2003) described three different channels through which economic growth influences environmental quality⁶ and shapes the EKC—scale effect, composition effect, and technique effect. The scale effect indicates the increase of pollution resulting from economic growth and growing market access. The composition effect implies changes in structure of an economy, as a consequence of trade liberalization, when the economy specializes growingly in activities in which it has a comparative advantage. The technique effect refers to the use of cleaner techniques of production with trade liberalization. As incomes grow, income-induced demand leads to more stringent environmental regulations, higher environmental standards and environmental protection, and access to environment-friendly techniques of production. The composition effect is the channel through which the pollution heaven hypothesis would have impacts on pollution. However, the extent of the composition effect on pollution depends on the comparative advantages of a country.

Most empirical studies used parametric specifications, such as cubic or quadratic polynomials, to examine the relations between environmental quality and per capita income, and to test the inverted U- shape⁷ hypothesis of

the EKC. Some studies investigated both the inverted U- and the N- shape hypothesis for developed countries.⁸ The effect of trade liberalization on the environment has been discussed in a number of papers.⁹ The evidence is mixed, with trade liberalization having positive or negative effects on the environment depending on sources of comparative advantage, environmental regulations, and the pattern of trade.¹⁰

2. Data and Variables

The relationship between trade liberalization and environmental degradation was studied using a parametric econometric model with a cross-country dataset of 3 countries in the Greater Mekong Subregion (People's Republic of China, Thailand, and Viet Nam) and 3 other (Association of Southeast Asian Nations [ASEAN]) countries (Indonesia, Malaysia, and the Philippines)¹¹ for the period 1980–2006. Two environmental indicators were used for analysis: carbon dioxide emissions from the consumption of energy and primary energy consumption. The presence of an environment Kuznets curve (EKC) was investigated to describe the interrelation between per capita income and environment quality.

In the analyses, the dependent environmental variables were carbon dioxide emissions from the consumption of energy and primary energy consumption. The countries in the analysis are newly industrialized and rapidly growing economies, consuming a large amount of energy (about 60% energy consumption by all non-Organisation for Economic Co-operation [OECD] Asian countries; Energy Information Administration [EIA] data, 2008) and generating a large amount of pollution, including carbon dioxide and other gases.

⁵ These authors are Grossman and Krueger 1992, 1995; Shafik and Boandyopadhyay 1992; Copeland and Taylor 1994; Cole 2000 and 2004; Copeland and Taylor 2003.

⁶ Grossman and Krueger (1993) also decomposed the effects of trade and foreign investment liberalization on the environment into three different channels: scale, composition, and technique effects, the same the growth-environment relation.

⁷ Authors such as Grossman and Krueger (1995) and Shafik (1994), found evidence for an N-shape EKC which implies that as economic activities enlarge rapidly, the negative impact of the scale effect is always larger than the positive impact of the other two effects—composition and technique.

⁸ These authors are Bruyn, van den Bergh and Opschoor (1998); Canas, Ferrao, and Conceicao (2003).

⁹ They are Suri and Chapman 1998; Antweiler *et al.*, 2001; Copeland and Taylor 2003; Cole 2004

¹⁰ The standard Heckscher-Ohlin model indicates that free trade makes a country with environment abundance specialize increasingly in pollution-intensive goods. However, the Stolper-Samuelson theorem shows that as the price for the use of environment rises, techniques of friendly environment production may be used.

¹¹ Cambodia, the Lao PDR, and Myanmar were excluded due to lack of data.

Per capita primary energy consumption is measured in quadrillion (10^{15}) British thermal units (Btu). Per capita primary energy consumption is considered as a pollutant. Per capita carbon dioxide emissions from the consumption of energy are calculated in metric tons of carbon dioxide. Data are from EIA (2008). Table 1 shows descriptive statistics for dependent and explanatory variables.

The explanatory variables were as follows. Data for all explanatory variables were from the World Development Indicators (WDI) 2008.

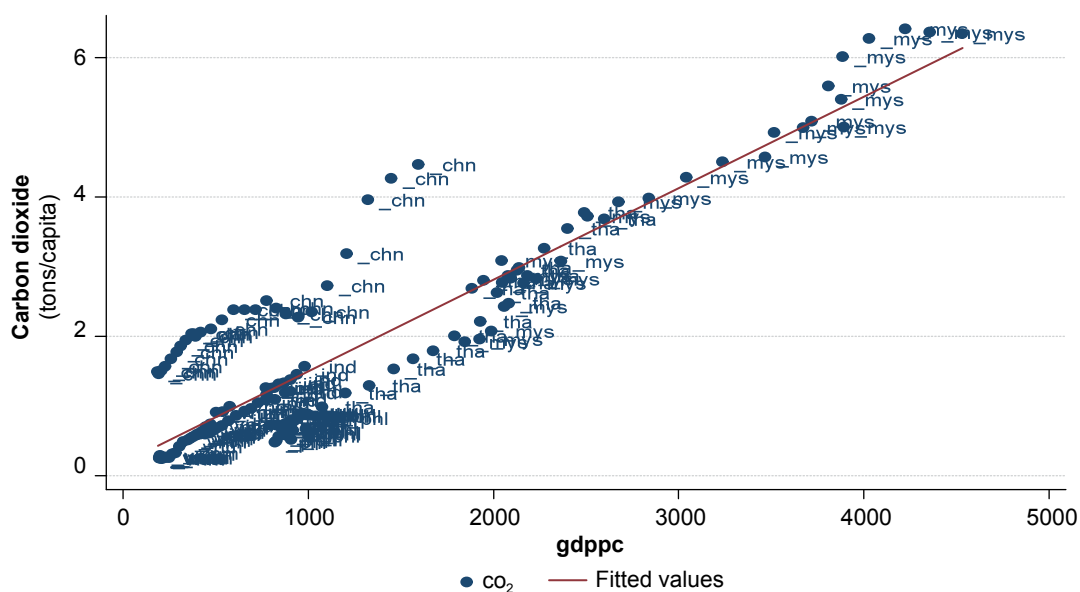
- Per capita GDP, measured in constant 2000 US dollars. Figure 1 presents the relation between carbon dioxide and per capita GDP; Figure 4 depicts the relation between energy consumption and per capita GDP.

- Level of openness or trade intensity as a percentage of GDP, measured as a share of the sum of exports (X) and imports (M) of goods and services in GDP $((X+M)/GDP)$; Figure 2 presents the relation between carbon dioxide and the level of openness; Figure 5 depicts the relation between energy consumption and the level of openness.
- Net total annual foreign direct investment (FDI), measured as percentage of GDP in current US dollars, to estimate FDI impacts on pollution in the context of trade liberalization. Figure 3 depicts the relation between carbon dioxide and FDI; Figure 6 presents the relation between energy consumption and FDI.
- Population density, measured in people per square kilometer.

Table 1: Descriptive Statistics

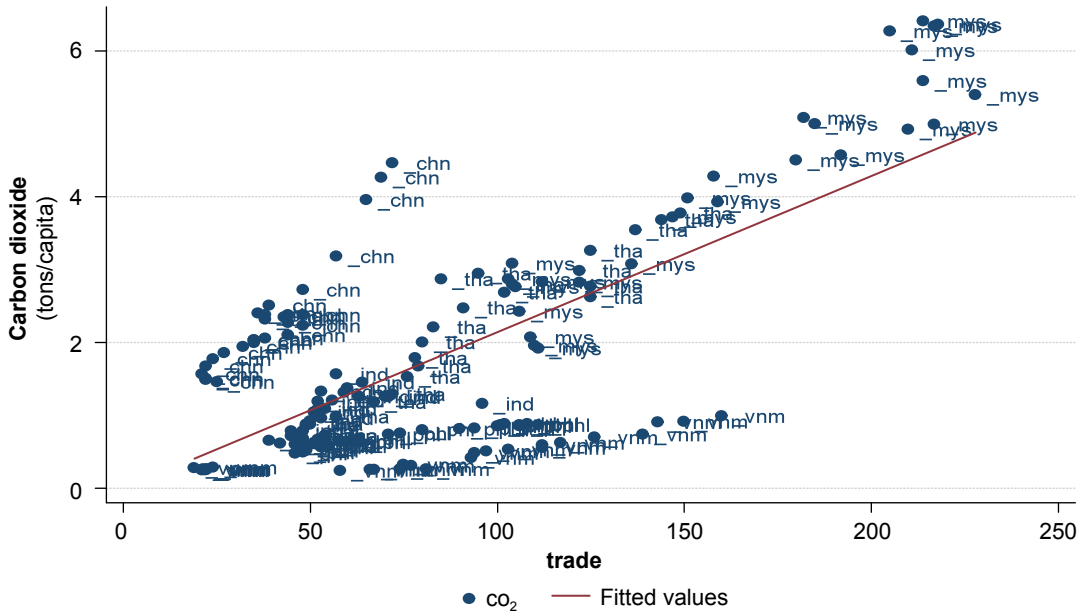
Variable	Mean	Standard Deviation	Minimum	Maximum
Energy consumption ($\times 10^{15}$ British thermal units)	26.50535	23.60734	3.08748	100.6928
Carbon dioxide (tons per capita)	1.778828	1.511246	0.23324	6.40294
Per capita GDP	1,216.451	1,028.053	186	4535
GDP growth rate	6.092407	4.124297	-13	15
Trade intensity	83.16049	50.23773	19	228
Foreign direct investment	0.0244874	0.0223661	-0.0032665	0.1193948
Population density	136.377	62.93917	41.74028	287.5457
Number of countries	6			
Number of years	27			
Number of observations	162			

Figure 1: Relationship between Carbon Dioxide and Per Capita GDP



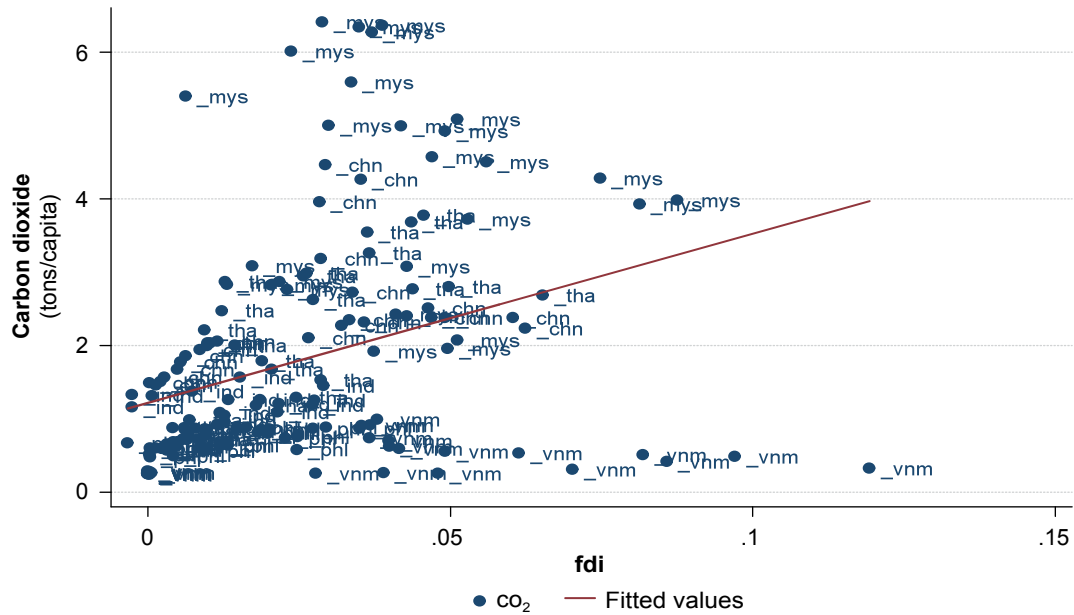
chn = People's Republic of China, co_2 = carbon dioxide, gdppc = gross domestic product per capita, ind = Indonesia, mys = Malaysia, phl = Philippines, tha = Thailand, vnm = Viet Nam

Figure 2: Relationship between Carbon Dioxide and Level of Openness



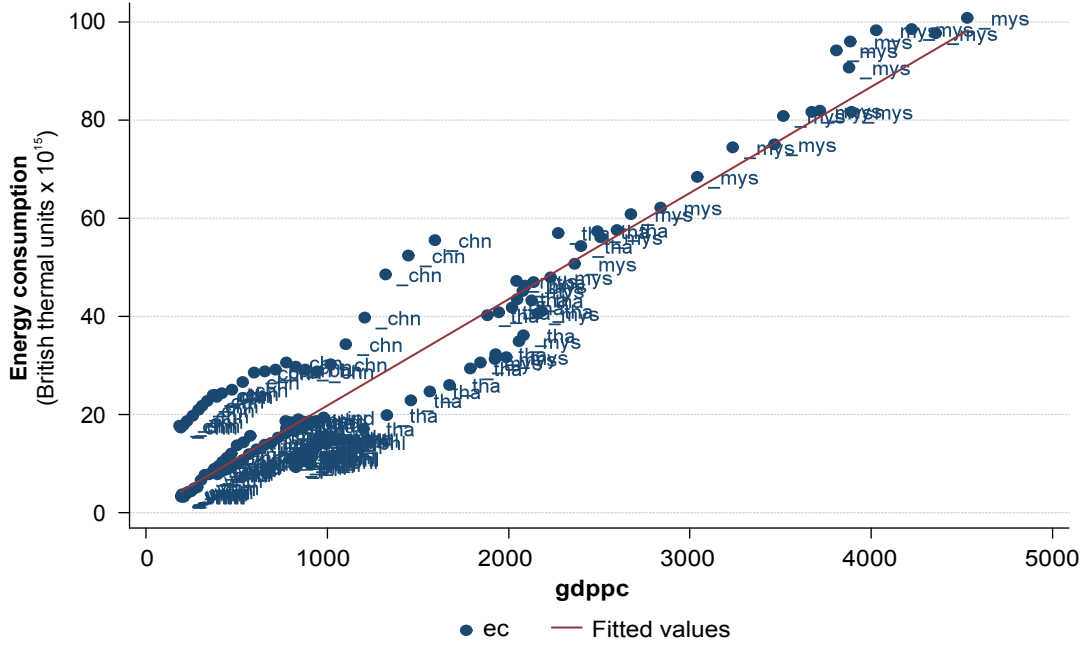
chn = People's Republic of China, CO₂ = carbon dioxide, ind = Indonesia, mys = Malaysia, phl = Philippines, tha = Thailand, vnm = Viet Nam

Figure 3: Relationship between Carbon Dioxide and FDI



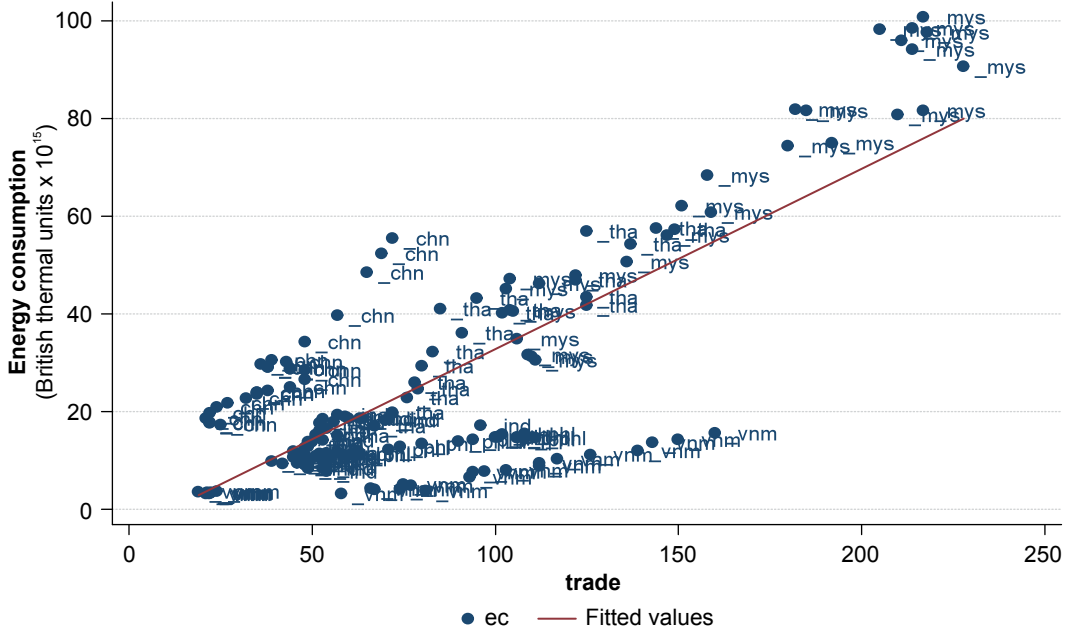
chn = People's Republic of China, CO₂ = carbon dioxide, fdi = foreign direct investment, gdpcc = gross domestic product per capita, ind = Indonesia, mys = Malaysia, phl = Philippines, tha = Thailand, vnm = Viet Nam

Figure 4: Relationship between Energy Consumption and Per Capita GDP

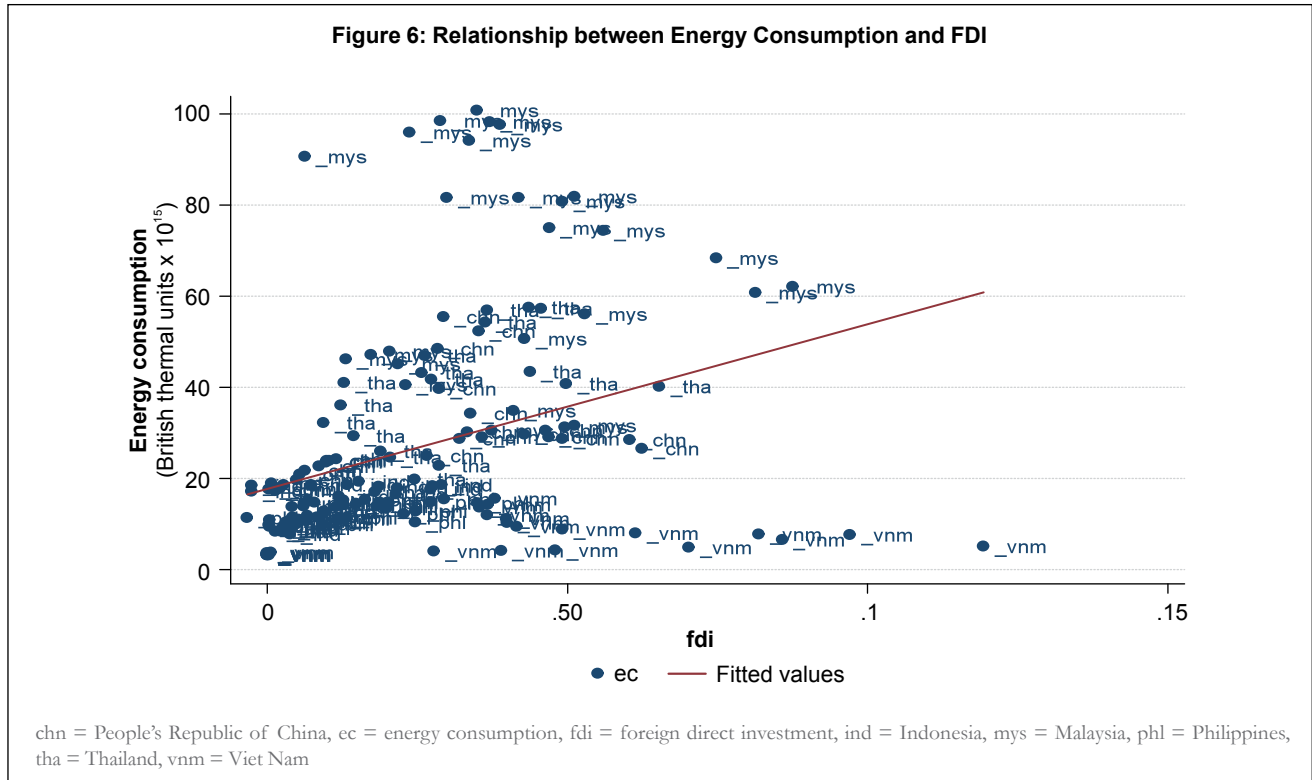


chn = People's Republic of China, ec = energy consumption, gdppc = gross domestic product per capita, ind = Indonesia, mys = Malaysia, phl = Philippines, tha = Thailand, vnm = Viet Nam

Figure 5: Relationship between Energy Consumption and Level of Openness



chn = People's Republic of China, ec = energy consumption, ind = Indonesia, mys = Malaysia, phl = Philippines, tha = Thailand, vnm = Viet Nam



3. Econometric Model

The EKC is a “reduced-form” relationship, in which the level of pollution is estimated as a function of per capita income. The advantage of the reduced-form approach is that it provides the net effect of income per capita on pollution. The econometric specification is based on the following model. Trade and FDI are included in this EKC framework, and the modifier model is estimated for the two environmental variables.

$$Y_{it} = b_0 + b_1x_{it} + b_2x_{it}^2 + az_{it} + \mu_i + \varepsilon_{it}, \quad (1)$$

Where y is the level of pollution; x is per capita income; z is a matrix of explanatory variables, including GDP growth rate, trade intensity or level of openness, FDI, and population density; b_0 is the intercept, μ_i is country-specific effects, fixed or random, and ε_{it} is error term. Subscripts i and t represent country and year, respectively. Data for this model are balanced cross country panel.¹²

¹² On the basis of earlier studies, aspects of a country that either do not change or change very slowly over time are controlled for by including country-specific fixed effects. The random effect is calculated for time-varying omitted variables and stochastic shocks that are common to all countries.

Equation (1) provides a test for various forms of economic and environmental relationships. If $b_1 > 0$ and $b_2 = 0$, it presents a monotonically increasing linear trend, meaning that rising income is accompanied by increasing pollution and energy consumption. If $b_1 < 0$ and $b_2 = 0$, it presents a monotonically decreasing linear trend, indicating the reverse relationship between income and environmental indicators. If $b_1 > 0$ and $b_2 < 0$, it indicates an EKC; if $b_1 > 0$ and $b_2 > 0$, the relationship would be U-shaped.

4. Does the EKC Exist?

Suppose y_{it} be the dependent pollutant variable (carbon dioxide and energy consumption) of country i , $i = 1, \dots, N$ in year t , $t = 1, \dots, T$; x_{it} is the level of real per capita GDP of country i at year t ; and z_{it} is the matrix ($p \times 1$) vector of the other explanatory variables. First, we test the existence of an EKC. Second, we study determinants for pollutants through examining the functional forms and testing the statistical hypothesis. The nonlinear and linear functional forms are checked to find the best fitting functional form for the data. For simplicity, the general parametric model is used:

$$Y_{it} = b_0 + b_1x_{it} + b_2x_{it}^2 + \mu_i + \varepsilon_{it}, \quad (2)$$

Where μ_i , which is country-specific effects, would be fixed or random;¹³ ε_{it} is the error term, and b_0 , b_1 , and b_2 are parameters to be estimated.

The quadratic functional form in X is taken to test for nonlinearity in the relationship between pollutants and per capita GDP, which would indicate the existence of an EKC. The Fisher test was applied to both variables. The results showed that for both carbon dioxide and energy consumption, the null hypothesis of the quadratic term could be accepted. Applying the Fisher test to linearity of the relationship showed the data for carbon dioxide and energy consumption best fitted a linear functional form.

The fixed and random effect specification for carbon dioxide resulted in $b_1 > 0$ and $b_2 < 0$, meeting the necessary condition for the existence of an EKC. However, the data did not fit the nonlinear functional form. The conclusion is that there is no evidence for the existence of an EKC for the two variables; the linear functional form best fits the data.

5. Determinants of Pollutants

Given that the linear functional form best fits the data, a modified version of equation (1) is used:

$$Y_{it} = b_0 + b_1x_{it} + az_{it} + \mu_i + \varepsilon_{it}, \quad (3)$$

where z_{it} is a matrix ($p \times 1$) vector of the other explanatory variables, including the growth rate of GDP, trade intensity, FDI, and population density.

The Fisher test for the null hypothesis of non significant conjoint explanatory variables showed that the explanatory variables were significantly conjoint. Similarly, the Fisher test for the null hypothesis of homogeneity in the presence of heterogeneity showed that the model is heterogeneous; that is, the fixed country effect model is preferred. Finally, the Fisher test for the null hypothesis of random country effect specification against the alternative fixed country effect specification for carbon dioxide showed that the fixed country effect model was preferable; estimates of the variables are given in Table 2. The results indicate that per capita GDP, GDP growth, and trade have significant positive impact on carbon dioxide emissions.

The null hypothesis for energy consumption, however, could be accepted, indicating that the random effect model was preferable for energy consumption. Specifications for the random country effect are reported in Table 3 and show that per capita GDP, GDP growth, and FDI are significant.

The chi-squared Test (X^2) for normality of residuals in the model showed that the error term followed the law of normal distribution.

The Breusch-Pagan test was used for the null hypothesis of homoscedasticity¹⁴ and showed that variables were heteroscedastic. It also showed that the random effects were very significant at the 1% level.

The Fisher and Durbin-Watson tests to look for autocorrelation of errors with AR (1) disturbance showed

Table 2: Estimates of Variables for the Fixed Effect Model for Carbon Dioxide

Variable	Coefficient	t- statistic
Intercept	-0.2110687***	-1.75
Per capita GDP	0.0015687*	29.80
GDP growth rate	-0.0081827***	-1.90
Trade intensity	0.0023365**	2.13
Foreign direct investment	0.1688006	0.19
Population density	-0.0004908	-0.42
F(5,151) ¹	548.32**	
F(5, 151) ²	284.49**	
Hausman χ^2 (4) test	14.19**	
Number of observations	162	

Estimates were made with a cross-country sample of 6 Asian countries for 1980–2006 using regression. The dependent variable is carbon dioxide. The first F test (F^1) is for the significance of conjoint explanatory variables. The second F test (F^2) is for the significance of heterogeneity. The Hausman test is for differentiating between the random effect model and the fixed effect model. Significance level: *1%, **5% and ***10%.

¹³ We estimated the fixed effect models by the fixed effect within regression and random effect by generalized least squares regression.

¹⁴ In statistics, a sequence or a vector of random variables is heteroscedastic, if the random variables have different variances. In contrast, a sequence of random variables is called homoscedastic if it has constant variance. (Wikipedia)

Table 3: Estimation of Variables for the Random Effect Model for Energy Consumption

Variable	Coefficient	z-statistic
Intercept	2.219393*	0.92
Per capita GDP	0.0194815*	13.28
GDP growth rate	0.4979969*	3.35
Trade intensity	0.0185132	0.66
Foreign direct investment	55.38848***	1.78
Population density	-.0391726	-3.00
Wald chi ² (5)	1563.83*	
Number of observations	162	

Estimates were made with a cross-country sample of 6 Asian countries for 1980–2006, using the feasible generalized least squares (FGLS) regression and autocorrelation structure for the correction of heteroscedasticity and autocorrelation. The dependent variable is energy consumption. Significance level: *1% and ***10%.

Table 4: Estimation of Variables for Carbon Dioxide with Correction for Heteroscedasticity and Autocorrelation

Variable	Coefficient	z-statistic
Intercept	0.1836027	1.56
Per capita GDP	0.0012385*	18.77
GDP growth rate	-0.0002581	-0.11
Trade intensity	0.0014568**	2.10
Foreign direct investment	0.5181289	0.88
Population density	-0.0014681**	-2.18
Wald chi ² (5)	551.37*	
Common AR(1) coefficient for all panels	0.8415	
Number of observations	162	

Estimates were made with a cross-country sample of 6 Asian countries for 1980–2006, using the feasible generalized least squares (FGLS) regression and autocorrelation structure for the correction of heteroscedasticity and autocorrelation. The dependent variable is carbon dioxide. Significance level: *1%, **5%.

that there was positive first-order autocorrelation for both carbon dioxide and energy consumption

In summary, the tests for the model of best fit for the data showed that the fixed country effect model with autocorrelation and heteroscedasticity across panels was applicable for carbon dioxide; for energy consumption, the random effect model with autocorrelation and heteroscedasticity exhibited the best fit. We also correct the autocorrelation of errors in these two models. In order to fit the panel data linear model with autocorrelation and heteroscedasticity, we apply the feasible generalized least squares (FGLS) to correct heteroscedasticity and autocorrelation structure. This method allows us to estimate an adjust matrix of variance- covariance of errors in the presence of heteroscedasticity and autocorrelation.

6. Empirical Results

Results for carbon dioxide with correction for heteroscedasticity and autocorrelation (Table 4) indicate

that per capita GDP, trade intensity, and population density are statistically significant, that is, per capita GDP, trade, and population density have positive significant effects on carbon dioxide emissions. GDP growth rate, FDI, and the intercept are not significant. The positive effect of population density, however, is not consistent with our arguments. The choice of population density in urban areas as an explanatory variable would be more appropriate.

Per capita GDP and trade have significant impacts on carbon dioxide. The coefficient of per capita GDP is greater than zero, indicating a monotonically increasing linear trend, which implies that a rise in income is accompanied by an increase in the level of carbon dioxide.

The positive trade coefficient similarly implies an increasing linear trend between the level of openness and carbon dioxide. This supports the pollution heaven hypothesis, implying that poor countries are destinations for polluting industries from rich countries, and that more liberalization in trade would further increase carbon dioxide.

Results for energy consumption with correction for heteroscedasticity and autocorrelation (Table 5) also indicated that per capita GDP, trade, and population density are statistically significant, i.e., there is monotonically increasing linear trend between energy consumption and per capita GDP. This is consistent with arguments that support a linear relation between energy consumption and per capita income (Suri and Chapman, 1998). The negative coefficient of population density is inconsistent with the argument that higher population density would make the environment more polluted.

As in the case of carbon dioxide, the positive coefficient of trade also supports the pollution heaven hypothesis. The evidence indicates that trade liberalization has negative impacts on energy consumption, and an increase in the level of openness would lead to a rise in energy consumption. There is no evidence to support the factor endowment hypothesis. The coefficients of GDP growth and FDI are insignificant and ambiguous in the regression for both carbon dioxide and energy consumption. Some effects may work against each other.

Trade liberalization has resulted in increased environmental pollution in these countries. Therefore, trade openness does not tend to improve the environment through more efficient use of resources and increasing competitiveness. The use of technological advances leading to an increase in efficiency, reduction in the cost of abatement or increases in awareness of pollution issues raise demand for environmental regulations. In the presence of environmental externalities, trade liberalization would harm environmental quality and sustainable development in the countries in this analysis. These countries should take into account the important role of environmental policy.

7. Conclusion and Policy Implications

The results provide a comprehensive picture of possible effects of trade liberalization and per capita income on environment quality. The evidence indicates a monotonically increasing linear relation between per capita income and both carbon dioxide emissions and energy consumption. There is no evidence for the existence of an EKC for either variable. No evidence supports the factor endowment hypothesis that trade liberalization is good for these developing countries. However, there is an evidence to support the pollution heaven hypothesis that considers the link between trade and environment. Some other factors, such as capital-labor endowment, endowment with natural resources, or strictness of implementation of environment policies, could help to provide better insights. The model is also a useful tool to examine linear heteroscedasticity and autocorrelation data for other pollutants, such as water, industrial waste, and toxic gases.

There is an evidence that trade liberalization is harmful for the environment in developing and poor countries. This indicates that economic and environmental policies need to be coordinated to play a greater role in reducing negative effects of trade liberalization on the environment. The application of environmental policies should be consistent with specific characteristics and development stages in each country.

Some global pollution issues, such as carbon dioxide emissions and global warming, require international cooperation to avoid a “free ride problem.” Public awareness and pressure could play an important role in perceptions of environmental change and a strong driving force for policy makers.

Table 5: Estimation of Variables for Energy Consumption with Correction for Heteroscedasticity and Autocorrelation

Variable	Coefficient	z-statistic
Intercept	0.9407799	0.61
Per capita GDP	0.0191888*	21.23
GDP growth rate	-0.0036318	-0.12
Trade intensity	0.0261686*	3.19
Foreign direct investment	5.897469	0.85
Population density	-0.0143953***	-1.67
Wald chi ² (5)	678.56*	
Common AR(1) coefficient for all panels	0.8475	
Number of observations	162	

Estimates were made with a cross-country sample of 6 Asian countries for 1980–2006, using the feasible generalized least squares (FGLS) regression and autocorrelation structure for the correction of heteroscedasticity and autocorrelation. The dependent variable is carbon dioxide. Significance level: *1%, ***10%.

In developing countries, solving environmental problems should not necessarily hurt economic growth (Grossman and Krueger, 1995). However, developing countries lack the capacity to implement sound and strict environmental protection policies. This study suggests that economies that are more open to trade and FDI will face increased pollution levels. The evidence also raises concerns on the “race to the bottom” as developing countries compete for FDI. Developed countries should help developing countries to build their capacity for making and implementing sound environmental policies and for making environmentally friendly methods of production.

Insight into the relationship between trade liberalization and the environment plays a crucial role and is helpful for environmental policy makers in developing countries. At higher levels of incomes, trade liberalization requires stricter environmental regulations and investment in abatement technologies. It is not clear whether developing countries follow a similar pollution-income path as some developed countries. However, there is no doubt that income elasticity of demand for pollution-intensive products falls as incomes increase. The countries in this analysis need to build up and coordinate economic and environmental policies for the protection of the environment to achieve sustainable development.

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ECONOMIC GROWTH AND POVERTY REDUCTION IN THE GREATER MEKONG SUBREGION

Peter Warr¹

Abstract

Over the first decade of this century the Greater Mekong Subregion (GMS) has achieved both impressive growth of output per person and large reductions in absolute poverty incidence. This paper examines the quantitative relationship between these two accomplishments among the GMS members. It also examines whether the sectoral composition of growth, focusing on the agricultural, industrial, and services sectors, is relevant for the rate at which poverty incidence declines for a given overall rate of economic growth.

The results confirm that poverty reduction in the GMS is strongly related to growth of real GDP per person. The sectoral composition of this growth affects the rate of poverty reduction in so far as it affects the growth of services relative to the rest of the economy. Structural changes that promote the growth of services relative to other sectors are conducive to poverty reduction, given the overall rate of GDP growth.

Global economic imbalances developing over the first decade of the 21st century will require major adjustments. Asia has run large current account surpluses, with the United States and Europe running corresponding deficits. It is generally recognized that continuation of this cumulative imbalance is unsustainable. Major adjustment is inevitable and it will mean a switch of final demand within Asia from export dependence toward domestic sources of demand. On the supply side, this will mean a switch of output from production of tradable goods, such as agricultural and industrial goods, toward nontradables, such as services. The rate of poverty reduction in the GMS may therefore increase over the coming decade. If past overall rates of GDP growth per person can be maintained, growth will become more poverty-reducing, given the structural changes that seem to be consistent with global economic restructuring.

1. Introduction

Despite impressive economic progress in recent decades, the Greater Mekong Subregion (GMS) remains poor relative to the rest of the world, and poverty reduction is consequently an urgent priority for international attention. This paper focuses on the seven GMS entities—Cambodia; the Peoples Republic of China (PRC), specifically Yunnan Province and Guangxi Zhuang Autonomous Region; the Lao People's Democratic Republic (Lao PDR); Myanmar; Thailand; and Viet Nam. The primary focus is on 2000–2010. Both economic growth and reduction in poverty incidence were enjoyed by all the GMS members over this period, but the rates at which these two phenomena occurred varied both over time and across the member countries. After documenting these events the study asks two statistical questions.

(i) To what extent was the rate of poverty reduction determined by the rate of economic growth per person?

(ii) Did the rate of poverty reduction depend on the sectoral composition of the growth as well as the overall rate?

The answers to these questions are important for the rate at which further poverty reduction might be expected over the coming decade, ending in 2020. It is argued in this paper that significant changes in the sectoral composition of growth can be expected. It is thus important to ask what this might imply for poverty reduction.

Section 2 of the paper reviews the growth of aggregate output and its sectoral composition in each of the seven GMS entities during 2000 to 2010. Section 3 performs a similar exercise for poverty reduction. This discussion makes it possible to compare the seven GMS entities in terms of not just the rate of economic growth, but also the poverty-reducing power of that growth. Section 4 looks in detail at the statistical questions posed above. Section 5 concludes on the prospects for continued growth and poverty reduction in the GMS.

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2. Economic Growth

In 2010, the levels of GDP per person among the seven GMS entities varied widely, from \$5,000 in Thailand to less than \$1,000 in Cambodia, the Lao PDR, and Myanmar (Table 1). The Asian financial crisis (AFC) of 1997-98 affected all the GMS entities to some extent, but in widely varying degrees. Thailand was most affected, Guangxi and Yunnan the least. In the countries most affected, restoration of economic growth became a policy priority. Thailand's growth resumed, but remained sluggish throughout 2000 to 2010 and Thailand's economic performance was again battered by the global financial crisis (GFC) at the end of 2010. The level of private investment did not recover to its pre-AFC share of GDP. Among the poorer countries, Cambodia, the Lao PDR, and Viet Nam grew well throughout this period.

A lesson from reflection on the period of economic boom that preceded the AFC was that the quality of growth

is important and not just the rate. But what is "quality" growth? One criterion for determining the quality of growth, though certainly not the only one, is its effects on the poor. What kinds of growth are most (and least) beneficial for the poor? Much of the development economics literature has dealt with the manner in which the distribution of income is affected by the rate and composition of economic growth. How do relative inequality, on the one hand, and absolute poverty, on the other, change with economic growth and how do these effects depend on the characteristics of that growth, such as its sectoral composition? This paper attempts to explore these issues in the context of the GMS. It begins with data on the rates of economic growth in each of the GMS entities (Table 1 and Figures 1.1–1.7).

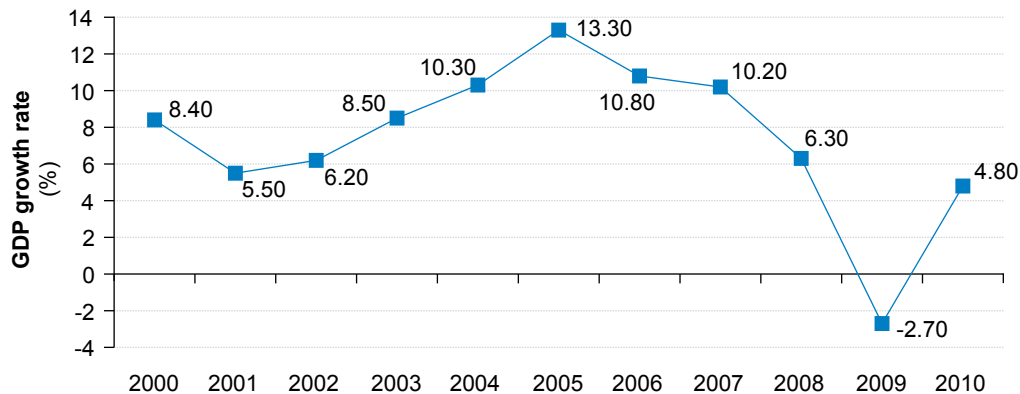
In the case of Myanmar, the level of GDP per person and its growth rate are contentious. The official data for Myanmar and various alternative estimates of its growth rate are described in the Appendix. The Myanmar data shown in Table 1 are based on ADB estimates.

Table 1: Economic Output and its Growth in the GMS

GMS Entity	Population	Population Growth Rate	GDP per Capita	Average Annual Growth Rate of Real	
	(million)			(current \$)	GDP per Capita (%)
	(2010)	(2010)	(2010)	value	(period)
Cambodia	14.30	1.5	788.0	10.97	(2002–2010)
PRC					
Guangxi	51.59	0.8	3050.0	10.77	(2000–2009)
Yunnan	45.97	0.7	2326.3	8.88	(2000–2009)
Lao PDR	6.23	1.7	984.2	6.87	(2003–2008)
Myanmar	59.78	1.1	702.0	3.60	(2005–2010)
Thailand	67.31	0.6	4991.5	3.59	(2000–2010)
Viet Nam	86.48	1.1	1172.0	5.56	(2000–2010)

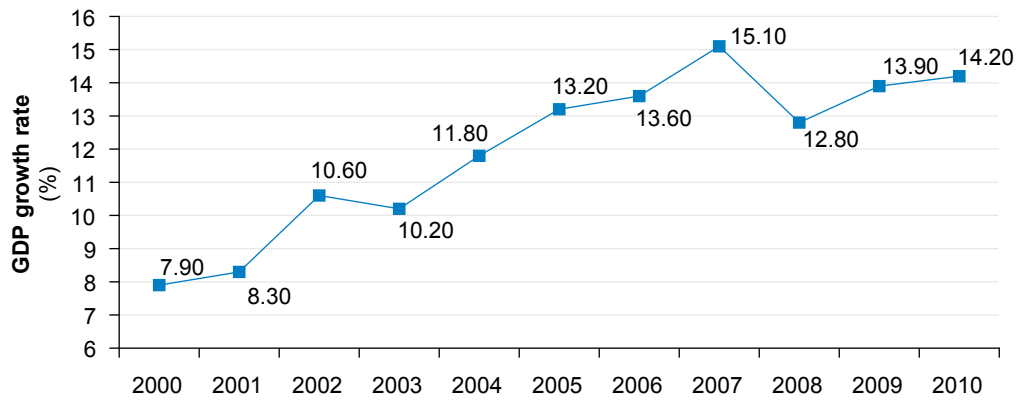
Note: Myanmar's growth data are discussed in further detail in the Appendix. Data for Myanmar shown above are from ADB *Outlook 2006*, 2010, and 2011. Sources: Council for the Development of Cambodia (2011). *Why Invest in Cambodia?*; *Statistical Communique on National Economic and Social Development of Guangxi*; *Statistical Communique on National Economic and Social Development of Yunnan*.

Figure 1: Cambodia: Growth of Real GDP per Person, 2000–2010



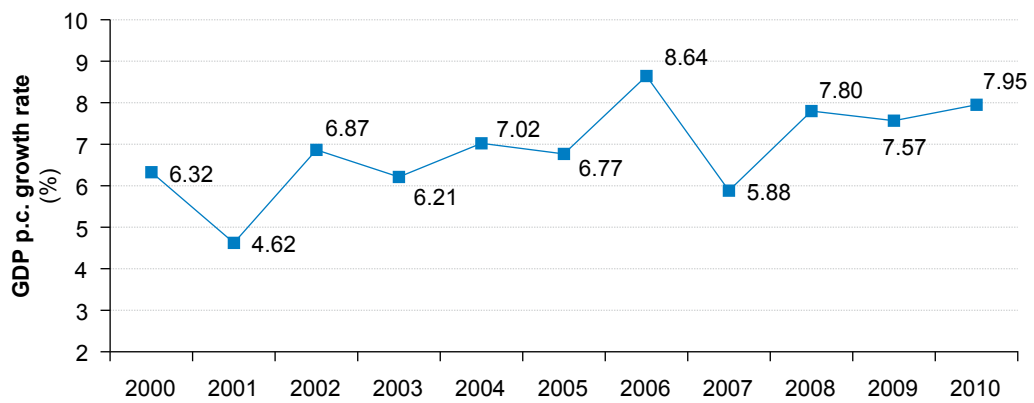
Source: See Table 1.

Figure 2: Guangxi: Growth of Real GDP per Person, 2000–2010



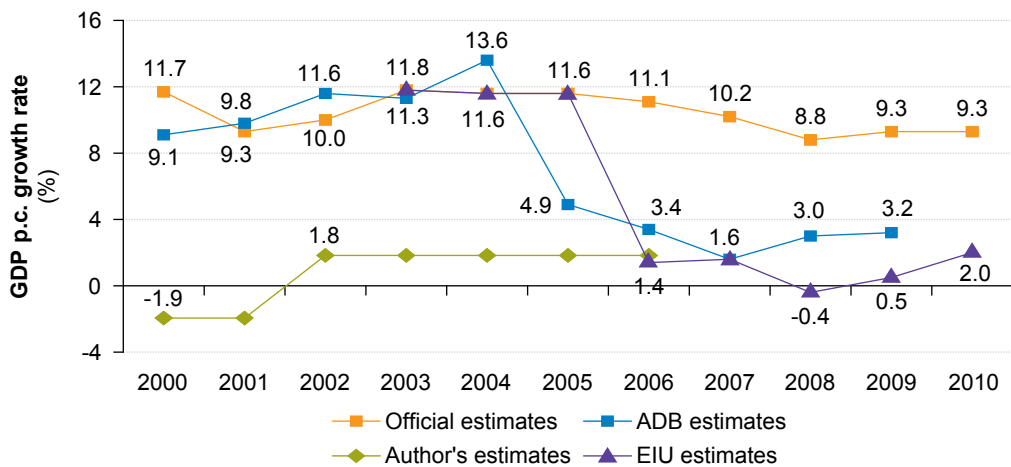
Source: See Table 1.

Figure 3: The Lao PDR: Growth of Real GDP per Person, 2000–2010



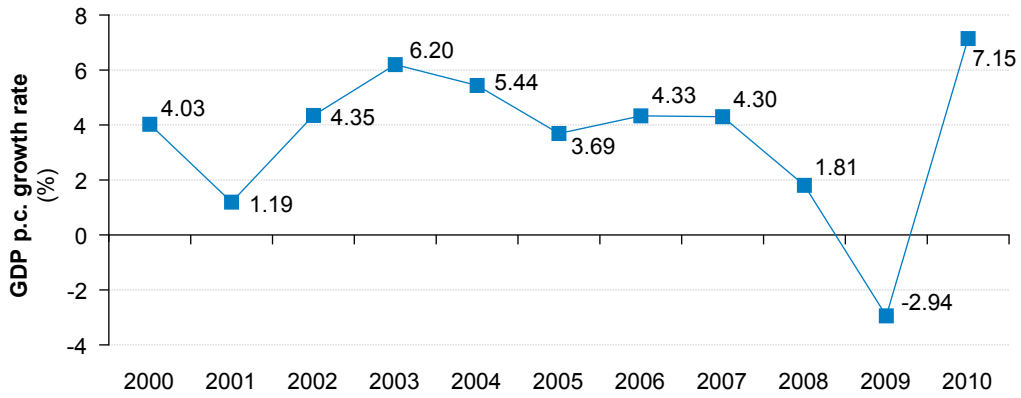
Source: See Table 1.

Figure 4: Myanmar: Growth of Real GDP per Person, 2000–2010



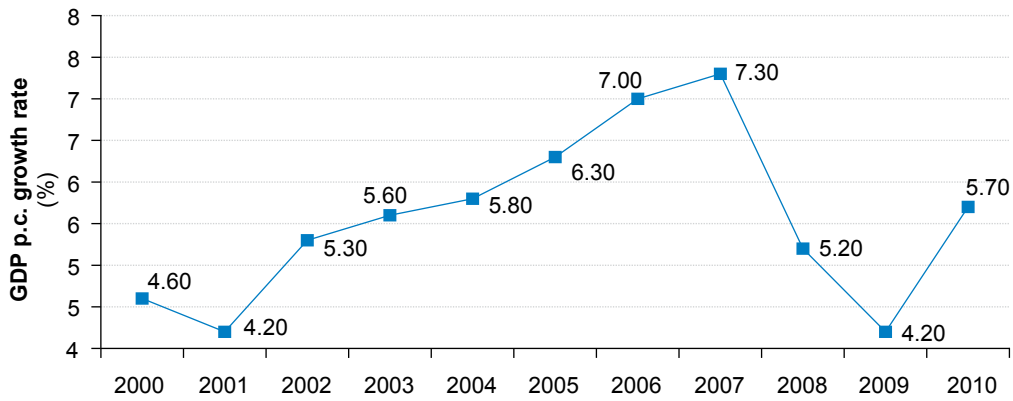
Source: See Table 1.

Figure 5: Thailand: Growth of Real GDP per Person, 2000–2010



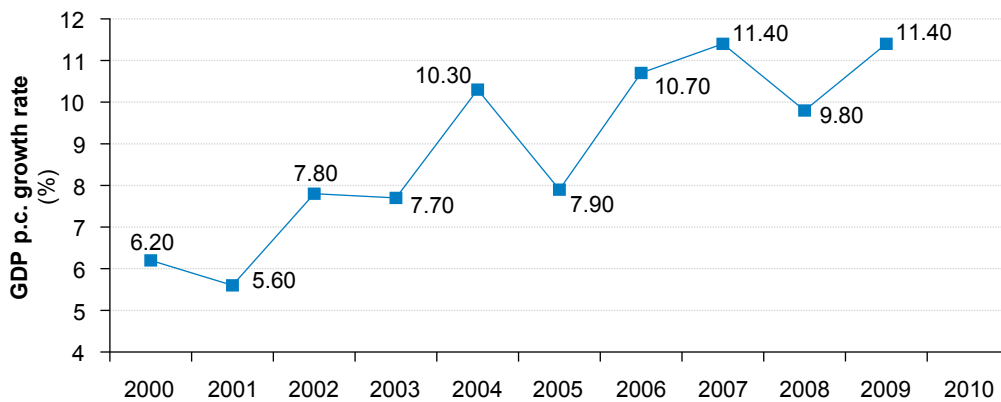
Source: See Table 1.

Figure 6: Viet Nam: Growth of Real GDP per Person, 2000–2010



Source: See Table 1.

Figure 7: Yunnan: Growth of Real GDP per Person, 2000–2010



Source: See Table 1.

3. Poverty reduction

3.1. Poverty Incidence in the GMS

Available data on poverty incidence in the seven GMS entities are summarized in Table 2 and in Figures 8 to 14. In the figures, the data are presented, where available (including all GMS entities except Guangxi and Yunnan), as aggregate poverty incidence and its rural and urban components. The poverty lines underlying these

data are the national poverty lines for the GMS entities themselves, and these poverty lines are held constant in real purchasing power over time. In some cases, the official data involve changes over time in the real purchasing power of the poverty line, but do not provide adjustments for the effects of these changes in the poverty line. This renders the poverty incidence data noncomparable over time and observations subject to this problem have been omitted from the data presented below.

Table 2: Poverty Incidence and Poverty Reduction in the GMS

GMS Entity	Level of Total Poverty Incidence		Levels of Rural and Urban Poverty Incidence			Average Annual Rate of Total Poverty Reduction	
	Value (%)	(year)	Rural (%)	Urban (%)	(year)	Value (%)	(period)
	Cambodia	30.1	(2007)	34.5	11.8	(2007)	1.55
PRC							
Guangxi	41.7	(2007)	N.A.	N.A.	N.A.	0.43	(2001–2007)
Yunnan	7.0	(2006)	N.A.	N.A.	N.A.	0.70	(2002–2006)
Lao PDR	27.6	(2008)	31.7	17.4	(2008)	1.18	(2003–2008)
Myanmar	25.6	(2010)	29.2	15.7	(2010)	1.30	(2005–2010)
Thailand	8.1	(2009)	10.4	3.0	(2009)	1.43	(2000–2009)
Viet Nam	14.2	(2010)	17.4	6.9	(2010)	0.65	(2004–2010)

Note: N.A. means not available.

Sources: ADB Outlook, various years; United Nations, Millennium Development Goals Indicators (<http://unstats.un.org/unsd/mdg/Data.aspx>); Royal Government of Cambodia (2010), *Achieving Cambodia's Millennium Development Goals*; Government of Viet Nam, *Viet Nam Statistical Yearbook 2010*. Data on Myanmar are from UNDP (2010), *Integrated Household Living Condition Survey in Myanmar (2009–10)*.

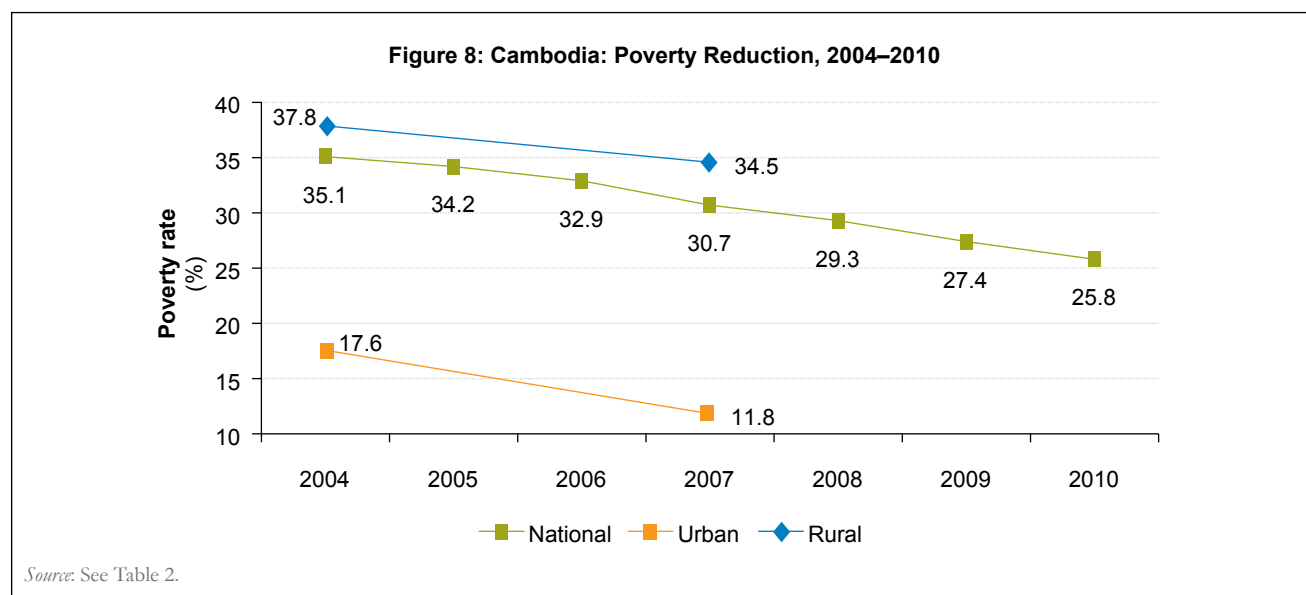
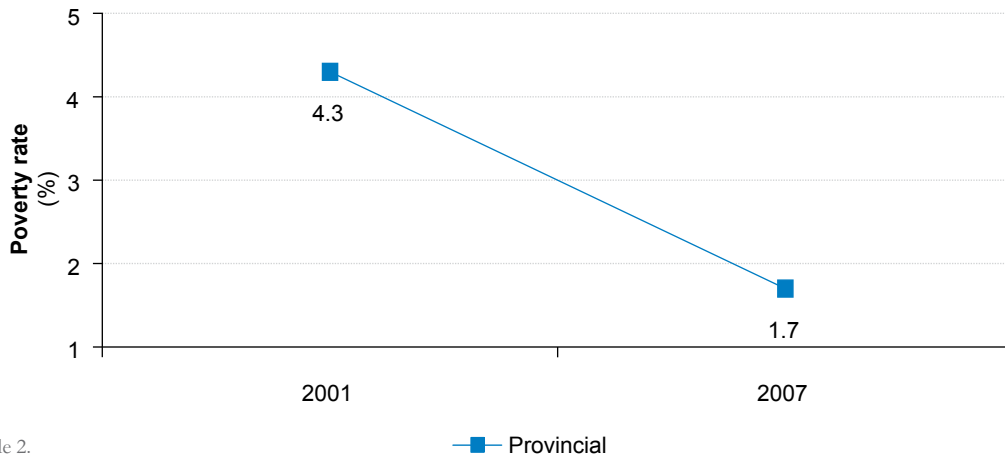
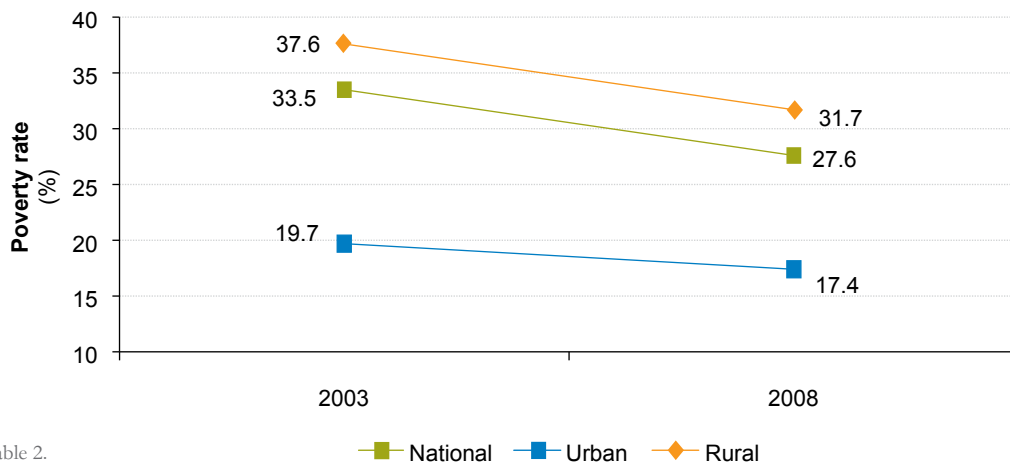


Figure 9: Guangxi: Poverty Reduction, 2001–2007



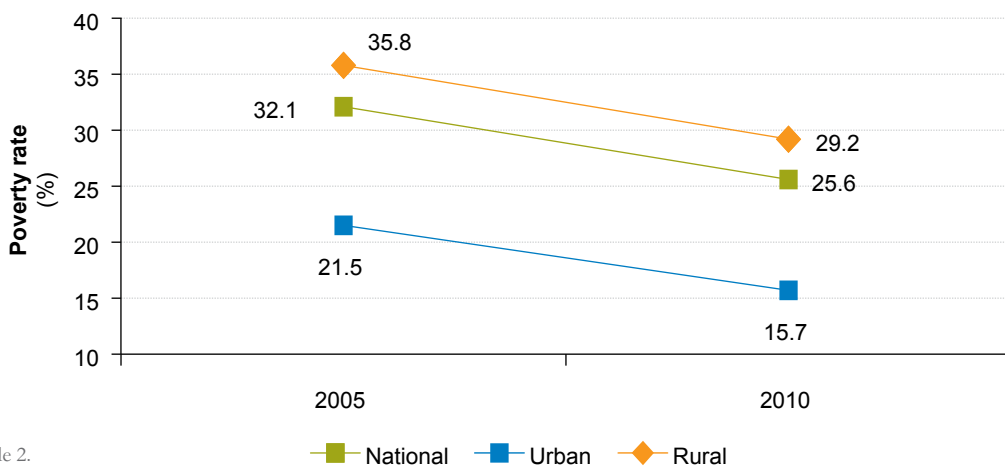
Source: See Table 2.

Figure 10: The Lao PDR: Poverty Reduction, 2004–2010

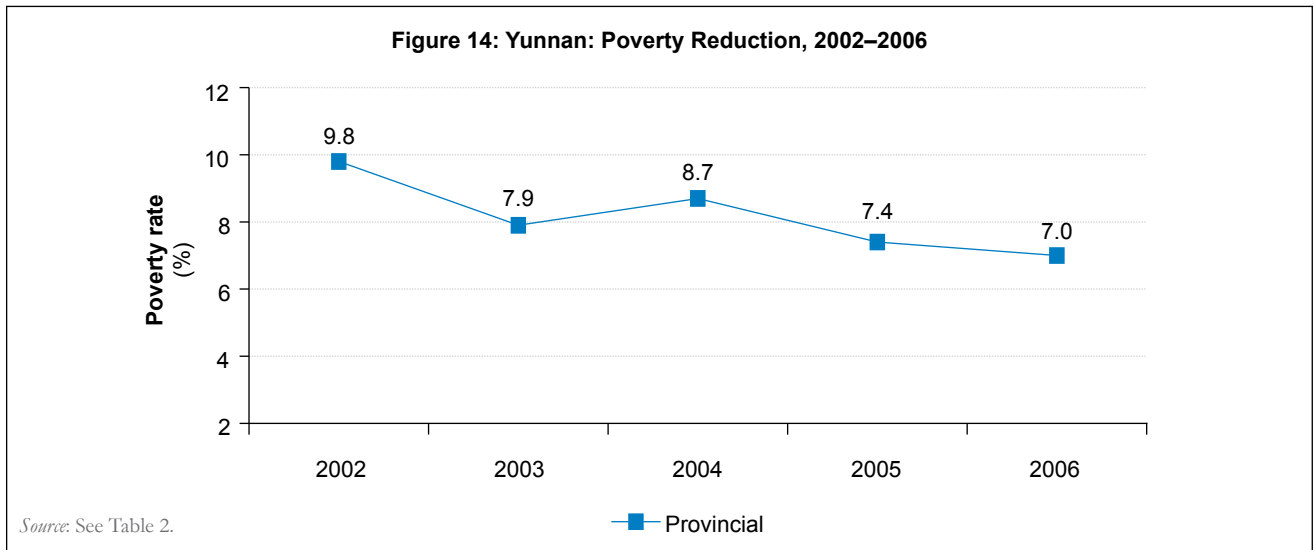
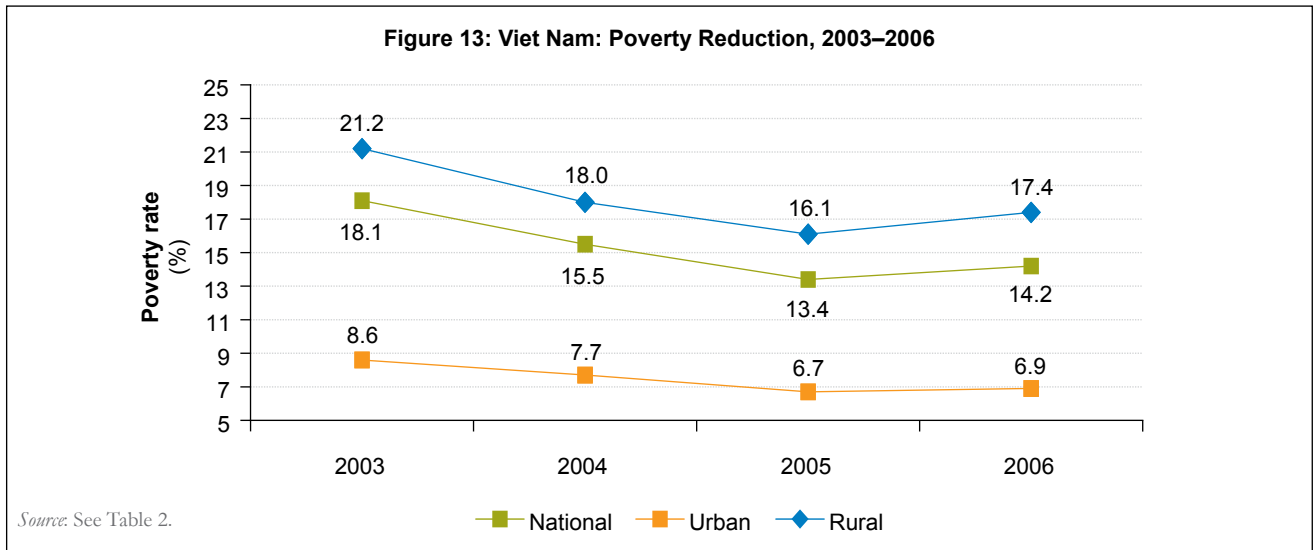
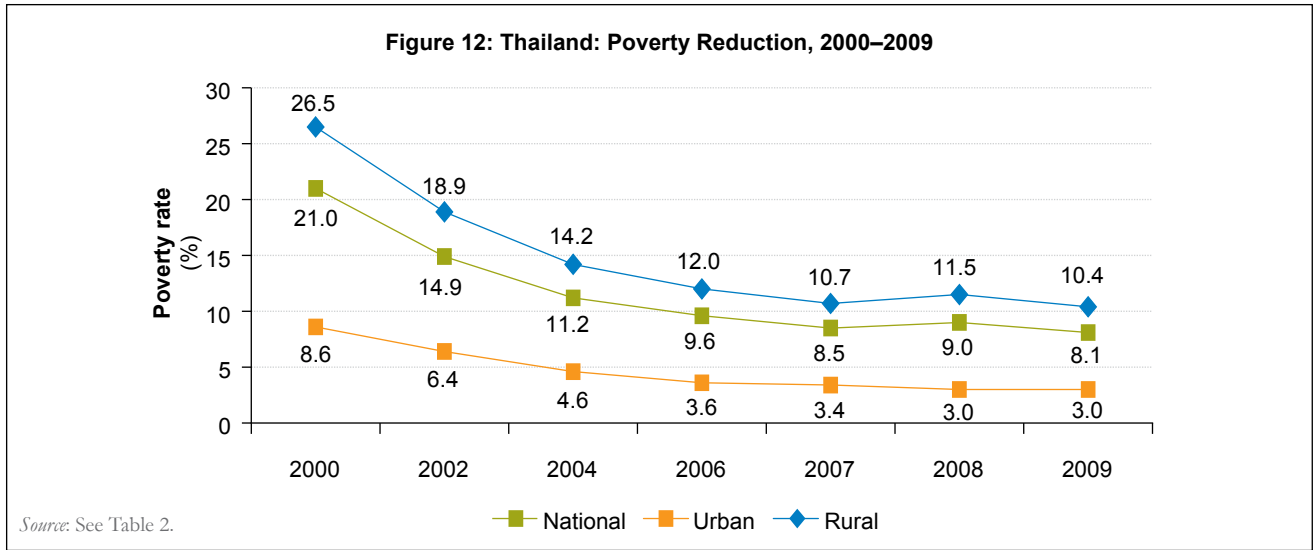


Source: See Table 2.

Figure 11: Myanmar: Poverty Reduction, 2005–2010



Source: See Table 2.



3.2. Poverty Reduction per Unit of Economic Growth

To what extent does economic growth actually reduce poverty? The most direct way of answering this question is simply to relate the annual rate of reduction in poverty shown in Table 2 to the rate of real economic growth per person over the same period shown in Table 1 (second to last columns in each case). The results are shown in the first column of Table 3. This is the average annual reduction in poverty incidence (dP) divided by the average rate of real GDP growth per person. This ratio varied widely across the seven GMS members.

Table 3 also shows, in the last column, the familiar growth elasticity of poverty, which is the proportional change in poverty incidence (dP/P) divided by the rate of GDP growth per person. While this measure is frequently reported, it is potentially misleading. As the level of absolute poverty incidence declines over time due to economic growth and other factors, small absolute reductions in poverty incidence can result in very large proportional reductions in the value of the poverty measure. This occurs merely because the base of the calculation—the level of poverty incidence—is low, wrongly suggesting that growth is more effective in relieving poverty in richer countries (such as Thailand) than in poorer ones (such as Myanmar). Despite this, the ranking of the seven GMS entities according to the two measures is similar.

3.3. Total, Rural, and Urban Poverty Reduction

Data on total, rural, and urban poverty incidence can be used to derive a useful decomposition indicating the degree to which reduction in total poverty incidence is due to poverty reduction in rural areas, urban areas, or the migration of people between the two. We review first the

quantitative relationship between total, rural, and urban poverty incidence and then turn to the manner in which each of these measures is affected by economic growth. Changes in total poverty incidence may be decomposed as follows: N , N^R and N^U are the total, rural, and urban populations, respectively, where $N = N^R + N^U$, $\alpha^R = N^R / N$ and $\alpha^U = N^U / N$ are the rural and urban shares of the total population, respectively, where $\alpha^R + \alpha^U = 1$. The total number of people in poverty is given by $N_p = N_p^R + N_p^U$, where N_p^R and N_p^U denote the number in poverty in rural and urban areas, respectively. Total poverty incidence is given by

$$P = N_p / N = (N_p^R + N_p^U) / N = \alpha^R P^R + \alpha^U P^U, \quad (1)$$

where $P^R = N_p^R / N^R$ denotes the proportion of the rural population that is in poverty and $P^U = N_p^U / N^U$ the corresponding incidence of poverty in urban areas.

Differentiating (1) totally provides a key relationship:

$$dP = \alpha^R dP^R + \alpha^U dP^U + (P^R - P^U) d\alpha^R. \quad (2)$$

From (2), the change in total poverty incidence may be decomposed into three parts: (i) the change in rural poverty incidence, weighted by the rural population share; (ii) the change in urban poverty incidence, weighted by the urban population share; and (iii) the movement of people from rural to urban areas, weighted by the difference in poverty incidence between these two areas.

The last of these terms is described by Anand and Kanbur (1985) as the "Kuznets effect". As the population relocates from rural to urban areas, a change in total poverty incidence will occur even at constant levels of rural and urban poverty incidence, provided that the levels of poverty incidence in these two sectors are different. In growing economies, we expect to find that the rural population share is falling ($d\alpha^R < 0$) and that the incidence of poverty in rural areas typically exceeds that in urban areas ($(P^R - P^U) > 0$). Thus, the expected sign of

Table 3: The Poverty-Reducing Quality of Growth in the GMS

GMS Entity	Poverty Reduction per Unit of Real GDP Growth per Capita ^a	Poverty Elasticity of Growth ^b
Cambodia	0.14	0.46
PRC		
Guangxi	0.04	0.10
Yunnan	0.08	1.14
Lao PDR	0.17	0.62
Myanmar	0.36	1.41
Thailand	0.40	4.94
Viet Nam	0.17	1.20

Notes: a calculated as $dP/(y-n)$, where dP is the average annual rate of absolute poverty reduction (expressed as a percentage of total population), y is the average annual growth rate of real GDP and n is the average annual growth rate of population.

b calculated as $(dP/P)/(y-n)$, where the value of P is the value shown in the first column of Table 2.

Source: author's calculations from the second to last columns of Tables 1 and 2.

Table 4: Decomposition of Average Annual Changes in Poverty Incidence, 2000–2010

	Cambodia	Lao PDR	Myanmar	Thailand	Viet Nam
Actual					
Total ^a	-1.467	-1.180	-1.300	-1.433	-0.650
Urban ^b	-0.324	-0.132	-0.309	-0.193	-0.086
Rural ^c	-0.916	-0.842	-0.968	-1.233	-0.440
Migration ^d	-0.227	-0.206	-0.023	-0.007	-0.123
Normalized (total =100)					
Total ^a	100	100	100	100	100
Urban ^b	22.07	11.18	23.79	13.49	13.28
Rural ^c	62.44	71.33	74.46	86.02	67.74
Migration ^d	15.49	17.49	1.74	0.49	18.97

Notes: Total change = Urban change + Rural change + Migration

a Mean annual value of dP , the y-o-y change in national poverty incidence

b Mean annual value of $a^U dP^U$, the y-o-y population share-weighted change in urban poverty incidence

c Mean annual value of $a^R dP^R$, the y-o-y population share-weighted change in rural poverty incidence

d Mean annual value of $(P^R - P^U) da^R$, the y-o-y migration-induced change in poverty incidence

Source: author's calculations using data described in the text.

$(P^R - P^U) da^R$ is negative. How important the Kuznets effect is as a determinant of overall poverty reduction is, of course, an empirical matter.

Table 4 shows the results of this decomposition. Because data on rural and urban poverty incidence were unavailable for Guangxi and Yunnan, the decomposition is possible only for the other five GMS entities. All results shown in this table are evaluated at the mean values of the data set. For example, the mean annual change in the aggregate level of poverty incidence for Cambodia was -1.467%.

Equation (2), above, is an identity and must apply at all points in the data set. It must therefore apply at the means of the data. The equation therefore shows that the mean change in poverty incidence can be decomposed into components capturing mean average poverty reduction in urban areas, mean average poverty reduction in rural areas, and the average movement of population between the two.

The lower half of the table normalizes the decomposition by dividing all values by this mean change in aggregate poverty (-1.467 for Cambodia, for example) and multiplying by 100. For Cambodia reductions in rural poverty accounted for 62% of the overall reduction in poverty over the period shown in Table 2, reduced urban poverty accounted for 22%, and migration accounted for 15%. Migration effects were more important for Viet Nam and the Lao PDR and least important for Thailand and Myanmar. For all five of these GMS entities, reductions in rural poverty accounted for more than 60% of the total reduction in poverty that occurred and for all except Cambodia the proportion is more than two thirds.

The above calculations are, of course, descriptions of the data. We now turn to the question of what caused these observed changes in poverty incidence to occur.

4. The Growth-Poverty Nexus

4.1. Conceptual Background

Poverty incidence and its change over time depend on many factors, of which economic variables are at most only part of the story. Among the economic variables, many issues are relevant aside from simply the overall rate of growth. Changes in commodity prices play a role, along with tax and public expenditure policies. The sectoral composition of growth may also be important.

As incomes rise, agriculture tends to contract as a share of GDP, as resources move to the manufacturing and services sectors (Martin and Warr, 1994). Economic policies, including public infrastructure investments, foreign investment policies, trade policies, and industrial policies, also influence the sectoral composition of growth. If poverty reduction is a priority, as the pronouncements of most governments suggest, then the way in which economic policies may indirectly affect poverty incidence is important. The sectoral composition of growth may play a role, but casual perusal of the data suggests that the overall rate of growth may be the dominant part of the story. To what extent does the overall rate of growth matter, and to what extent is its sectoral composition also important in determining its effect on poverty incidence?

The literature has emphasized the sectoral composition of growth in relation to its poverty implications, but this emphasis has been based primarily on a priori theorizing, rather than evidence. The obvious argument is that in most poor countries a majority of the poor lives in rural areas and employed in agriculture. From this it has seemed probable that growth of agriculture is more important for poverty reduction than growth of industry or services. But this conclusion does not necessarily follow. Sectoral growth rates may not be independent. Expansion of capacity in one sector—say, food processing—may stimulate output growth elsewhere—say, fruit production. More importantly, people are potentially mobile; given sufficient time, even poor people can presumably move to whichever sector is generating the growth. Rural poverty may therefore be reduced by urban-based growth, drawing the poor away from rural areas (Fields, 1980; Chenery and Syrquin, 1986). When sectoral interdependence and intersectoral factor mobility are taken into account, it is not obvious whether the sectoral composition of growth is important for poverty reduction or not.

Even if labor were fully and instantaneously mobile, poverty incidence could still be affected by the sectoral composition of growth. To a first order of approximation, the level of absolute poverty presumably depends on the demand for the factors of production owned by the poor, especially unskilled labor and, to a lesser extent, agricultural land. Growth in different sectors has differential effects on the demands for these factors, depending on these sectors' factor intensities, and may have different effects on poverty, inequality, or both. Finally, the distinction rural/urban is not synonymous with the distinction agriculture/non-agriculture. Much agricultural production may occur in full or part-time farming on the fringes of urban areas and much industrial and services activity may occur in rural areas.

Only careful quantitative analysis can resolve questions of this kind, but the limited availability of data that can support statistical analysis has been an impediment to the systematic study of poverty incidence and its determinants. Some recent studies have attempted to explore the relationships involved by analyzing cross-sectional data sets across countries, or across regions or households for individual countries, while others have attempted to assemble long-term time-series data sets on poverty incidence for individual countries. The time-series approach is generally preferable, in that it makes possible a direct study of the determinants of changes in poverty at an aggregate level.

Unfortunately, in most developing countries, the consumer expenditure surveys on which studies of poverty incidence must be based are conducted only intermittently. Data are thus normally available at most only with intervals of some years between observations. This is true of all the GMS entities. The data are most extensive for Thailand, but even when all national time-series observations on poverty incidence are assembled for Thailand, the number of observations is only 7. For Viet Nam the number is only 4. In this study, data for the 1990s have been drawn on, where available, to supplement the number of data points available for statistical analysis. The number of observations is still insufficient to sustain formal statistical analysis for any one of these countries, but when all GMS entities are pooled, the total number of observations is adequate. The present study thus attempts to pool the data for the seven GMS entities. The economic growth data for Myanmar are the subject of considerable debate. The empirical exercise uses ADB estimates for Myanmar, as discussed in the Appendix.

Since the meaning of the poverty lines is different in each of the countries and also since the structure of the economies is different, we should not expect that the same quantitative relationship between poverty incidence and aggregate growth will necessarily exist in all GMS entities. In the present study, intercept dummy variables were used for 6 of the 7 GMS entities. These dummy variables were then dropped when they proved to be highly insignificant in order to preserve statistical degrees of freedom and thereby improve the quality of the estimation process. Each interval between the data points indicated in Table 2 and similar data for the 1990s are used to construct the values of the dependent variables described below, with the calculated value divided by the number of years corresponding to that time interval, giving an annual rate of change for the variable concerned. These annualized rates of change then become the variables used in the regression analysis described below.

4.2. Poverty and Aggregate Growth

We now turn to the manner in which poverty incidence is affected by economic growth and, for simplicity, hypothesize initially that the total number of households in poverty, N_p , depends on the aggregate level of real income, Y , and the size of the population, N . Thus

$$N_p = \varphi(Y, N). \quad (3)$$

The incidence of poverty is defined as

$$P = N_p / N = \varphi(Y, N) / N. \quad (4)$$

Totally differentiating this equation,

$$dP = (\varphi_Y Y/N)y + (\varphi_N - \varphi/N)n, \quad (5)$$

where lower case Roman letters represent the proportional changes of variables represented in levels by upper case Roman letters. Thus $y = dY/Y$ and $n = dN/N$ are the growth rates of aggregate real income and of population, respectively. In the special case where the function $\varphi(\cdot)$ is homogeneous of degree one in Y and N , (3) may be written $N_p = \varphi_Y Y + \varphi_N N$ and (5) reduces to $dP = (\varphi_Y Y/N)(y - n)$.

In this case, we estimate relationships of the kind

$$dP = a + b(y - n) = a + b\tilde{y}, \quad (6)$$

where $\tilde{y} = y - n$ denotes the rate of real GDP growth per person, and test whether the coefficient b is significantly different from zero.

4.3. Poverty and Sectoral Growth

Whether the sectoral composition of economic growth affects poverty reduction can be investigated as follows. The level of real GDP per person is given by

$$\tilde{Y} = \tilde{Y}_a + \tilde{Y}_i + \tilde{Y}_s, \quad (7)$$

where \tilde{Y}_a , \tilde{Y}_i , and \tilde{Y}_s denote value-added (contribution to GDP) per person in the total population, measured at constant prices, in agriculture, industry, and services,

respectively. The overall real rate of growth per person can be decomposed into its sectoral components from

$$\tilde{y} = H_a \tilde{y}_a + H_i \tilde{y}_i + H_s \tilde{y}_s, \quad (8)$$

where $H_k = Y_k / Y$, $k = (a, i, s)$, denotes the share of sector k in GDP. By estimating the equation

$$dP = a + b_a H_a \tilde{y}_a + b_i H_i \tilde{y}_i + b_s H_s \tilde{y}_s, \quad (9)$$

and testing whether $b_a = b_i = b_s$, we may test directly whether the sectoral composition of growth affects the rate of poverty reduction.

5. Estimation results

5.1. Poverty and Aggregate Growth

Equation (6) was estimated as described above and the results are summarized in Table 5. Dummy variables were estimated for all countries except Thailand. All country dummy variables were insignificant except Guangxi and Yunnan. The insignificant dummy variables were all dropped and the equation was re-estimated. The estimated relationship is significant and the Ramsey RESET test suggests that it has no omitted variables, although with low degrees of freedom, this test is relatively weak. The Breusch-Pagan/Cook-Weisberg test for heteroskedasticity indicates the absence of heteroskedasticity. Nevertheless, the adjusted R-squared of 0.23 is low and suggests that other variables may also be contributing to the behavior of the dependent variable.

Table 5: Regression Results – Poverty and Aggregate Growth

Variable	Change in Total Poverty (dP)				
	Coefficient	Standard error	t-statistic	$p > t $	95% confidence interval
Constant (a)	-0.505	0.531	-0.957	0.352	-1.607 0.597
GDP growth per capita (b)	-0.274	0.092	-2.960	0.007	-0.467 -0.082
Intercept dummy Guangxi	2.991	1.595	1.885	0.074	-0.316 6.299
Intercept dummy Yunnan	2.098	1.132	1.856	0.077	-0.250 4.447
Number of observations	26				
F (3, 22)	3.502				
Prob >F	0.032				
R-squared	0.322				
Adjusted R-squared	0.230				

Source: author's calculations using data described in the text.

Table 6: Regression Results – Poverty and Sectoral Growth

Variable	Change in Total Poverty Incidence (dP)				
	Coefficient	Standard error	t-statistic	$p > t $	95% Confidence Interval
Constant (a)	-1.218	0.861	-1.414	0.178	-3.054 0.617
Growth of agriculture GDP per capita (b_a)	0.996	1.053	0.954	0.359	-1.248 3.241
Growth of industry GDP per capita (b_i)	0.356	0.571	0.676	0.511	-0.832 1.602
Growth of services GDP per capita (b_s)	-0.672	0.320	-2.101	0.053	-1.354 0.010
Number of observations	26				
F (6, 22)	1.88				
Prob >F	0.149				
R-squared	0.429				
Adjusted R-squared	0.202				

Source: author's calculations using data described in the text.

5.2. Poverty and Sectoral Growth

Equation (9) is now estimated to capture the behavior of the dependent variable when the sectoral composition of growth appears on the right hand side of the equation. The results suffer from the low number of observations, but support the notion that growth of services in the GMS is more poverty-reducing than growth of either agriculture or industry. The expected result that agricultural growth is the strongest contributor to poverty reduction was not obtained. Instead, services growth was the only component of GDP that was significantly associated with poverty reduction (at the 10% level of significance). The hypothesis that the coefficients on share-weighted sectoral growth rates per capita were all equal ($b_a = b_i = b_s$) was rejected by an F-test at the 10% level of significance.

6. Conclusions

The results of this study confirm that poverty reduction in the GMS is strongly related to growth of real GDP per person. The sectoral composition of this growth affects the rate of poverty reduction in so far as it affects the growth of services relative to the rest of the economy. Structural changes that promote the growth of services relative to other sectors are conducive to poverty reduction, given the overall rate of GDP growth. These findings have relevance for the future rate of poverty reduction that might be achieved in the GMS over the coming decade to 2020.

Global economic imbalances developing over the first decade of the 21st century will require major adjustments. Asia has run large current account surpluses, with the

United States and Europe running corresponding deficits. The cumulative effects have been the development of a large stock of assets, denominated in foreign currencies, held by Asian countries and a corresponding stock of debt incurred by the United States and Europe. It is generally recognized that continuation of this cumulative imbalance is unsustainable.

Major adjustment is inevitable and it will mean a switch of final demand within Asia from export dependence toward domestic sources of demand. On the supply side, this will mean a switch of output from production of tradable goods, such as agricultural and industrial goods, toward nontradables, such as services. That is, the sources of growth will have to shift away from agriculture and manufacturing toward services. This will entail costs and could well mean that the rate of overall growth of GDP per person will slow, but the composition of output will shift toward services and away from agriculture and industry.

The rate of poverty reduction in the GMS may rise over the coming decade. If past overall rates of GDP growth per person can be maintained, growth will become more poverty-reducing, given the structural changes that seem to be consistent with global economic restructuring.

Acknowledgement

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Appendix: Estimates of Level and Growth Rate of GDP in Myanmar

There are divergent views on Myanmar's level of GDP and its growth rate. Myanmar's official government estimates are generally considered too high. They imply a level of investment relative to GDP that is higher than the Myanmar data indicate and they are also inconsistent with direct observation of Myanmar's economy.

Table A.1 shows alternative sets of estimates. The ADB has published alternative estimates of the growth rate of GDP per person for the years since 2005. Except for 2005 these estimates are less than half the official estimates. These are the data that were used in the econometric estimation reported in the text of this paper. The Economist Intelligence Unit has also published estimates below official data. This Appendix attempts to use another method.

Table A.1: Estimates of Annual Rates of Real GDP Growth per Person, Myanmar (%)

Source	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Official data	11.70	9.30	10.00	11.80	11.60	11.60	11.10	10.20	8.80	9.30	9.30
ADB Outlook	11.50	9.10	9.80	11.60	11.30	13.60	4.90	3.40	1.60	3.00	3.20
EIU reports	N.A.	N.A.	N.A.	11.80	11.60	11.60	1.40	1.60	-0.40	0.50	2.00
Author's estimates	-1.95	-1.95	1.83	1.83	1.83	1.83	1.83	N.A.	N.A.	N.A.	N.A.

Although Myanmar's national accounts data are considered inaccurate, the government statistical agency also conducts a periodic consumer expenditure survey, which seems more reliable. The Myanmar Statistical Yearbook reports these data for the years 1989, 1997, 2001, and 2006. There is a well-known behavioral relationship between food expenditure and total consumer expenditure and the consumer's income, known as Engel's law. As incomes rise, food expenditure accounts for a declining proportion of total expenditure. This relationship can be observed across countries as well as within countries. Data on this matter for a wide range of countries are assembled in Figure A.1. The data on food expenditures relative to total expenditures are from the Food and Agriculture Organization of the United Nations compendium of national consumer expenditure surveys. The data on GDP per capita in US dollars at 2000 prices are from the *World Bank's World Development Indicators*.

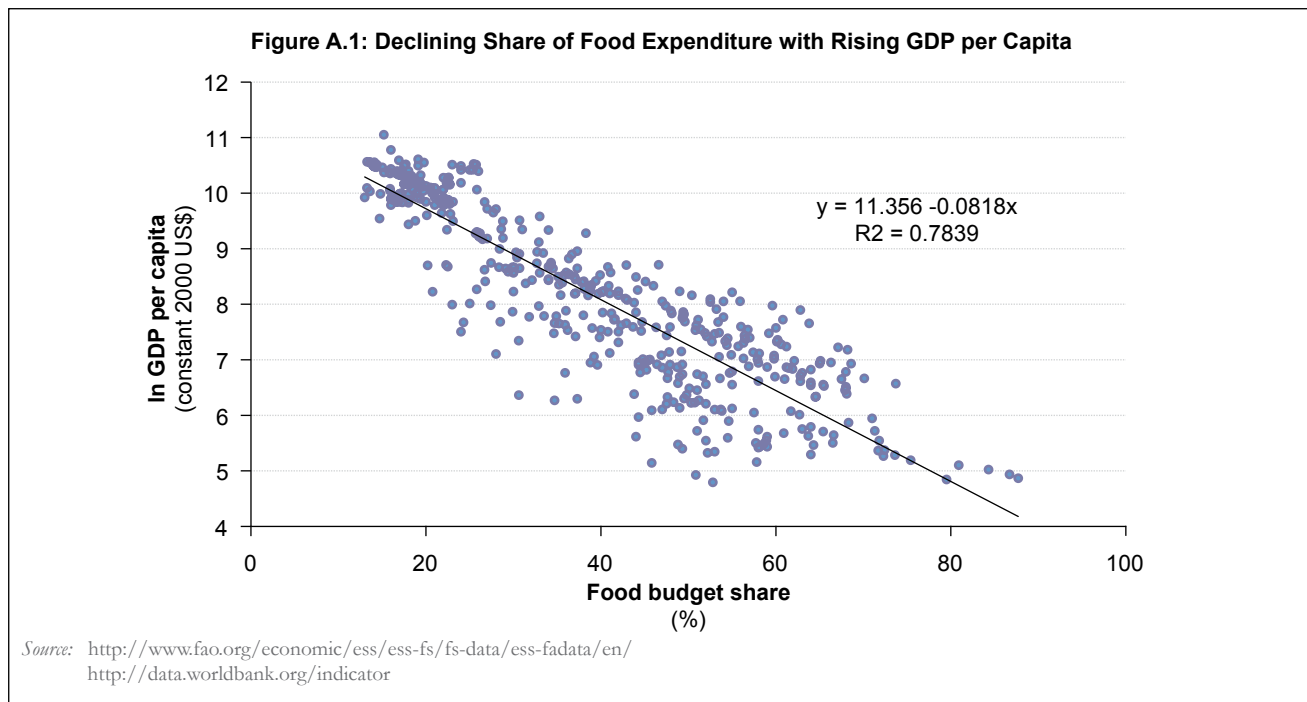


Table A.2: Myanmar: Estimates of Real GDP per Person based on Engel's Law

Year	Food share (%)	Predicted			Constant Annual Growth Rate (%)	Average Annual Growth Rate (%)
		GDP pc (2000 \$)	95% Lower bound: (GDP pc)	95% Upper bound: (GDP pc)		
1989	74.029	199.916	171.652	232.834	N.A.	
1997	70.950	257.200	223.234	296.334	3.200	
2001	71.910	237.768	205.679	274.862	-1.945	
2006	70.800	260.376	226.109	299.838	1.833	1.59

Source: author's estimates based on data described in the text.

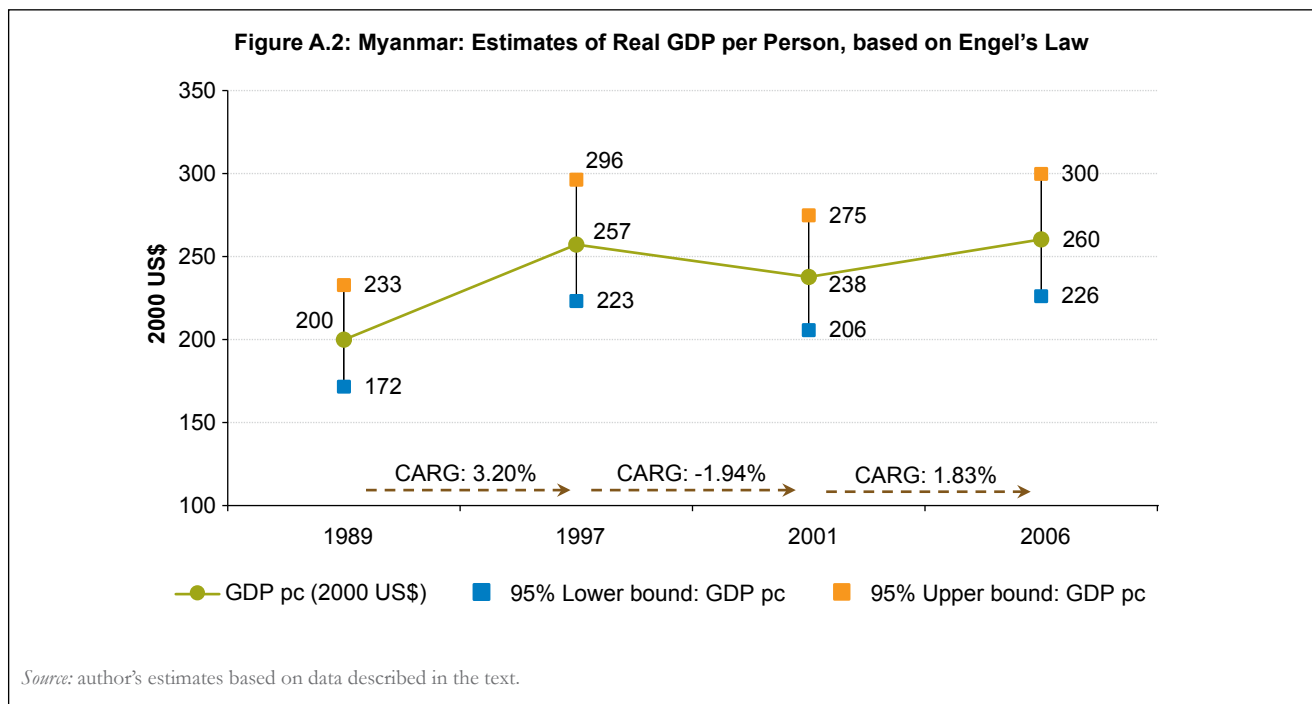


Figure A.1 also reports the regression equation fitted to these data. This relationship is used to estimate real GDP per person for Myanmar, as reported in Table A.2. Figure A.2 shows the resulting estimates and the 95 per cent confidence intervals around these estimates. The estimates are closest to the Economist Intelligence Unit's estimates, summarized in Table A.1.

WATER AND FOOD SECURITY IN THE GREATER MEKONG SUBREGION: OUTLOOK TO 2030/2050

Mark W. Rosegrant¹, Claudia Ringler, Tingju Zhu,
Simla Tokgoz and Pascale Sabbagh²

Abstract

While the importance of agriculture has been gradually declining in the Greater Mekong Subregion (GMS) the sector still contributes 30 percent to Gross Domestic Product (GDP) in Cambodia and over 40 percent in Lao People's Democratic Republic (PDR). In addition, while malnutrition levels have declined in much of the region since 1995, they still average 18% of the population in Southeast Asia with 26% of the population of Cambodia classified as malnourished. Importantly, reducing the food security risks in Southeast Asia through rapid agricultural and economic growth over the last two decades has required intensive use of the agricultural resource base, particularly land and water resources.

Under business-as-usual, food security will remain out of reach of key constituents in the Greater Mekong Subregion (GMS), particularly in Cambodia and the Lao PDR. Climate change impacts, higher energy prices, biofuel developments and growing water scarcity are challenges that will increase in the region and need to be addressed through pro-active policies and investments by the governments in the region. Greater trade integration, pro-poor energy and biofuel policies and investments rather than across-the-board subsidies for water and other agricultural inputs that affect the natural resource base adversely and increased focus on agricultural research and development investments to address growing water, climate and energy challenges are urgently called for to ensure that food and water security in the GMS become a reality, particularly for the poorer countries in the region.

1. Introduction

The current global food situation—marked by relatively high levels of input use and productivity levels in much of

Asia and the world, increasing land and water scarcity, and the impacts of climate change—presents a complex set of challenges to sustainable agricultural productivity growth. With lower food stocks and reduced excess capacity, the global food system is exposed to greater price volatility and instability in trade when exogenous supply shocks occur, as was seen in the food price spike of 2007 and 2008 and in the run-up of prices as of early 2011. Food price spikes (as well as sharply rising energy prices and the financial crisis) have affected all countries in differing ways, but the developing world, especially its poor and vulnerable producers and consumers, has generally fared the worst. The poor in the Greater Mekong Subregion (GMS)³ still spend 40%–60% of their income on food; even most farmers are net purchasers of food. These groups will be most impacted by price spikes and fluctuations.

In the coming decades, both demand and supply factors will pose challenges to agricultural growth and food security. On the demand side, food, feed, fertilizer, and energy demand and prices; water, and land scarcity; climate change mitigation; population and income growth; urbanization; and demand on environmental and recreational uses of natural resources will influence agricultural markets and food security. On the supply side, critical factors include climate change; water and land scarcity; limited investment in science and technology policy, particularly agricultural research; and continued need of management and governance reform affecting agricultural outputs. Water scarcity due to competition from other sectors, changes in the volume and pattern of rainfall, and declining water tables and quality will play a particularly important role. Farmers who rely on irrigation and who live in water scarce or drought and flood-affected areas—where GDP is rising and populations continue to expand—will be most affected. All of these demand and supply side factors—in addition to bioenergy-based demand for water and land—are projected to increasingly constrain food production growth, adversely impacting food security and human well-being goals.

This paper assesses challenges to water and food security for the GMS as a result of biophysical and socioeconomic changes on both the supply and demand side of water

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³ GMS countries are defined here as Cambodia, Lao PDR, Myanmar, Thailand and Vietnam. The current version of the IMPACT model combines results for Lao PDR and Cambodia. Although only the Guangxi and Yunnan provinces of China are included in the Greater Mekong Subregion, we are providing results for all of China because disaggregation by province does not exist in IMPACT; instead subnational disaggregation is done on the basis of major river basins.

and food for 2030 and 2050 using the IMPACT⁴ modeling framework, with a focus on climate change and changes in energy prices; and identifies policy options and investments to strengthen the agriculture sector.

2. Baseline results

2.1 Food supply and demand

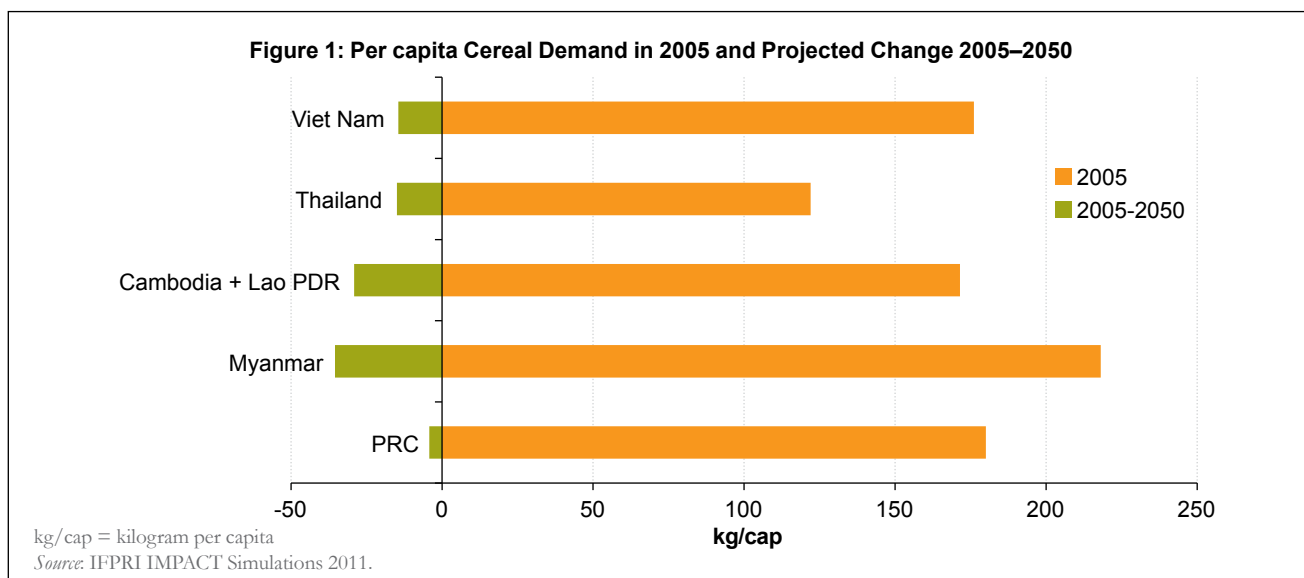
The baseline scenario assumes a continuation of current trends and existing plans in agricultural policies and investments in agricultural productivity growth. Population projections are the “medium” variant population growth rate projections from the Population Statistics division of the United Nations Food and Agriculture Organization and income projections are estimated by the authors, drawing on the Millennium Ecosystem Assessment (2005). Over the next four decades, demand for cereals⁵ in the GMS countries is expected to increase by only 6% to reach 38 million tons by 2050. This is the result of slowing population growth in much of the subregion⁶ combined with changes in dietary preferences leading to rapid growth in other food categories, particularly livestock, sugars, oils, and fruits and vegetables as a result of continued rapid income growth and urbanization. Per capita cereal food

demand, particularly rice, will decline across the subregion (Figure 1). Similarly, cereal demand growth in the People’s Republic of China (PRC) is expected to slow considerably, with total demand shrinking by 3% between 2005 and 2050. Much of the projected growth in cereal demand will be used to feed livestock.

At the same time, demand for livestock products is expected to continue to rapidly increase across Asia and the GMS. In the GMS, meat demand is projected to increase by 150% during 2005–2050, from relatively low levels. In the PRC, where per capita meat demand is much higher, demand is still expected to grow by a further 64% (Figure 2).

Furthermore, demand for root and tuber products (mainly potatoes) is expected to grow by 38% in the GMS while remaining stagnant in the PRC. Demand for sugar is projected to increase by 124% in the GMS and by 120% in the PRC. Finally, demand for fruits and vegetables combined is expected to grow by 90% in the GMS and by 50% in the PRC. Fish products are expected to continue to play a major role in GMS and Chinese diets.

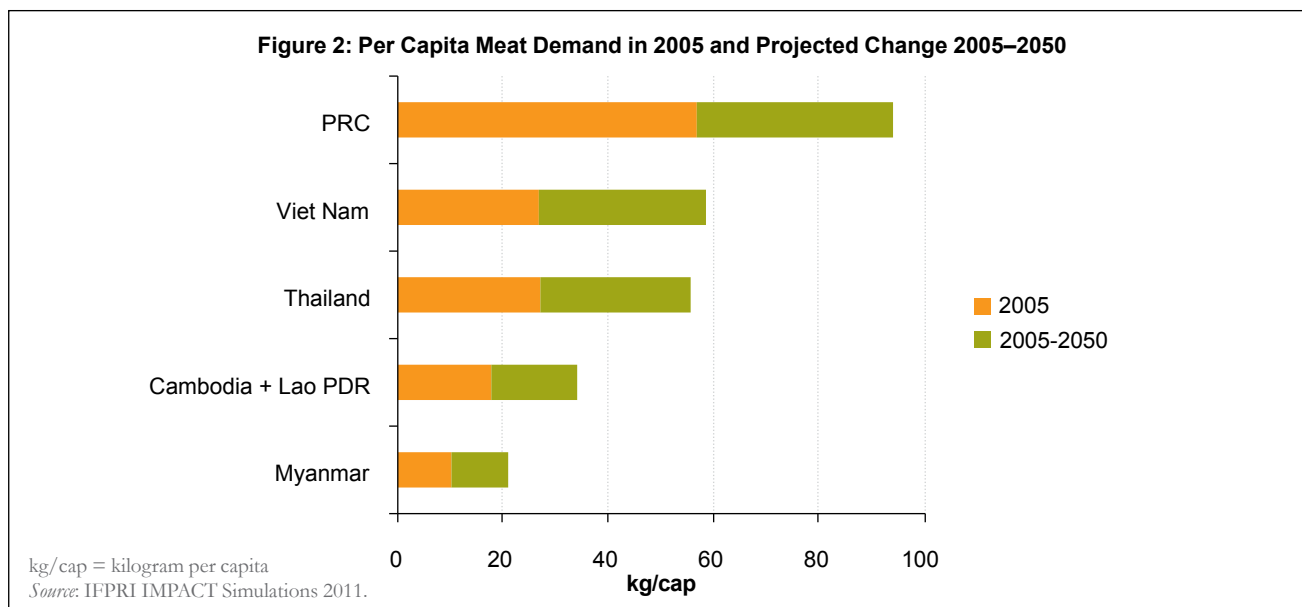
How will the expanding food demand be met? For meat in developing countries, increases in the number of animals slaughtered have accounted for 80%–90% of production



⁴ IMPACT – International Model for Policy Analysis of Agricultural Commodities and Trade

⁵ Cereals are defined as barley, maize, millet, oats, rice, rye, sorghum and wheat.

⁶ Population growth rates during 2030–2050 are expected to slow to half or less of the rates of 2010–2030 for China, Myanmar and Thailand; only Cambodia and Lao PDR and Vietnam are predicted to still experience rapid growth during 2030–2050 (UN 2010).



growth during the past decades. Over the next four decades, increased production is expected to come increasingly from slaughtered carcass weight, particularly for pork and poultry in the PRC and the GMS, due to a shift to more intensive production systems and improved breeds.

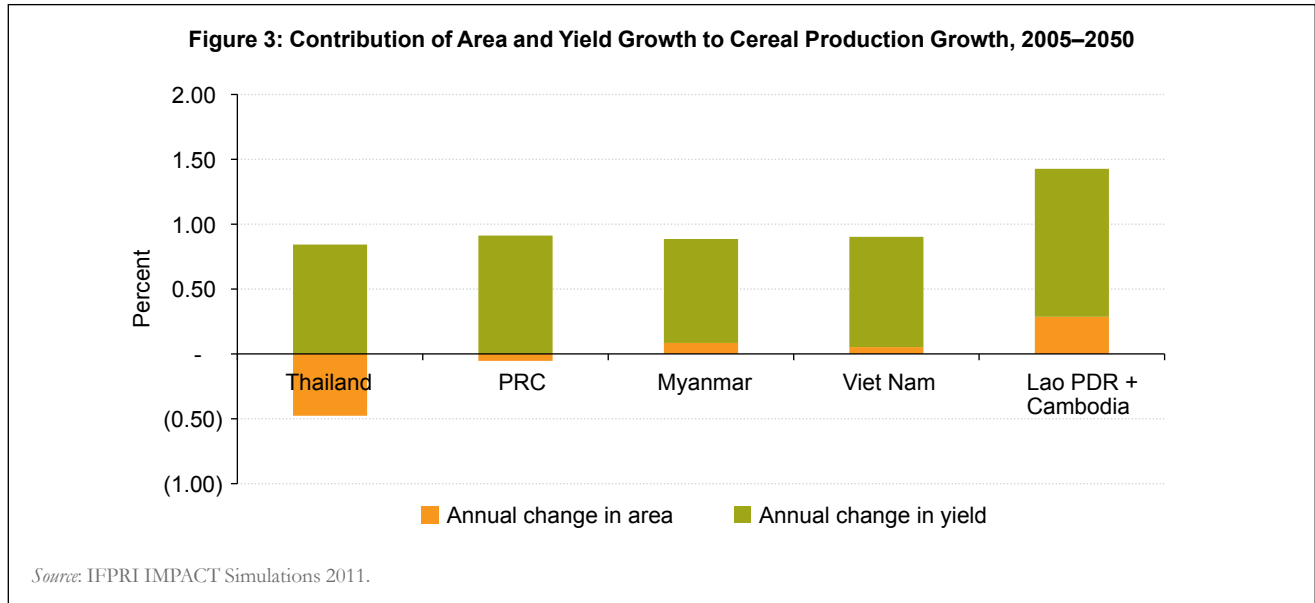
For the crops sector, water scarcity is expected to increasingly constrain production with little additional water available for agriculture due to slow increase in supply and rapid shifts of water from agriculture in key water-scarce agricultural regions. While the GMS water endowment is considerable, water scarcity is expected to increase. Water demand in the nonagriculture sectors is expected to account for 15% of total demand in Thailand by 2050, for example, up from 7% in 2005. This shift of growth in demand outside agriculture will put pressure on improving water use efficiency in agriculture.

Climate change will increase heat and drought stress in many of the current breadbaskets across the world, including in the GMS. Once plants are weakened from abiotic stresses, biotic stresses tend to set in and the incidence of pest and diseases tends to increase. With declining availability of water and land that can be profitably brought under cultivation, expansion in area is not expected to contribute significantly to future production growth; particularly not in Asia, where population density is highest. In the baseline, total crop harvested area expands from 52 million hectares (ha) in 2005 to 55 million ha by 2050 in the GMS and from 214 million ha to 221 million ha in the PRC. The projected slow growth in crop area places the burden to meet future cereal demand on crop yield growth.

Although yield growth varies considerably by commodity and country, in the aggregate and in most countries it will continue to slow. The global yield growth rate for cereals is expected to decline from 1.96% per year in 1980–2000 to 0.99% per year during 2005–2050 and in the remainder of the GMS, yield growth is expected to grow at levels below the global average. In the PRC, cereal yields are projected to increase by 0.91% per year during 2005–2050 and in the remainder of the GMS, yield growth is projected at 0.88% per year. Small contractions in harvested area and slow yield growth will put increased pressure on food prices. Figure 3 presents the contribution of area and yield growth to future cereal production growth for the individual GMS countries. Yield growth is expected to clearly dominate area growth in the GMS, with overall cereal production growth expected to grow fastest in Cambodia and the Lao People’s Democratic Republic (Lao PDR) (albeit from low levels), and slowest in Thailand, where significant area contractions are expected for cereals, particularly rice, as land shifts into diversified crops.

2.2 Implications for Prices, Trade, and Food Security

In the last few years, real prices of food have increased dramatically as a result of changes in biofuel/climate policies, rising energy prices, declining food stocks, and longer-term trends in slow growth in agricultural productivity. Projections reported here show that higher food price trends are likely to stay as a result of increased pressure on land and water resources, adverse impacts from climate variability and change, and rapidly rising incomes in most of Asia and Africa. Given the long-term

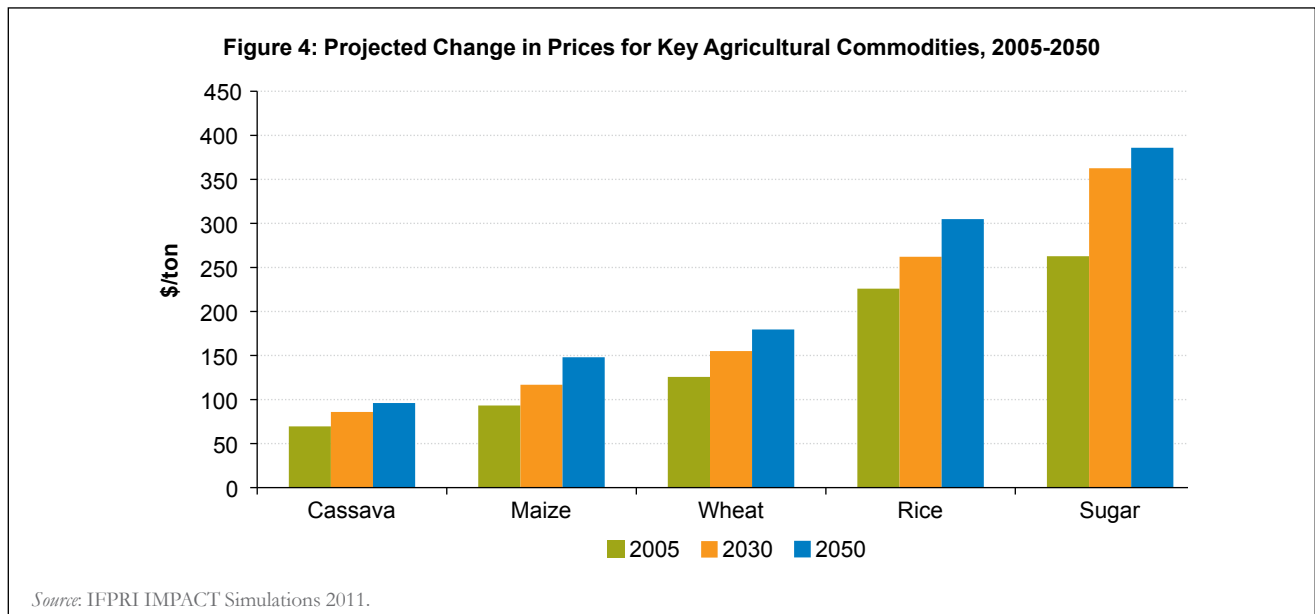


underinvestment in agriculture and poor government policies in response to rising food prices in many countries, it is unlikely that the supply response will be strong enough in the short to medium term.

During 2005–2050, prices for cassava, maize, wheat, rice, and sugar are expected to grow by 38%, 59%, 43%, 35%, and 47%, respectively (see also Figure 4). Maize prices are expected to increase faster than most other commodities to meet the rapid increase in demand for animal feed and ethanol. Sugar prices are also affected by use as feedstock for first-generation biofuel technologies. Higher food prices will depress food demand by net food purchasers in the longer term, increasing childhood malnutrition rates and

reversing progress made in several low-income countries in terms of nutrition and food security.

World trade in food is expected to continue to increase, driven by the increasing import demand from the developing world, particularly Asia, the Middle East, and subSaharan Africa. With much of the developing countries unable to increase food production rapidly enough to meet growing demand, the major exporting countries—mostly in high-income countries but also in Latin America and countries from the former Soviet Union—will play an increasingly critical role in meeting global food consumption needs. However, given the strong demand for food crops as feedstock for biofuels in the short to



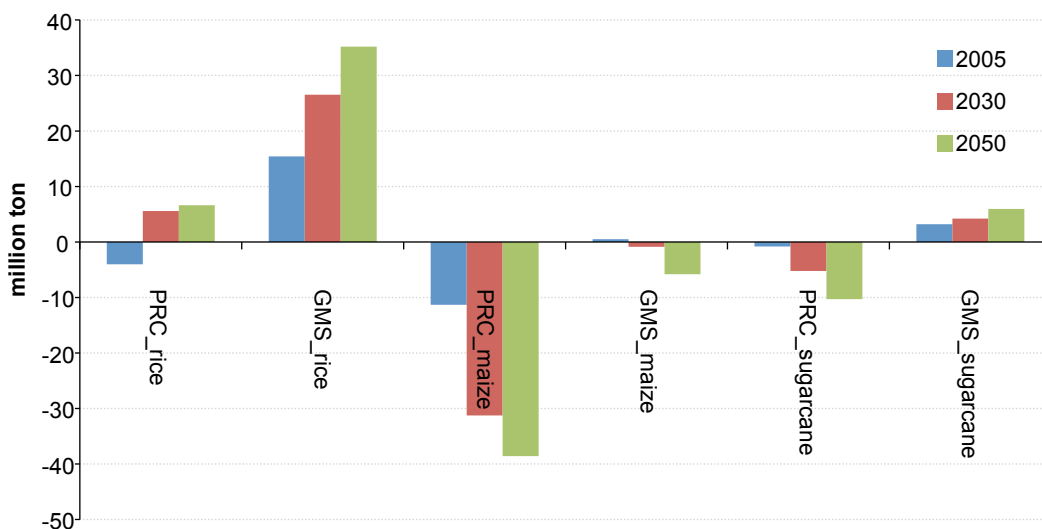
medium term, net cereal export levels are projected to be reduced in key exporting countries, notably the United States and parts of Europe, until a transition out of first-generation technologies has been implemented. The PRC is expected to significantly increase net imports of maize, from 11 million tons in 2005 to 39 million tons by 2050. Cambodia, the Lao PDR, Myanmar, Thailand, and Viet Nam are expected to see net import increases of maize of almost 6 million tons by 2050. The PRC could become a small net exporter of rice over the next few decades; and the GMS countries in the lower Mekong Basin are expected to considerably expand their net exports of rice, from 15 million tons in 2005 to 35 million tons by 2050 given their relatively favorable rice growing environments and projected increased investment in rice breeding in the subregion (Figure 5).

The substantial increase in food prices will slow growth in calorie consumption, with both direct price impacts and reductions in real incomes for poorer GMS country consumers who still spend a large share of their income on food. The PRC has had an excellent performance in reducing poverty and increasing food availability, with poverty and malnutrition levels now mostly concentrated in the western, mountainous areas of the country. The two PRC entities that are part of the GMS generally show higher poverty and lower calorie availability levels than the PRC average. Per capita calorie availability is expected to continue to increase in the PRC, by 448 kilocalories during

2005–2030 and further increase by 428 kilocalories during 2030–2050. Both Thailand and Viet Nam show similar performance, but at both lower initial calorie availability levels and with smaller improvements; calorie availability is expected to surpass 3,000 kilocalories in Thailand by 2050 and reach close to these levels in Viet Nam. Cambodia and the Lao PDR have the lowest calorie availability levels in the GMS, at just over 2,000 kilocalories per capita per day. These levels are expected to improve only slowly over the next several decades as a result of continued slow agricultural and economic growth. Myanmar, finally, has seen its agricultural and economic base eroding over the last decades and this development is unlikely to reverse unless the country’s government takes deliberate steps toward more investment in the agriculture sector and the overall economy (Figure 6).

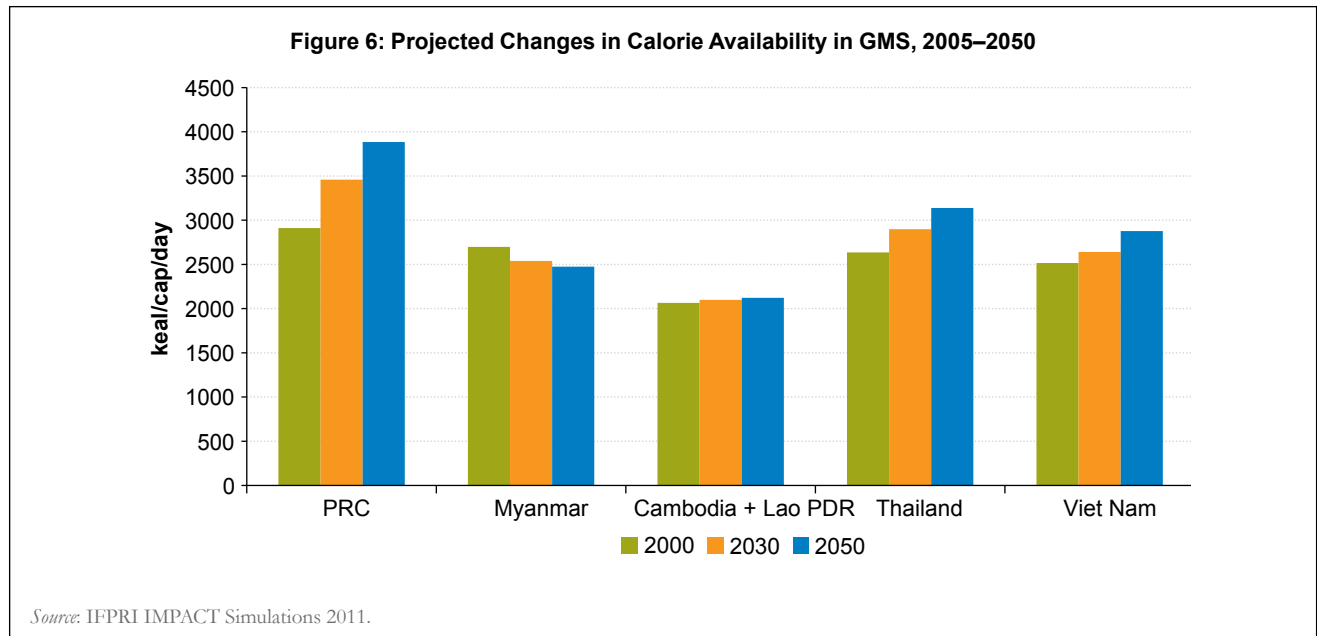
As a result of rising food prices and relatively slow growth in consumption, there will be only slow improvement in food security for the poor in many regions, including the GMS. The PRC and Viet Nam are expected to continue to reduce poverty and malnutrition level fastest in the GMS, with the PRC’s rate of childhood malnutrition (children of up to 60 months) all but vanished by 2050, and Viet Nam’s rate projected to drop to 27% by 2050 down from 35% in 2005. Small improvements are also expected in Myanmar and Thailand. Malnutrition levels in Cambodia and the Lao PDR are expected to remain at a high of 42% over the next several decades (Figure 7).

Figure 5: Projected Change in Net Trade for Key Agricultural Commodities, 2005–2050



GMS here refers to the summed net trade across Cambodia, Lao PDR, Myanmar, Thailand and Viet Nam

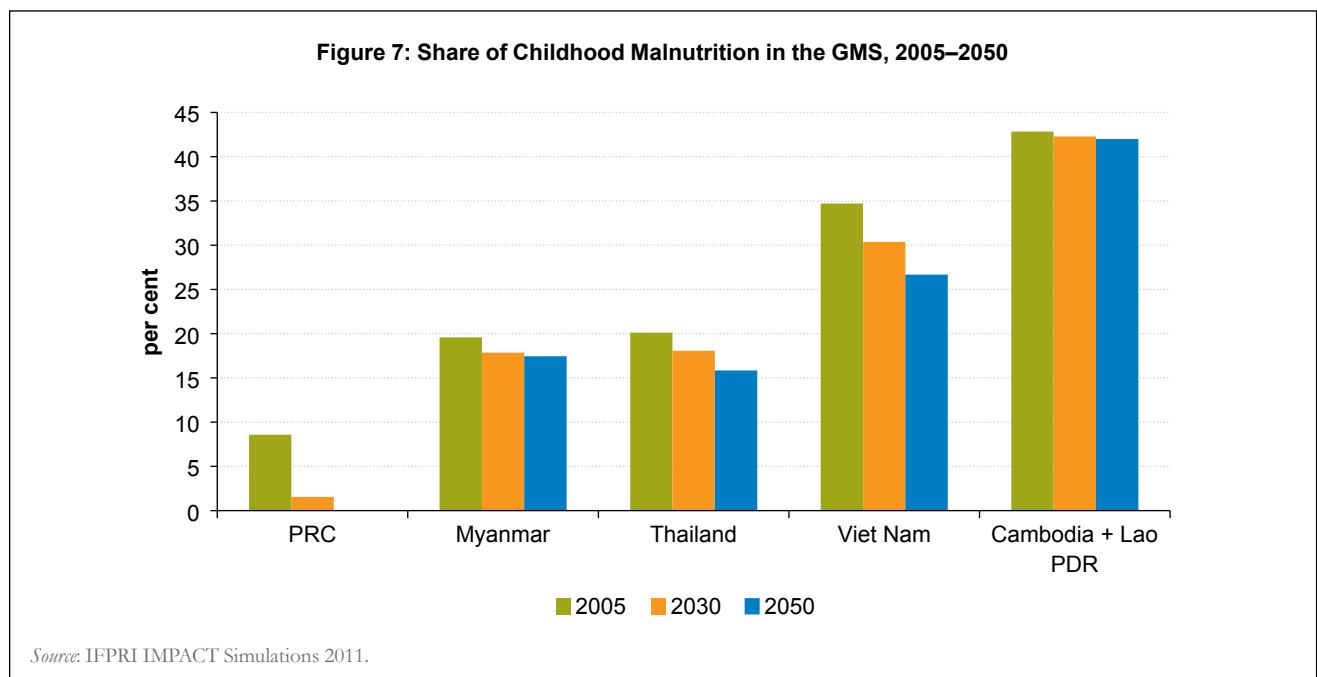
Source: IFPRI IMPACT Simulations 2011.



3. Climate Change Impacts On Water and Food

The Mekong River Basin is susceptible to climate change. To evaluate the water resources impacts of climate change in the basin, we used climate projections produced by General Circulation Models (GCM), which account for the complex set of climate-related processes occurring in the coupled atmosphere-land surface-ocean-sea ice system.

GCM projections are subject to significant uncertainties in the modeling process; as a result, different GCMs produce different geographical patterns of change for the same emissions scenario, particularly with respect to precipitation, the most important driver for freshwater resources (Kundzewicz *et al.*, 2007). We evaluated temperature and rainfall changes of the downscaled projections under the A1b and B1 emissions scenarios of the Intergovernmental Panel on Climate Change (IPCC), and selected projections from two GCMs: MIROC



3.2 (MIR), and CSIRO-MK3.0 (CSI).⁷ Use of these two scenarios and GCMs provides a range of climate change outcomes. The MIROC model projects increases in maximum temperatures between 2000 and 2050 of 2.3° Celsius for the B1 scenario and 2.8° Celsius for the A1b scenario. The CSIRO model projects smaller changes of 1.0° Celsius for the B1 scenario and 1.4° Celsius for the A1b scenario.

To implement these scenarios, we utilized the work of Jones *et al.* (2009), who statistically downscaled a number of GCM projections, based on data from the World Climate Research Program (WCRP) Coupled Model Intercomparison Project phase 3 (CMIP3) multi-model dataset. We used the historical mean monthly gridded precipitation and temperature series computed from the 1951–2000 series of the CRU TS2.1 global climate database (Mitchell and Jones, 2005) as climate baseline. The climate baseline and the constructed climate change scenarios are used to drive the IMPACT Global Hydrologic Model (IGHM) to simulate evapotranspiration and water availability. For convenience, we hereafter call the baseline “NoCC” and the two GCM-based scenarios CSI and MIR.

The long term climate data are then input into the Decision Support System for Agrotechnology Transfer (DSSAT) crop modeling framework to generate the biophysical impact of climate change on crop yields. The DSSAT crop simulation model, an extremely detailed biophysical process model of the daily development of a crop from planting to harvest-ready, is used as the underlying crop model for the analysis. The model requires daily weather data, including maximum and minimum temperature, solar radiation, precipitation, a description of the soil physical and chemical characteristics of the field, and crop management, including crop, variety, planting date, plant spacing, and inputs, such as fertilizer and irrigation. The DSSAT models are used for each of the major crops to estimate the impacts of climate change on crop yields by inputting the projected climates with and without climate changes. The biophysical impacts on crop yields are then

fed into the yield growth assumptions in the IMPACT food module to assess the impacts on food supply, demand, prices, and trade.

3.1 Water Resources Impacts of Climate Change in the Mekong River Basin

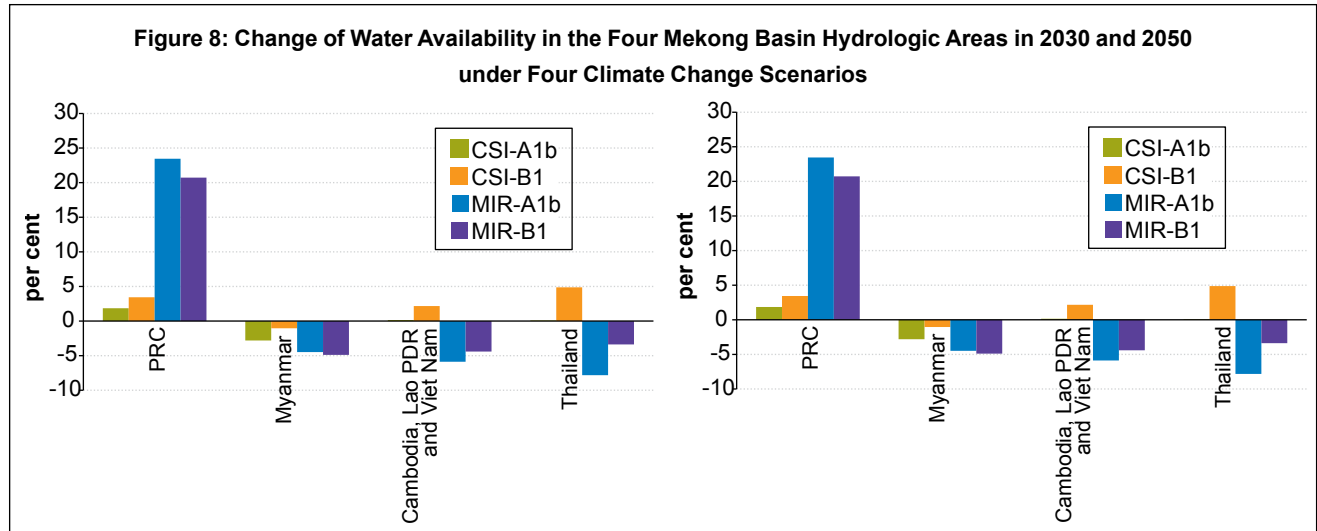
Climate change affects hydrological cycles locally and globally. It alters the amount and timing of river flow, challenges the coping capacities of existing water infrastructure and management systems, and increases the risk of extreme events, both droughts and floods. In this section, we discuss changes of water availability and irrigation water supply in the riparian country catchments of the Mekong River Basin, which were simulated using the IMPACT GHM and water simulation modules based on the climate change scenarios and climate baseline discussed above.

Climate Change Impacts on Water Availability

We computed percentage changes of annual runoff in the various riparian areas of the Mekong River Basin, as well as the runoff changes for the GMS countries (Figure 8). At both Food Producing Unit (FPU) and country levels, runoff changes display a diverse pattern across scenarios. In the Mekong River Basin, the PRC catchment has increased runoff in 2030 under all climate change scenarios, with the MIR-A1b and MIR-B1 scenarios causing the most pronounced increases—over 20%. By 2050, the two MIR GCM scenarios lead to runoff increases of more than 20%. However the two CSI GCM scenarios cause slight declines of runoff in 2050. The Myanmar catchment is projected to experience moderate declines of runoff in 2030 under all scenarios, and declines are expected to become larger by 2050 for all scenarios. For the Cambodia, Lao PDR, and Viet Nam catchments of the Mekong, a marginal increase of runoff under CSI-A1b, and a slightly larger increase under CSI-B1 are found, while MIR-A1b and MIR-B1 lead to moderate reductions by 2030; runoff changes will continue to grow out to 2050. The Thailand catchment shows largely the same pattern of runoff change as the Cambodia, Lao PDR, and Viet Nam catchment.

At the national scale, runoff in the PRC decreases moderately under the two CSI GCM scenarios and increases significantly under the two MIR GCM scenarios in 2030, with the changes continuing to 2050. Myanmar shows increased runoff for all scenarios in 2030 and the changes continue to 2050, except that MIR-B1 causes a marginal runoff decline in 2050. In Cambodia, Lao PDR and Viet Nam, runoff increases marginally under CSI-A1b,

⁷ The International Model of Policy Analysis of Agricultural Commodities and Trade (IMPACT) is a partial equilibrium model of the agricultural sector, representing a competitive agricultural market for crops and livestock. The model incorporates a Water Simulation Model (WSM) to assess the impact of water supply, demand and variability on food outcomes. To assess climate change impacts, IMPACT is linked with a semi-distributed Global Hydrological Model (GHM) to assess changes in water availability and with a standard crop model (DSSAT) to assess impacts of temperature and changes in water availability on crop yields. For additional details, see Rosegrant *et al.* (2008) and Nelson *et al.* (2010).



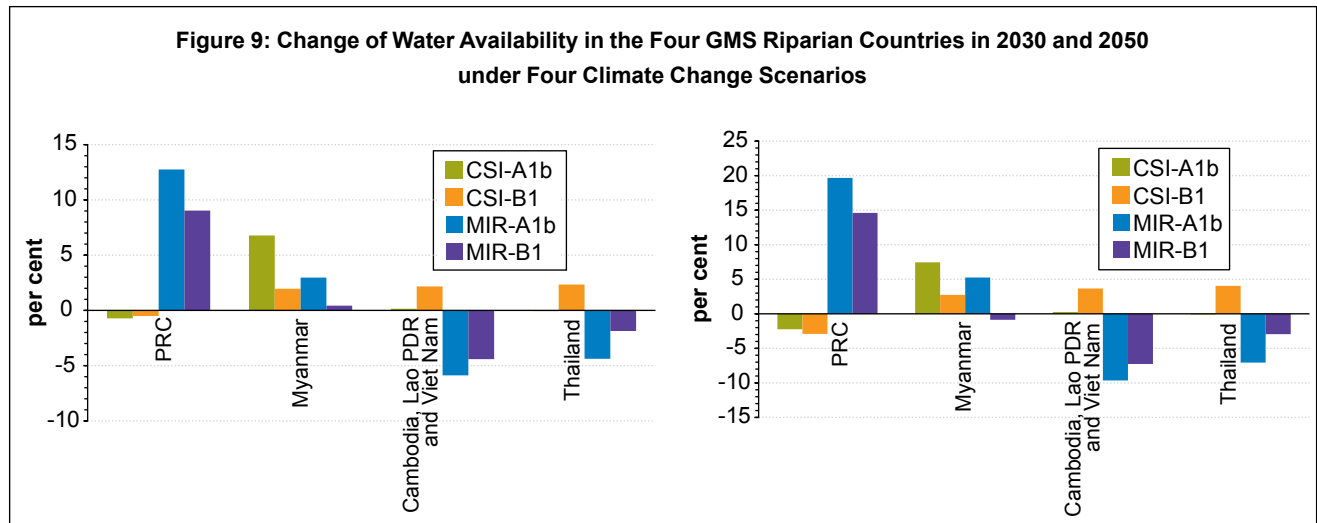
moderately under CSI-B1, and decreases under MIR-A1b and MIR-B1. Thailand is projected to experience runoff increase under CSI-B1, and runoff decline under MIR-A1b and MIR-B1. Runoff in Thailand virtually does not change under CSI-A1b.

Water-Use Impacts of Climate Change

Irrigation is the largest water user in the Mekong River Basin, particularly for rice. Climate change affects both the supply and the demand side of irrigation. We used irrigation water supply reliability (IWSR) as an indicator to depict both the irrigation water supply and demand situation. By definition, IWSR is the ratio of water supply to water demand at an annual basis. In the Water Simulation Model (WSM) model, IWSR is defined as the ratio of annual irrigation water supply to annual irrigation water demand, which represents total gross consumptive irrigation water requirement of all crops, considering “losses” by dividing total requirement by effective irrigation efficiency.

Figure 9 presents IWSR values in the PRC and Thailand catchments of the Mekong River Basin, under climate baseline and climate change scenarios, for three periods: 2000, 2030, and 2050. The computed present IWSR level in the PRC catchment is very low, reflecting the fact that irrigation infrastructure is rather under developed in the Lancang catchment. However, with infrastructure and management improvement, IWSR is expected to increase considerably by 2030 and 2050. All climate change scenarios lead to IWSR increases in 2030 and 2050, owing to increased rainfall, which reduces irrigation demand and increases runoff, augmenting irrigation water supply with the same irrigation infrastructure capacity. MIR-A1b raises IWSR from 0.5 under the climate baseline to over 0.8 by 2050, implying significant potential of climate change to alter water management outcomes.

The Thailand catchment has generally higher IWSR than that of the PRC. However, a relatively slow IWSR



improvement over 2000–2030 under the climate baseline leads to reduced IWSR under the MIR-A1b and MIR-B1 scenarios. CSI-A1b results in IWSR levels below the baseline and CSI-B1 results in IWSR levels above the baseline in 2030. By 2050, differences across scenarios are larger.

Figure 10 presents projections of IWSR for the entire PRC and Thailand. For the PRC, IWSR is expected to increase from 0.70 in 2000 to about 0.75 by 2050. During this period, considerable improvements in infrastructure and management are expected. However, strong competition for water from nonagricultural sectors squeezes irrigation water supply. The two MIR GCM scenarios lead to higher IWSR than the climate baseline and the two CSI scenarios lead to decreased IWSR. Thailand shows a largely similar pattern of IWSR changes as in the Mekong catchment alone shown in Figure 11, with IWSR under CSI-B1 being higher than the baseline and IWSR for the remaining scenarios below the baseline.

Impacts of Sea Level Rise on the Mekong River Delta

The GMS is expected to be strongly affected by sea-level rise and climate extreme events (Table 1). Sea-level rise increases the risk of coastal inundation, soil erosion, displacement of communities, loss of agricultural land, and intrusion of saline waters into surface and groundwater. Global sea level gradually rose during the 20th century and continues to rise at increasing rates (Cruz *et al.*, 2007). In Asia and the Pacific, sea level is expected to rise approximately 3–16 centimeters (cm) by 2030 and 7–50 cm by 2070 in conjunction with regional sea-level variability (Preston *et al.*, 2006). Under a conservative scenario of a 40 cm rise in sea level between 2011 and the end of 21st century, the number of people facing floods in coastal areas will increase from 13 to 94 million, annually, with a significant share of the population in Myanmar, Thailand, and Viet Nam affected (Cruz *et al.*, 2007).

Figure 10: Irrigation Water Supply Reliability in the Mekong Catchments in the PRC and Thailand under Climate Normal and the Four Climate Change Scenarios, 2000, 2030, and 2050

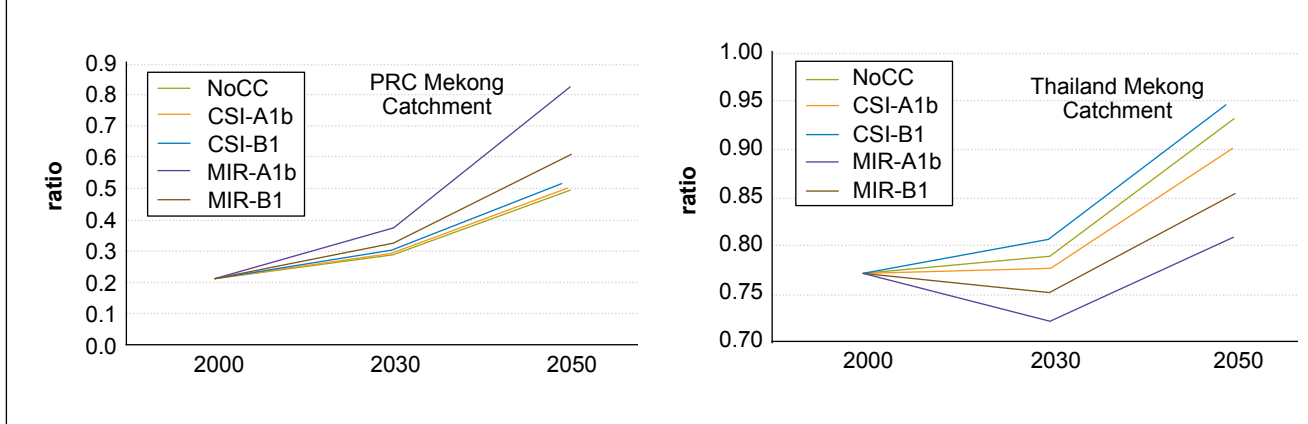


Figure 11: Irrigation Water Supply Reliability in the PRC and Thailand under Climate Normal and the Four Climate Change Scenarios, 2000, 2030, and 2050

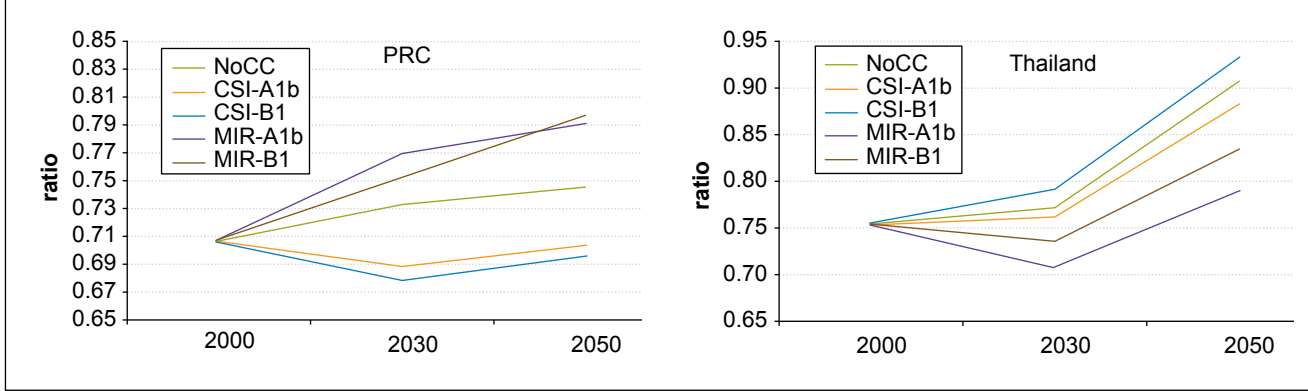


Table 1: Countries in the GMS Vulnerable to Rising Sea Levels and Extreme Climate Events

Subregion/country	Rise in sea level	Floods	Droughts	Storms
Cambodia		X	X	
PRC	X	X	X	X
EAST ASIA				
Lao PDR		X	X	X
Myanmar	X	X		X
SOUTHEAST ASIA				
Thailand	X	X	X	X
Viet Nam	X	X	X	X

Note: Disasters were taken from EM-DAT lists and represent the top ten natural disasters by numbers of people killed, affected people, and the costs of economic damage for the period 1900–2008; “X” indicates that the country is vulnerable to the indicated climate event.

Source: Adapted from EM-DAT 2009, as reported in ADB and IFPRI (2009).

The International Food Policy Research Institute (IFPRI) calculated potential impacts of sea-level rise on crop production for key Asian developing countries for sea-level rise of 1 meter and 3 meters, respectively.⁸ Under 1-meter sea-level rise, a total of 7.7 million ha of crop land is submerged, while under a 3-meter sea-level rise, the area submerged more than doubles to 16.1 million ha. Rice is by far the most affected crop. In the GMS, Viet Nam is most affected from sea-level rise, losing more than 2.5 million ha under 1-meter and close to 4.5 million ha under 3-meter sea-level rise. Myanmar ranks second with 0.3 and 1.2 million ha under 1- and 3-meter sea-level rise, respectively, followed by Thailand and Cambodia with smaller areas. The PRC ranks second in Asia regarding area affected by sea-level rise, but none of this area is part of the GMS (ADB and IFPRI, 2009).

For Viet Nam, the Ministry of Natural Resources and the Environment (MONRE) recommended the use of specific sea-level rise scenarios (MONRE, 2009). The Southern Institute for Water Resources Planning prepared a map and tables indicating what this relatively conservative sea-level rise value would mean for the Vietnamese Mekong Delta. Figure 12 presents the flood inundation situation in the Mekong River Delta with 30 cm sea-level rise under current infrastructure levels. Table 2 presents the area in the delta under water with and without sea-level rise and with and without current levels of hydraulic structures. The case without hydraulic structures assumes natural conditions in the delta, without human intervention for flood control and prevention of salinity intrusion with sluice gates or other measures. With existing hydraulic structures, when the sea-level rises by 30 cm, the inundation area

Table 2: Inundated Land Area under 30-cm Sea-Level Rise with and without Hydraulic Structures in the Mekong Delta ('000 ha)

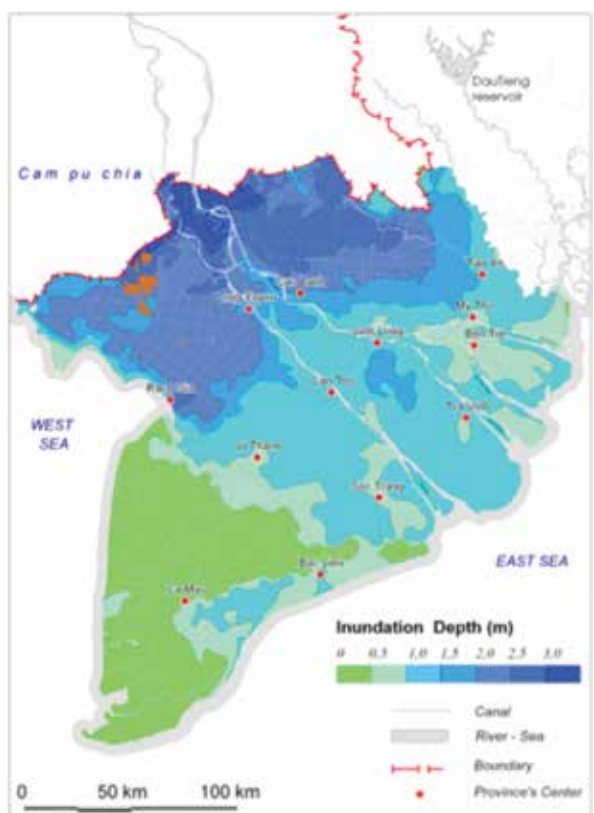
Inundation depth (m)	Present area	Area under 30 cm sea-level rise	
		Without structures	With structures
< 0.5*	1,049	623	773
0.5 - 1	1,063	688	542
1 - 1.5	724	1,207	1,218
1.5 - 2	459	685	410
2 - 2.5	288	343	578
2.5 - 3	212	240	262
> 3	66	77	78
Total	3,862	3,862	3,862

* Includes areas not being inundated.

Source: Analysis based on hydrodynamic simulations by SIWRP.

⁸ These sea-level rise assumptions are higher than IPCC predictions for 2050 and 2100. However analysis of less-than-1 meter sea-level rise requires digital elevation model (DEM) data with higher vertical resolution, which is not currently available in public domain. Moreover, IPCC (2007) predictions have underestimated the level and speed of recent Arctic ice melt, which gives more credence to the possibility of levels above the 0.5–0.6 meters generally anticipated.

Figure 12: Flood Inundation with 30 cm Sea-Level Rise and Present Hydraulic Structures in the Vietnamese Mekong Delta



Source: Southern Institute of Water Resources Planning, Viet Nam

with water depth greater than 0.5 m would increase from 2.8 million ha to 3.1 million ha (Zhu *et al.*, 2010).

Table 3 presents the areas affected by different levels of salinity intrusion in the Mekong Delta with and without hydraulic structures. With 30-cm sea-level rise, areas affected by salinity intrusion with concentration greater than 4 grams per liter increases from 1.3 million ha to 1.7 million ha. We assume that about 70% of the affected areas are paddy (personal communications with Dung Do Duc of Southern Institute of Water Resources Planning, Viet Nam). Thus, under sea-level rise of 30 cm, 0.2 million

ha of paddy area is lost due to inundation, and 0.3 million ha due to salinity intrusion, accounting for about 13% of current harvested rice area in the Mekong Delta. Flooding occurs in the rainy season, affecting the summer rice crop while salinity intrusion occurs during the dry season affecting the winter-spring rice crop (Zhu *et al.*, 2010).

3.2 Impact of Climate Change on Food Outcomes in the GMS

Under climate change, all major agricultural commodity prices are projected to increase compared to a base or no-climate change scenario. Figure 13 depicts changes in international prices for maize, rice, and sugar under the four climate change scenarios. Under climate change, 2050 maize prices would be 15%–32% higher, rice prices would be 31%–35% higher, and sugar prices 23%–33% higher than those in the no-climate change baseline.

Higher prices are a result of impacts on crop yields and areas from higher temperatures and gradual changes in rainfall under climate change. Table 4 presents changes in rice yields under the four climate change scenarios, separated for irrigated and rainfed yields, by 2050. As expected, irrigated yields will continue to outpace rainfed crop yields over the next decades, with irrigated rice yields close to double rainfed yields in the PRC and Viet Nam, and three times the level of rainfed yields in Cambodia, the Lao PDR and Thailand. Climate change is set to particularly affect the intensively grown irrigated crops, with high levels of fertilizer and water inputs. In the PRC, irrigated rice yields are projected to drop by 3%–5% as a result of climate change. Declines are expected to be much higher in the lower Mekong countries, but also vary more significantly across climate change scenarios, with irrigated rice yield falling 2%–16% below levels without climate change in Cambodia and the Lao PDR.

Higher food prices and differing changes in crop production levels in different parts of the world as a result of climate change will influence global trading patterns. Figure 14 shows the changes in net trade (exports minus imports)

Table 3: Area Affected by Salinity Intrusion in the Mekong Delta with and without Hydraulic Structures ('000 ha)

Salinity (gram/liter)	Present	30-cm Sea-level rise	
		Without Structure	With Structure
0 – 4*	2,558	2,085	2,139
> 4	1,303	1,777	1,723
Total	3,861	3,862	3,862

Note: *Includes area without salinity problem.

Source: Analysis based on hydrodynamic simulations by SIWRP

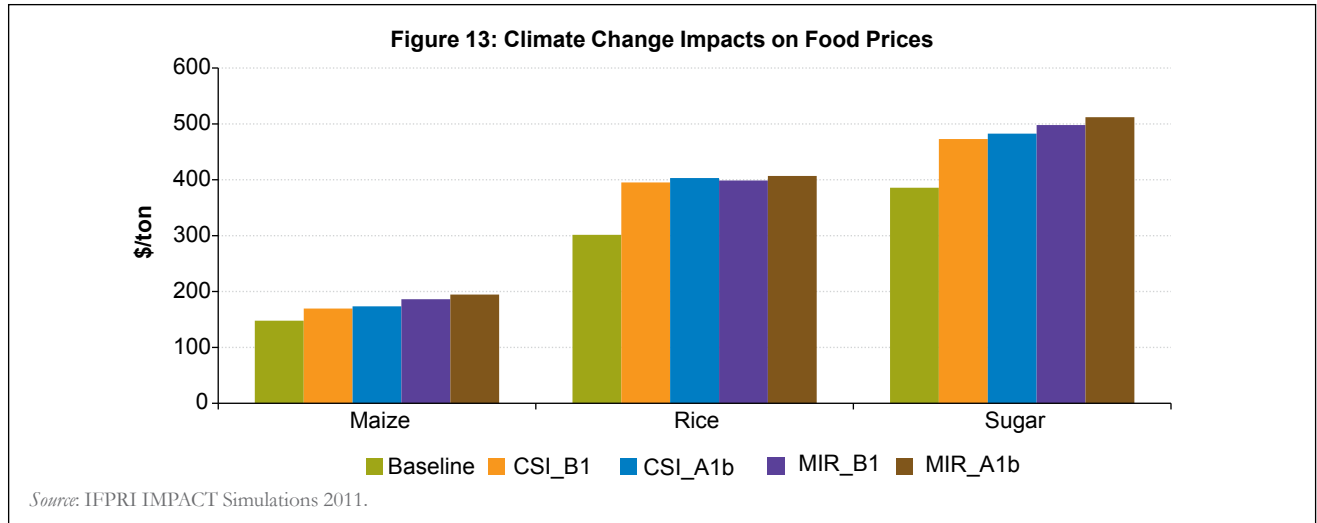
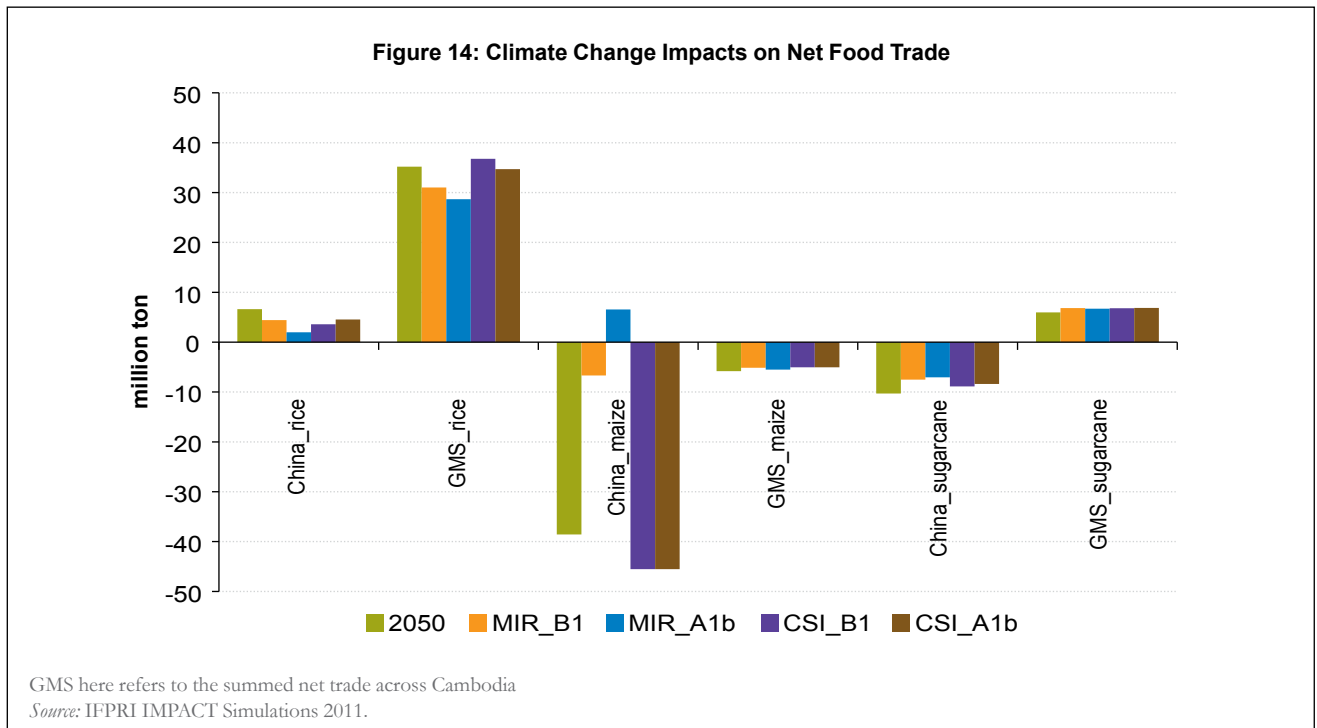


Table 4: Change in Rice Yields under Climate Change, Various Scenarios, Projected to 2050, GMS Countries

Country	Base2050	MIR_B1	MIR_A1b	CSI_B1	CSI_A1b
	(kg/ha harvested)	(percent change from 2050 base)			
IRRIGATED					
Cambodia + Lao PDR	4,735	-12	-16	-2	-6
PRC	4,992	-3	-5	-4	-3
Myanmar	5,371	-12	-13	-6	-10
Thailand	4,052	-13	-20	-6	-10
Viet Nam	5,004	-13	-14	-1	-4
RAINFED					
Cambodia + Lao PDR	1,557	1	-6	8	5
PRC	2,637	6	5	-1	1
Myanmar	2,257	-2	-1	0	-2
Thailand	1,137	2	-7	8	3
Viet Nam	2,856	0	-2	2	2

kg/ha = kilogram per hectare



for the PRC and the sum of the remaining GMS countries for rice, maize, and sugarcane. The PRC's net trade in rice declines under all four climate scenarios, while outcomes for the lower Mekong Basin countries vary depending on the scenario. The largest trade shifts by far relate to maize, as the various climate scenarios have differential impacts on the key maize growing areas, particularly the United States. Under both CSI climate scenarios, the PRC would significantly increase net imports of maize to up to 46 million tons by 2050. Under the MIR climate scenarios, net imports would drop dramatically to 7 million tons under the more 'benign' B1 emissions scenario and to net exports of 7 million tons under the A1B scenario. Changes for maize for the other GMS countries would be relatively small. Similarly, changes for net trade in sugarcane would be minor.

Changes in food prices as a result of climate change will also affect calorie availability. Table 5 presents significant and similar declines in calorie availability across all GMS countries. Average calorie availability is projected to drop by 6%–7% in the PRC, by 9%–10% in Myanmar, by 8% in Cambodia and the Lao PDR, by 5%–6% in Thailand, and by 6%–8% in Viet Nam, as a result of climate change. Thus, average calorie availability in Cambodia and the Lao PDR will be close to levels experienced in parts of sub-Saharan Africa.

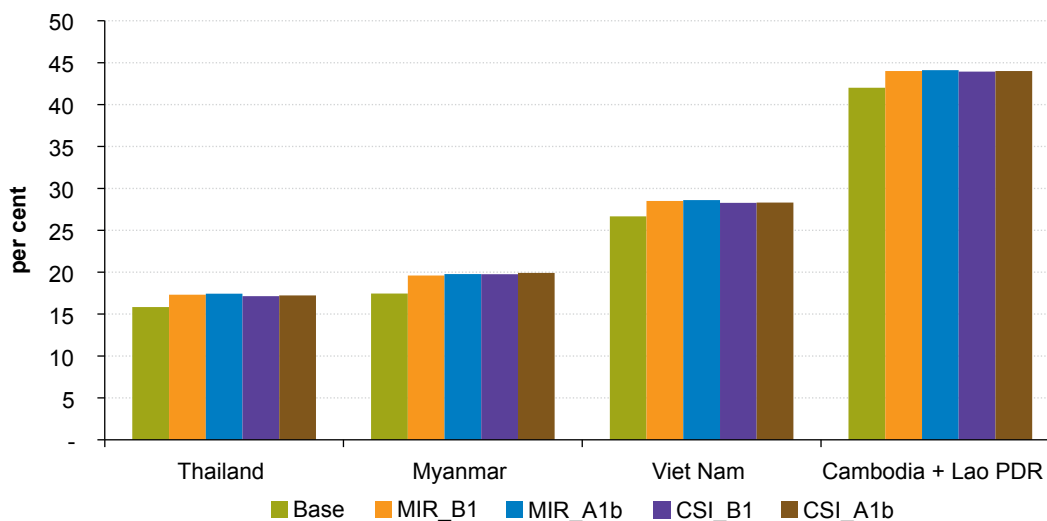
Finally, climate change will also affect childhood malnutrition outcomes in the GMS (Figure 15). The share of malnourished children is projected to increase by approximately 2% for each of four lower Mekong countries. These impacts will be particularly severe for Cambodia and the Lao PDR, where childhood malnutrition levels are extremely high, even without adverse climate change impacts.

Table 5: Impact of Climate Change on Calorie Availability in the GMS, 2050 Projections

Country	Base 2050	MIR_B1	MIR_A1b	CSI_B1	CSI_A1b
	(kcal/cap/day)	(percent change from 2050 Base)			
Cambodia + Lao PDR	2,128	-8	-8	-8	-8
PRC	3,887	-7	-7	-6	-6
Myanmar	2,486	-9	-9	-9	-10
Thailand	3,140	-6	-6	-5	-5
Viet Nam	2,883	-7	-8	-6	-7

kcal/cap/day = kilocalories per day per capita

Figure 15: Impact of Climate Change on Child Malnutrition Levels, 2050



Source: IFPRI IMPACT Simulations 2011.

4. Energy, Water, and Food

4.1 Background on Energy, Water, and Food Linkages

Energy is connected with both the food and water sectors in important ways. Higher energy prices can raise the price of agricultural inputs and reduce the availability of land and water for food production due to competition from expanded biofuel production. This dampens food demand as a result of higher food prices. The close correlation between food and oil prices is evidence of the close relation between energy and food. Higher energy prices also induce increased hydropower production, which can enhance or reduce food production outcomes. Ensuring increased energy production through hydropower development has been a long-term strategy in the GMS (see, for example, MRCS, 1995). Limited empirical evidence seems to indicate that hydropower development, focused on increasing energy supplies, supports irrigation

but reduces access by the poor to inland capture fisheries in the Mekong Basin (see, for example, Ringler, 2001; MRC, 2006; Johnston *et al.*, 2009).

Bioenergy development has been promoted to increase energy security and support climate mitigation goals. However, this strategy also competes with food production for water, land, and other natural resources. According to IFPRI research, biofuel development added 30% to weighted average cereal prices during 2000–2007. This affected maize prices the most, with increasing biofuel demand estimated to account for 39% of the increase in real prices. Increased biofuel demand is also estimated to account for 21% of the increase in rice prices and 22% of the rise in wheat prices (Rosegrant, 2008). In the GMS, Cambodia, Thailand, and Viet Nam have limited production of bioethanol from cassava and sugarcane. Thailand is the third largest biodiesel producer from palm oil, after Indonesia and Malaysia.

Table 6: Characteristics of the Four Energy Scenarios

Scenario	Description of scenario assumptions	Translation into IMPACT
IEA 450	Energy pathway consistent with the 2° Celsius goal through limitation of the concentration of greenhouse gases in the atmosphere to 450 ppm CO ₂ -equivalent by 2080	Growth rates of biofuel demand increased, as follows (2035 values): <ul style="list-style-type: none"> – 142% for OECD North America – 57% for Latin America – 81% for EU – 102% for Non-OECD Asia – 150% for Africa – 450% for OECD Pacific – 150% for Eastern Europe and Eurasia – 100% for the Middle East
Higher energy prices	<ul style="list-style-type: none"> • Doubling of oil prices in 2050 compared to baseline • Higher fertilizer prices 	<ul style="list-style-type: none"> • Annual growth rate of biofuel sector's demand for feedstock (first generation) increased throughout the projection period (2000–2050) so that biofuel sector's demand for feedstock (first generation) increases by 67% in all countries and crops in 2035 • Annual growth rate of fertilizer prices increased by 75% throughout the projection period (2000–2050), which corresponds to an increase in fertilizer prices by an average of 103%
Biofuel technology pessimistic	Second generation biofuels start 10 years later (in 2039 instead of 2029)	Year in which second generation biofuels start: 2039 (instead of 2029)
Higher energy prices and higher productivity	<ul style="list-style-type: none"> • Doubling of oil prices in 2050 compared to baseline • Higher in fertilizer prices by an average of 103% • Productivity growth rates for all crops increased by 20% 	<ul style="list-style-type: none"> • Annual growth rate of biofuel sector's demand for feedstock (first generation) increased throughout the projection period (2000–2050) so that biofuel sector's demand for feedstock (first generation) increases by 67% in all countries and crops in 2035 • Annual growth rate of fertilizer prices increased by 75% throughout the projection period (2000–2050), which corresponds to an increase in fertilizer prices by an average of 103% • Productivity growth rates for all crops increased by 20%

The following section presents the impact on food and water in the GMS of four energy scenarios—current policies, higher energy prices, biofuel technology pessimistic, and higher energy prices and higher productivity—on world prices, malnutrition, trade, and crop areas, analyzed with the IMPACT model.

4.2 Energy Scenario Description

The first scenario, IEA 450, describes an energy pathway consistent with the goal of a 2° Celsius temperature increase by 2080 through limitation of the concentration of greenhouse gases in the atmosphere to 450 parts per million (ppm) carbon dioxide (CO₂)-equivalent, based on the International Energy Agency's Energy Outlook (IEA, 2010). Under this scenario, renewables supply 45% of total electricity and 20% of total heat by 2035, while oil production peaks before 2020 and declines steadily to 2035. The share of biofuels in total transport fuel supply reaches 14% in 2035. To achieve such a high level of renewable requires increased investment in and expansion of renewable energy sources, including biofuels. As a result, growth rates of biofuel demand increase by 57% to 450% by 2035, depending on geographic region. We extrapolated growth from 2035 to 2050 at the 2025–2035 growth level. The other three scenarios are based on specified changes relative to the IEA “current policies” scenario, a reference scenario that postulates business as usual, with an increase in energy demand of 1.4% per year through 2035. The IEA current policies scenario is used in the IMPACT baseline described above.

The second scenario, higher energy prices, postulates a doubling of baseline oil prices by 2050, resulting in both higher fertilizer prices, a key input to agricultural production, and accelerated demand for biofuels. Under this scenario, biofuel demand for feedstocks (first generation) increases by 67% in all countries and crops by 2035. Moreover, annual growth rate of fertilizer prices increases by 75% throughout the projection period (2000–2050), which corresponds to an increase in fertilizer prices, on average, of 103%.

The third scenario, biofuel technology pessimistic, assumes that second-generation biofuel development is postponed by 10 years, putting additional pressure on the use of first-generation technologies to meet fuel standards.

The final scenario, higher energy prices and higher productivity, examines whether higher agricultural productivity growth can offset the impacts of higher energy prices on food prices, consumption, and food security. This

scenario assumes the same implications for fertilizer and biofuels as the higher energy prices scenario, but also includes a 20% increase in crop yield growth.

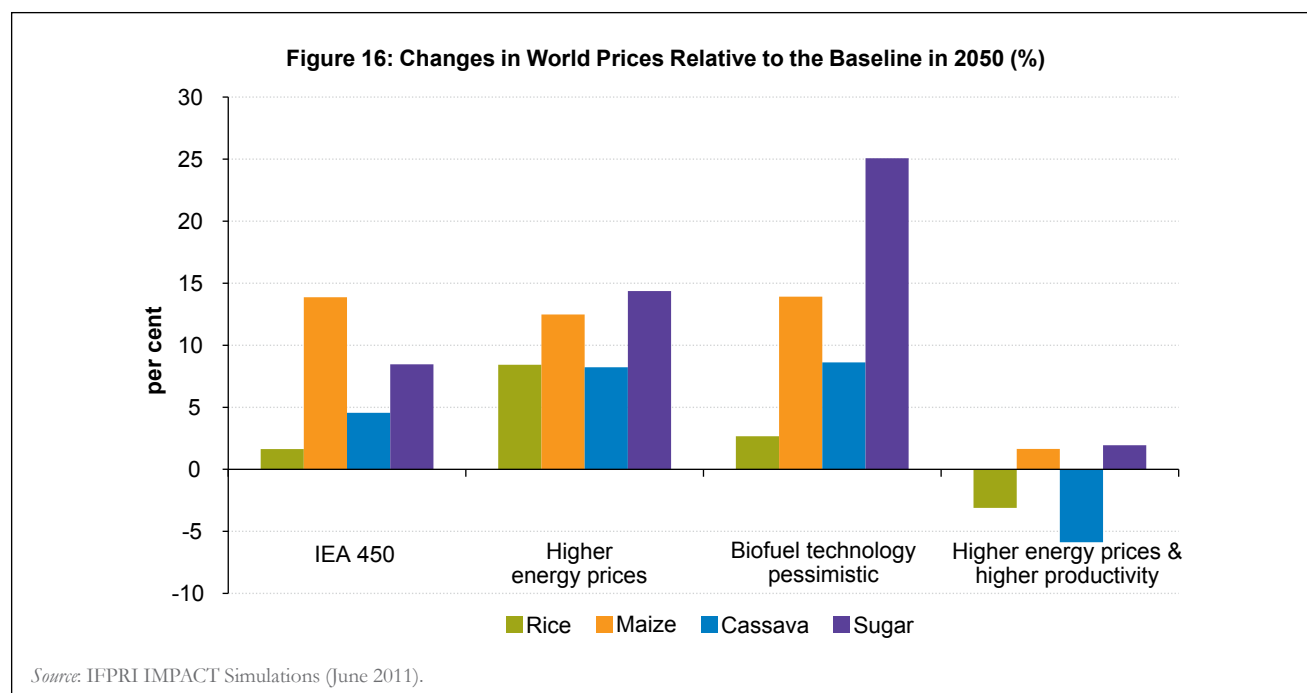
We present results for these four scenarios for four key food and biofuel crops in the GMS: rice, maize, cassava, and sugarcane. The scenario results are presented in terms of relative and/or absolute changes relative to the IMPACT model baseline by 2050.

4.3 Energy Scenario Results

Changes in energy prices have large impacts on world food markets as evidenced by impacts on global food prices (Figure 16). Under the IEA scenario, maize prices increase by 14% and sugar prices by 8%, while cassava and rice (generally not a biofuels crop) are less affected. Under the higher energy prices scenario, prices increases are somewhat similar for the biofuel crops, by 12% for maize and 14% for sugar, but higher fertilizer prices affect all crops, and rice and cassava prices also increase by almost 10% over the baseline. The biofuel technology pessimistic scenario, which assumes a delay in getting second-generation feedstock technologies online, has very large negative impacts on first-generation feedstock: maize prices increase by 14%, sugarcane by 25%, and palm oil by 21%. If investment in agricultural productivity responds to higher energy (and resulting higher food prices), then food markets will respond in the longer term, resulting in lower food prices across all crops. For the crops of importance in the GMS, this policy would result in maize and sugar price increases of only 2%, while palm oil prices would be 1% higher, and wheat, rice, and cassava prices would be 1%, 3%, and 6% below those of the reference scenario.

Higher energy prices do not only push up food prices, but also put pressure on expansion of crop area: under the IEA 450, higher energy prices and biofuel technology pessimistic scenarios, crop area expands for all four crops, but particularly for the biofuel feedstocks: maize and sugarcane (Table 7). Results shown here include the five lower Mekong countries, and for the PRC only the Lancang Jiang (Mekong) area. The higher energy prices and higher productivity scenario leads to a small decrease in rice and cassava areas and a small increase in maize and sugarcane areas as productivity growth more than outstrips pressure on land expansion, at least in the GMS.

Trade is an important means to balance climate, energy, and other shocks to agricultural production. Net trade

**Table 7: Crop Area Changes as a Result of the Four Energy Scenarios (%)**

Crop / Scenario	IEA 450	Higher energy prices	Biofuel technology pessimistic	Higher energy prices and higher productivity
Cambodia + Lao PDR				
Rice	0.00	1.10	0.00	-0.60
Maize	3.10	2.60	3.00	0.60
Cassava	0.40	0.80	1.00	-0.90
Sugarcane	1.90	2.80	5.50	0.80
PRC (Lancang Jiang area only)				
Rice	0.40	3.40	0.70	-1.40
Maize	6.70	5.10	6.00	1.40
Cassava	0.50	0.90	1.10	-0.80
Sugarcane	1.70	2.50	4.90	0.70
Myanmar				
Rice	0.30	2.40	0.50	-1.00
Maize	4.00	3.10	3.90	0.80
Cassava	0.40	0.70	1.00	-0.80
Sugarcane	1.70	2.60	4.90	0.60
Thailand				
Rice	-0.20	2.00	-0.10	-1.10
Maize	4.60	3.80	4.40	0.90
Cassava	0.50	0.90	1.10	-0.90
Sugarcane	2.00	3.20	5.90	0.70
Viet Nam				
Rice	-0.30	1.90	-0.10	-1.10
Maize	4.70	4.00	4.60	0.80
Cassava	0.40	0.70	1.00	-0.80
Sugarcane	1.70	2.60	4.90	0.60

Source: IFPRI IMPACT Simulations 2011.

in rice is least affected under the alternative energy scenarios. Rice exports decrease slightly in the GMS countries under the higher energy prices scenario, by 2.5%, and slightly increase under the remaining scenarios. Net trade for cassava also remains relatively unaffected by the energy price changes but both sugar and maize net trade change significantly under all scenarios. Net maize imports decline by 34% and by 32% under the IAE 450 and biofuel technology pessimistic scenarios, respectively, as maize is redirected to use as biofuels, particularly in the United States. Under the higher energy prices scenario and the higher energy prices and higher productivity scenario net maize imports also decline, by around 12%, but for different reasons. Higher energy prices increase the cost and reduce the access to maize use as food, whereas under concomitant higher productivity, the need for expanding imports is reduced. For sugarcane, net exports increase under all alternative energy scenarios; with the highest increase in net exports under the biofuel technology pessimistic scenario, where the subregion increases net exports by 25%. Under the other energy scenarios, the subregion increases net exports by 4%–8%.

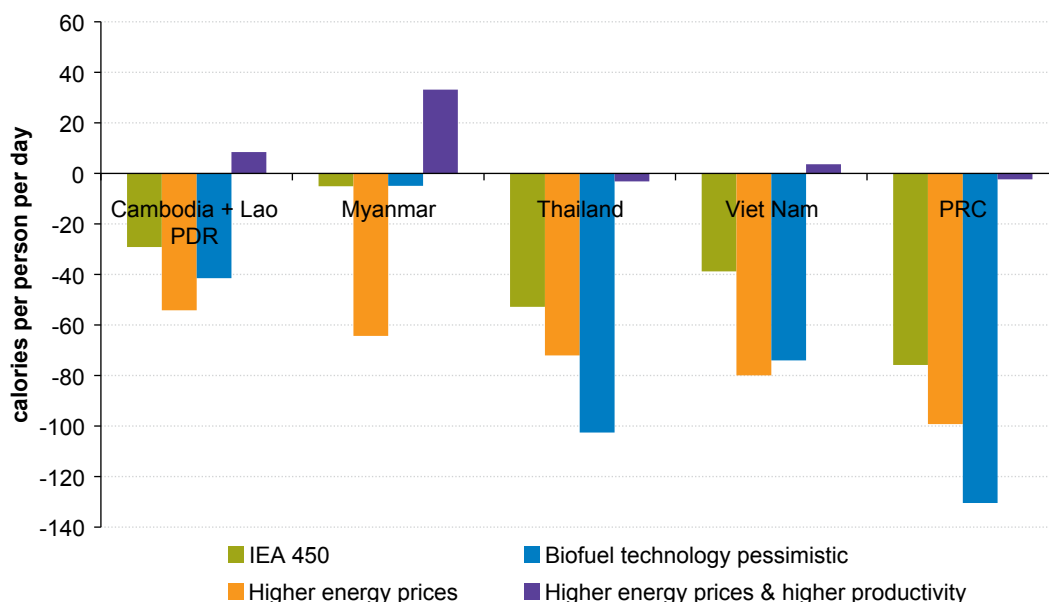
In the PRC, the energy scenarios result in sharp declines in net maize imports, by 76% and 69% under the IAE 450 and biofuel technology pessimistic scenarios, respectively; and by 19% and 17% under the higher energy prices scenario

and the higher energy prices and higher productivity scenario, respectively. Changes in net imports for sugarcane are relatively small, while net imports for cassava increase significantly and almost triple under the biofuel technology pessimistic scenario, given that cassava is used for biofuel production. Finally, rice exports, which are estimated to be very low by 2050, decline by 30% under the higher energy prices scenario, but increase by 7% under the IAE 450 and biofuel technology pessimistic scenarios.

Higher food prices reduce affordability of food, and thus dampen food consumption. The IEA 450, higher energy prices, and biofuel technology pessimistic scenarios result in a decline in calorie availability. For Cambodia together with the Lao PDR, Myanmar, and Viet Nam, the decline is strongest for the higher energy prices scenario, whereas for the PRC and Thailand, the drop is largest for the biofuel technology pessimistic scenarios. The overall largest decline, by 130 calories, is observed for the PRC under the biofuel technology pessimistic scenario, while the higher energy prices and higher productivity scenario leads to an increase in calorie availability for Myanmar (33 calories per person per day); impacts for the other countries are negligible (Figure 17).

Larger price increases correspond with larger increases in the population at risk of hunger as well as child

Figure 17: Change in Calorie Availability Relative to Baseline by 2050



Source: IFPRI IMPACT Simulations (June 2011).

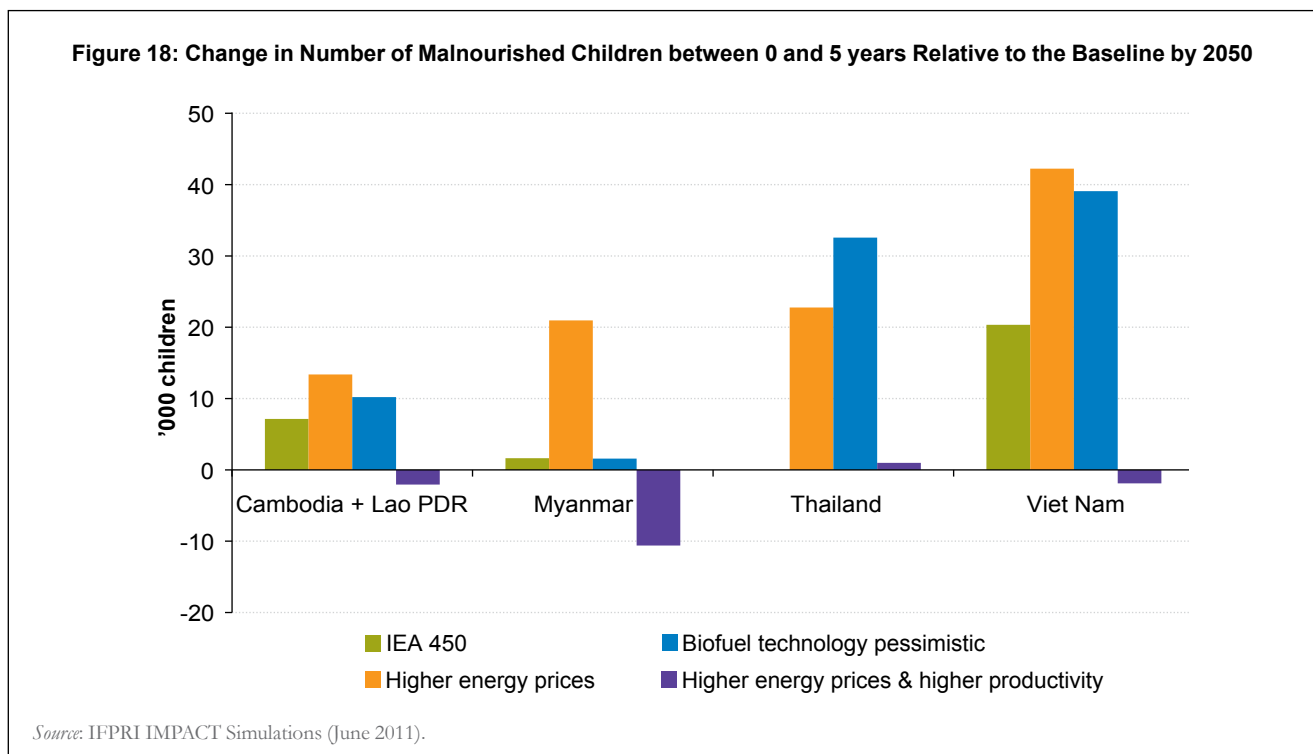
malnutrition. The higher energy prices scenario leads to more than 42,000 additional malnourished children in Viet Nam. Under the biofuel technology pessimistic scenario, Thailand experiences a 5% increase, or 33,000 more, malnourished children. Under the higher energy prices and higher productivity scenario, malnutrition number barely change, by 0.3% for Cambodia together with the Lao PDR, Thailand, and Viet Nam, and decrease by less than 2% for Myanmar (Figure 18), showing that higher agricultural productivity can offset much of the negative impact of higher energy prices.

In terms of population at risk of hunger, the highest absolute increase is observed for the higher energy prices scenario for Myanmar, with an increase of the population at risk of hunger by 1.5 million people. In terms of relative changes, the increase is largest for Thailand, with a 20% increase in the population at risk of hunger under the higher energy prices scenario, and a 25% increase under the biofuel technology pessimistic scenario. Consistent with the results for calorie availability, the higher energy prices and higher productivity scenario prompts a decrease in the population at risk of hunger for Myanmar (– 4%, or – 0.7 million people) compared to the baseline. For other countries, the higher productivity scenario also virtually eliminates the negative impact of higher energy prices on food security.

5. Conclusions

The GMS is rich in natural resources and has large populations dependent on agriculture for their livelihoods. However, under business as usual, agriculture will have to face a number of new and difficult challenges. Food security will likely still be a problem 50 years from now. Agricultural production is going to be increasingly constrained by competition for land and water. Water will increasingly be transferred out of agriculture to meet domestic and industrial demands; at the same time, expansion of agricultural production will require increased irrigation water resources.

There is also heightened global concern for potential impacts on agriculture of future climate change and climate change response policies. Rising energy prices, biofuel demand, and other supply and demand drivers will lead to higher agricultural prices. Regional and national income growth, urbanization, and growing global inter-connectedness are expected to increase diet diversification and homogenization. Trade liberalization and greater integration of global food markets can support more reliable food supplies and lower food prices. But food security will remain out of reach of key constituents in the GMS, particularly in Cambodia and the Lao PDR. Many of the negative impacts of water scarcity, climate change, and



rising energy demand are global in nature, and will require broad global efforts to solve. But countries in the GMS can also reform their own policies to improve food security.

The scenario on high energy prices and high agricultural productivity shows that the “food and water versus fuel” tradeoff in agriculture can be reduced if innovations and technology investments in crop productivity are higher. Both improvements in biofuel conversion and crop productivity reduce the tradeoffs. Finally, biofuel development has provided new incentives for crop breeding for productivity improvement in biofuel feedstock crops.

Growing pressure on food supply and natural resources requires new investments and policies for the GMS. Under tightening food markets, a business-as-usual approach to agriculture cannot meet the development and sustainability goals of reduction of hunger and poverty; the improvement of rural livelihoods and human health; and equitable, environmentally sustainable development. Innovative agricultural technology policies, reform of management of both agricultural and natural resources, and enhanced public-private partnerships, making food security “everyone’s business,” will be essential in the years ahead. Such policies will also require more investment in agriculture. The PRC is the regional and global leader in investment in agricultural research and development. While difficult to replicate in the rest of the GMS, lessons should be learned on what can and what would not work there.

In the water sector, the GMS countries need to move rapidly toward improving water use efficiency in the agriculture sector, expanding traditional water conservation measures of canal lining with real reforms in water management. Elimination of demand side measures, such as the recent removal of irrigation fees in Viet Nam, will make it more difficult to implement reforms. Second, the countries in the GMS, particularly Viet Nam, need to increasingly prepare for climate change adaptation. The focus here needs to be two-fold: early warning and preparedness for extreme events, both floods and droughts; and investment in capacity, infrastructure, and research and development to cope with gradual, long-term changes in sea-level rise, and hotter weather. Given that all countries in the GMS tend to be affected at the same time by droughts and floods, as the 2010 and 2011 events have shown, climate change has opened an opportunity for the GMS countries to work together to mitigate adverse and enhance positive impacts from a changing climate. Technology transfer and joint

learning and capacity building events would be essential elements for such a cross-GMS collaboration.

To reduce adverse impacts of energy prices on water and food in the GMS, it will be important to work toward a global commitment to reduce both subsidies and mandates for biofuels and to liberalize trade in biofuel products, so that those countries and players who have a comparative advantage can produce biofuels with the least adverse impacts on water and land. Moreover, under a tighter water, land, and energy picture, that is, a situation where demand may outstrip supply, costs of subsidies for water and energy are rapidly increasing, putting further constraints on already strained agricultural budgets in Asia and elsewhere, reducing funds that might otherwise be available for agricultural research and development. Reduction in subsidies and shifting of funds to investments in agricultural productivity growth would have substantial benefits.

Biofuel policies and other climate mitigation policies also need to be strengthened to increase pro-poor access, through the development of production processes that bring benefits to the poor. An example is rural biogas systems using livestock waste in northern Viet Nam. Moreover, biofuel and energy saving production systems should be designed toward integrating rural households into the value chain, allowing for on-farm addition of value, rather than just extracting raw biomass. Finally, localized biofuel development provides a real pro-poor opportunity to expand electricity to those areas in the GMS still not served by the electricity grid, by producing household electricity and lamp oil.

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GENDER AND REGIONAL ECONOMIC INTEGRATION IN THE GMS: ROLE OF CROSS-BORDER TRANSPORTATION DEVELOPMENT¹

Kyoko Kusakabe²

Abstract

This paper analyzes, through three case studies, the changes in women's and men's livelihoods at the border areas of countries in the Greater Mekong Subregion (GMS) after the development of cross-border road networks. Roads provide access for formerly marginalized villagers to the market and social services, and facilitate employment and income-generating opportunities. However, varied levels of impact and benefits are enjoyed across gender, ethnicity, and class. The paper argues the importance of analyzing the effects of road development in specific situations in order to obtain an in-depth understanding of the impact.

1. Introduction

Globalization has increased the mobility of goods and people. To strengthen the economy, regional economic integration has been facilitated around the world and the Asian region is no exception. The Association of Southeast Asian Nations (ASEAN), South Asian Association for Regional Cooperation (SAARC), and Greater Mekong Subregion (GMS) are all aiming to strengthen their regional economic connections; cross-border transport facilities are one of the core activities to achieve this aim. Documents by international organizations reveal widespread support for cross-border road infrastructure development:

[Cross-border infrastructure projects] enlarge market access, reduce economic distance and facilitate trade, investment, and labor flows. The

¹ This paper is based on selected cases from the forthcoming book *Gender, roads and mobility in Asia* (Practical Action Publishing). The author would like to acknowledge the support of Japan-ASEAN solidarity fund of ASEAN Foundation through the project "Capacity building for gender, poverty and mobility analysis of road transportation development in GMS region".

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resulting intensification of cross-border economic activities can create employment, particularly in the labor-intensive sectors of DMCs (Developing member countries), thus contributing to poverty reduction. (ADB, 2006a p. 8)

However, who will be able to benefit from such infrastructure development? As Dobbs (2007) rightly noted, transportation planning has not always included social analysis.

Research into transport planning and practice has consistently failed to apply a social science perspective to transport policy or to fully understand the way in which social organizations can play a role in determining patterns of transport and travel. (Dobbs, 2007 p. 86)

2. Cross-Border Road Development in the GMS and Development of Border Towns

International roads in Cambodia, the Lao People's Democratic Republic (PDR), Myanmar, Viet Nam, and Thailand total 20,132 kilometers (km); they are part of the ASEAN highway network, which consists of 26 roads totaling 37,193 km in 10 ASEAN countries (Regmi and Hanaoka, forthcoming). Road connectivity complemented by the Cross Border Transport Agreement (CBTA) and other bilateral agreements facilitates close trade linkages between these countries. The contribution of transport to gross domestic product (GDP) varies from 4% to 10% in GMS countries (ESCAP, 2009; cited in Regmi and Hanaoka, forthcoming). The cross-border highways not only increased trade and investment but also created flourishing border towns (Kammeire, forthcoming). This paper introduces studies conducted in the following border towns: Tachilek, Myanmar, and Mae Sai, Thailand; Laiza, Myanmar, and Jiego, People's Republic of China (PRC); and Huayxay, the Lao PDR, and Chiang Khong, Thailand.

3. Gender Impact of Roads and Mobility

It has long been pointed out that road development can increase disparity (Leinbach, 2000; McCall, 1977), and since the 1970s, women's access to transport has been explored along with its implications for gender inequalities (Dobbs, 2007).

Major gender issues identified in the literature³ are as follows:

1) Women's triple burden that restricts their mobility: Because of women's reproductive work, they are not expected to travel far from home.

2) Cultural restriction on women's mobility: Women's travel restriction is exacerbated by their cultural seclusion. In some societies, women are not permitted to travel alone.

3) Women's access to means of transportation: Few women ride motorbikes or private cars, and even fewer own them. Women often have less priority than men in using vehicles owned by the household. Women sometimes have difficulty accessing public transportation because of security concerns.

4) Women's different travel needs: Because of the gender roles, women's travel needs differ from those of men. For example, they need more convenience in transport for fetching water and fuelwood, sending children to school, etc.

Women's lesser access to transport has various effects:

- Girls' education: Difficulty in going to school can discourage girls from continuing their education.
- Access to health services: Maternal mortality is high when transport to hospitals is not easily accessible.
- Access to information and training: Since women are expected not to travel, they often do not attend training outside their villages, and hence have less access to information.
- Opportunity for social visits and strengthening their social capital: If women travel less, they will have fewer opportunities to make new contacts or strengthen old ones.
- Health: Women carrying heavy load on their heads or on their back can affect their health.
- Women's time burden in fetching water and marketing goods.
- Opportunities for income-generating activities.

The negative impacts of transport development on women include the following:

1) HIV/AIDS: Road development has implications on the prevalence of HIV/AIDS, and how women become more vulnerable to infection (ILO, 2006).

2) Lost markets and business: Highways can eliminate roadside stalls where women have been selling their wares.

3) Road safety: Women are not necessarily more vulnerable to road accidents (Turner and Fouracre, 1995), but they are the ones who look after the family members, especially those injured or disabled by road accidents. Women spend more time looking after children to prevent them from being injured by vehicles. For example, in the Lao PDR, fearing that without their constant supervision, children would run onto the road, women stopped travelling out after a highway was built in front of their village (Kusakabe and Saphakdy, 2010).

Even though the gender effect of road development has been discussed for the last 40 years, the level of gender mainstreaming in the transport sector remains low. Bamberger and Lebo, (1998; cited in Peters, 2001) reported that in fiscal year 1997, only 4% of World Bank's projects included gender component or gender actions. In comparison, 67% of the projects in population, health, and nutrition and 35% of the projects in agriculture included a gender component. A gender review of ADB loans revealed that 29% of all loans during 1998–2004 had effective gender mainstreaming, while only 3% of all loans in the transport and communication sector during 2002–2004 had such a component (ADB, 2006b).

As Mandel (2004) said,

By addressing women's ability to be mobile, development scholars and practitioners may provide opportunities for women to enhance their income generating capacity. In so doing, they may also open up spaces within which women can gain greater autonomy and independence. Facilitating mobility for women may well provide them with opportunities to reconfigure the gender ideologies that shape their lives. (p. 284)

Kronlid (2008) and Cresswell (2006) noted that mobility is a capability. And as capability, it will be different for each individual; thus, we need to make specific analysis of each case in order to understand the implications of road development to women's mobility, livelihoods, and relations.⁴

3.1. Case 1: Border development and livelihood diversification in Houayxay, Lao PDR

National Road Number 3 (NR3) links Thailand and the PRC via the Lao PDR. A study of four villages by Thammanosouth *et al.* (forthcoming) in Bokeo Province, with different degrees of connectivity through the NR3,

³ Porter, 1995, 2002; Turner and Fouracre, 1995; Fernando, 1998; Law, 1999; Leinbach, 2000; Fernando and Porter, 2002; Tanzarn, 2003; Mandel, 2004; Riverson *et al.*, 2005; Parikesit and Czuczman, 2006; World Bank, 2006; Gajewski *et al.*, 2007.

⁴ see also Wisner (2001) for the need to have a case specific analysis in order to have an indepth understanding of people's vulnerability.

found that road development does not necessarily improve people's mobility, and men get more mobility than women. Also, road development does not automatically improve income or income-generating opportunities, nor does mobility necessarily lead to better income. The study also found that an increase in women's income does not change the gender division of labor at home.

The four villages in the Thammanosouth *et al.* study were: (i) a village located near a border checkpoint, (ii) a village located near the border city center and along the road, (iii) Lao Lum (lowland Lao PDR) village located far from the border and city center but along the road, and (iv) Lao Thung (highland Lao PDR) village located far from the border and city center but along the road. Almost 25% of the respondents (18 out of 73 households) reported having multiple sources of incomes after NR3 was completed. The study found that the first two villages diversified their income sources with burgeoning border trade; tourism creating more opportunities for them; the other two villages have not changed their income source much. However, women in the border village were having more difficulty competing with larger businesses which started to operate with the development at the border. Around 30% of the respondents at the border town said that their income decreased with the border and road development. They enjoyed good business when the border town was still small, but when the economy started to grow, they began to lose out. However, the second village was able to take advantage of the growing border town by diversifying into trade while still depending mainly on agriculture. Women in this village were much in control of both the agriculture activities as well as trade. In the last two villages, opportunity to diversify income was small, since they were far from the border town. However, in Lao Thung village, whatever opportunity that was there to benefit from the border trade, was obtained by men, since men were the ones who were mobile while women were expected to stay at home. In Lao Lum village, that was not the case. There, men respondents were more enthusiastic about the development of the cross-border highway. All men interviewed said that agriculture prices increased after the highway development, while 40% of women respondents said that there was no change in price.

Although women were losing out in the border towns, the increased income-generating opportunities and associated income shifted some of their reproductive work to other people. In the border towns, women became busier and needed to spend more time for their business because of increased opportunities and higher competition. Cooking

is now done by other women in the households (such as grandmother, etc). In the outer town village, there is a higher opportunity to sell agricultural goods, and women are getting busier in both farming and trading activities. So, women are doing less cooking and women and men cook together. Similar tendencies are seen for washing clothes. Especially in border towns, clothes are now being outsourced to laundry services.

3.2. Case 2: Livelihoods at the Myanmar Border

To evaluate the impact of cross-border road development on rural livelihoods in Myanmar, Win Myo Thu (forthcoming) studied 247 respondents in 7 villages along the Kyaing Tong–Tachilek road in Shan state, northeastern Myanmar, which crosses the border at Mae Sai, Thailand, and constitutes part of the Asian Highway Number 2 (AH2). Win Myo Thu selected three sets of villages with varying access to transport facilities, such as roads and public transport: (i) villages located on the AH2 route, with good connectivity through public transport, allowing people to commute to the border in a day (termed *border villages*); (ii) villages located along the AH2, but lacking public transport facilities to commute to the border in a day (*highway villages*); (iii) villages located away from the AH2 and lacking public transport facilities (*distant villages*).

Win Myo Thu's study showed that people in the study villages depend on Tachileik road to access health services. However, since the highway and distant villages are far from the border, they are more dependent on traditional health practitioners, while nearly half (48%) of the border villages respondents sought health care in Tachileik. This was also seen in the significantly better situation in border villages for such diseases as malaria, tuberculosis, and waterborne diseases than in the other two villages. The respondents, both women and men, in border villages expressed higher satisfaction for the healthcare access with the road development than did respondents in the other two types of villages.⁵

Border villages relied more on non-agriculture income; the other villages relied on agriculture. It is the men who are engaged in non-agriculture activities, so men now enjoy more employment opportunities than women in border towns. While more than 70%–80% of the respondents in highway and distance villages replied that both husband and wife worked together to earn incomes, in the border villages, only around 40% said so and other 40% said

⁵ Note that all the studied villages were patriarchal in practice.

that only men earn incomes. More than 70% of border village respondents said that men are the ones who borrow money, while 0% in highway villages and 44% in distant villages did so. Women in the border villages found that they are now more marginalized economically, which is also reflected in their perception about the changes after the road improvement. Women in the border villages perceived income increase and family happiness to be significantly lower than did men in their own village and women in other villages. In-depth interviews showed that they were worried about their future because of unstable income. Community decision making was much more skewed to men in border villages than in other villages.⁶

3.3. Case 3: State-Facilitated Route and People's Route from Myitkyina, Myanmar to Jiego, PRC

Khin Hnin Phyu (forthcoming) studied the traders of Myitkyina in Kachin State, Myanmar, who trade with the PRC, and how the state's policy to change trade route has affected their trade. Traders in Myitkyina have been trading with the PRC, taking vegetables from Myanmar to the PRC, and bringing consumer goods and machinery/construction materials from the PRC to Myanmar. From Myitkyina, they go to Laiza (69 km; costing \$10) and from there, cross the border to the PRC and go to Yingjiang and then to Ruili and Jiego trade zone. The whole route is 160 km, taking 4.5–5.5 hour, with total transportation cost of \$20. Almost all the vegetable traders are women, and many do not even cross the border. But those women who trade in both agriculture goods and consumer goods go to Ruili and Jiego. This route is the shortest and cheapest route, and controlled by the "cease-fire group." Since the transportation cost is low, traders can start businesses with little capital.

An alternative trade road to the PRC from Myitkyina was recently constructed by the Myanmar Government. The Myitkyina-Teng Chong road is around 224 km, takes around 5.5 hours to Teng Chong and costs \$40. Goods in Jiego are cheaper than in Teng Chong, so traders prefer to use their old road to trade with the PRC. Also, along the new government-constructed route, there are checkpoints, where traders need to undertake paperwork, which is an additional cost and a barrier for them. Only large exporters are able to prepare such paperwork, and

⁶ In the border village, more than 70% of men, but only 11% of women, replied that they were actively participating in village development organizations. In the other villages, 25% of women and 25% of men said that they were actively participating in village development organizations.

small traders need to bribe their way through. In order to discourage traders from using the old route, the Myanmar Government has been strict in confiscating goods along the old Myitkyina-Laiza road.

Khin Hnin Phyu's study show that both women and men who had long experience in trade (more than 10 years) were able to increase their income after the new road construction, but women traders with less experience (less than 6 years) reported decreases in income. None of the men or more experienced women traders reported loss. Those who have long years of experience have established good relations with Chinese merchants; thus are able to obtain credit and expand business as well as recover from the confiscation of their goods. Men were engaged more in machinery trade, such as motorbikes. However, they tended to take a "bush" road, avoiding both the state constructed road and the old road, and hence able to avoid confiscation and arrest. Those who were most affected by confiscation and collection of fees from authorities were women trading in consumer goods, rice, and garlic. These women were able to increase their sales but their costs also increased, making them lose business in the end.

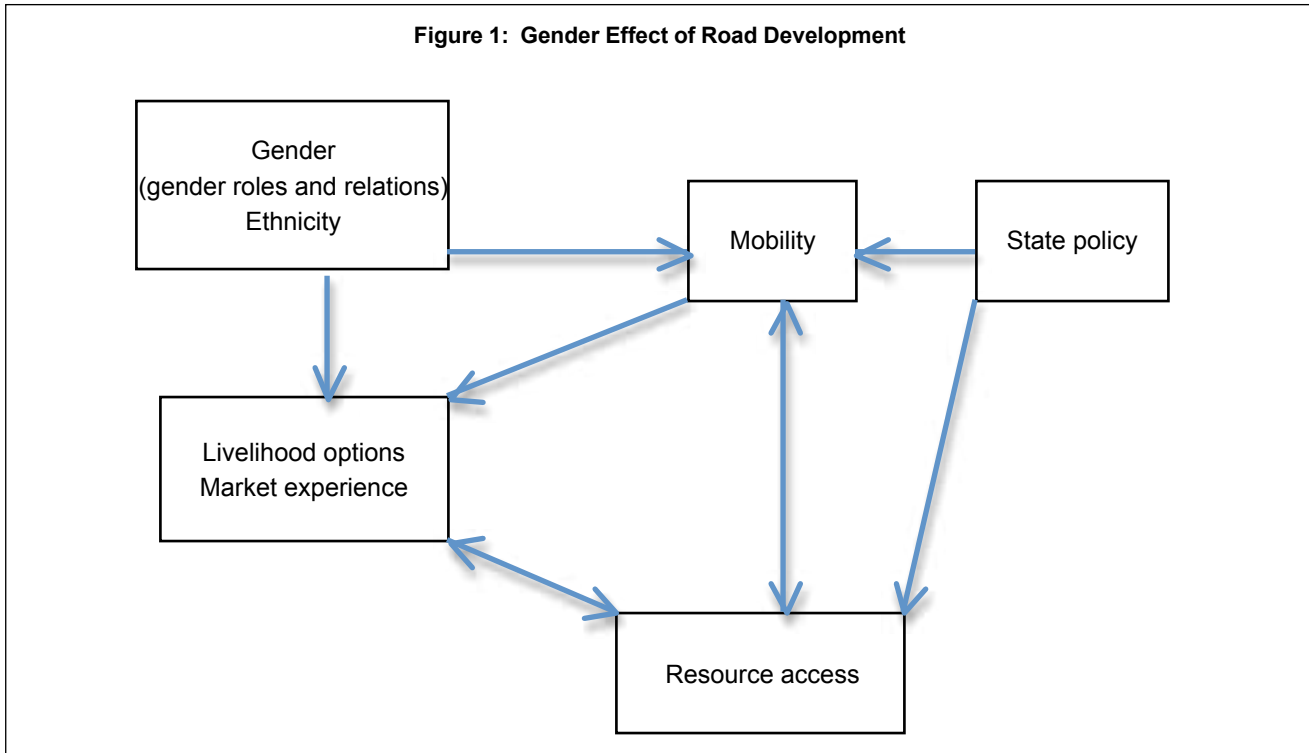
Women traders of consumer goods had the least negotiation power with consumers and the authorities. They also could not diversify to other products or other routes, since most women, with their domestic responsibilities, do not have time to explore new markets and routes.

4. Discussion

The paper has explored the gender impact of road construction in three cases in GMS.⁷ From the literature and the cases discussed, we can summarize the gender effect of road development as follows. First, gender roles and relations as well as ethnicity determine women's and men's mobility as well as their business characteristics, experience in the market, and livelihood choices. For example, the Lao-Thai case showed how different ethnic groups responded differently to road development and market access. The Myanmar-PRC case showed how gender determines the type of trade they pursue and thus, the effect of road development. It was also pointed out that women were not able to diversify their trade since they were less mobile and could not travel to find new markets.

⁷ More than 13 cases from GMS are included in the forthcoming book *Gender, roads and mobility in Asia*.

Figure 1: Gender Effect of Road Development



The Myanmar-Thailand case showed how gender roles divide the benefit that women and men can enjoy from road and border development. In this case, women were seen to be less mobile than men because of women’s domestic responsibilities.

Second, different mobility is related to the resources that women and men can access, and hence to their livelihood/business options. For example, because the mobility of Myitkyina women traders was restricted, they were not able to diversify their trade or expand their network. In the Tachilek case, women were not able to earn independent incomes because they had to stay home; this was because men’s mobility had increased and they were often out of the house.

Third, state policy influences mobility and resource access. The Myitkyina case showed the gender effect of the state’s forcing traders to use a road constructed by the state. There were differences between women and men and also among women in how much they were able to negotiate with the authorities and suppliers/buyers.

Figure 1 is an illustration of this summary. This shows how mobility as capability (Cresswell, 2006; Kronlid, 2008) is determined by gender and determines gender differences in livelihood options as well as gender differences in the effect of state policy. This paper argues that the effects of

road development on women and men are determined by various factors that constitute capability of individuals, and hence need specific analysis of specific cases in order to have an in-depth understanding of gender effects.

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WATER - ENERGY NEXUS: SUSTAINABLE URBANIZATION IN THE GREATER MEKONG SUBREGION

Peter Rogers¹

Abstract

This paper assesses the current energy demanded by urban water in the Greater Mekong Subregion (GMS), predicts how large the future demands could be, and reviews technical options for resolving the urban water-energy nexus in the GMS. A simple model was constructed for the water and energy uses for the largest 10 cities in the GMS and for each of the national entities, with projections into the future. The model showed that despite the relatively low rates of total population growth in the region, urban populations are likely to rise by about 60% by 2030, but the large cities in the region will only experience a modest increase of about 30%. This implies that there will be big population increases in the smaller cities and towns in the region. The really surprising result is that in the face of a 60% increase in population there will be a doubling in the demands for urban water supply and management because of increasing development and the push toward attainment of the Millennium Development Goals. This implies for Viet Nam a use by 2030 of 91% of the total water used in 2005 just for urban municipal and industrial uses, and as low as 19% for Myanmar. For Viet Nam it may be difficult to meet the needs of agriculture and other water users if its urban needs grow so rapidly. Typically in the region, electricity capacity is increasing to meet demand but, this is not the case with water supply. There are some serious limits on water availability, hence the need to conserve water in this sector. This may be quite difficult given the pressures to expand the actual quantities of water supplied and broaden the coverage of the systems.

1. The Water and Energy Nexus

This paper attempts to put the roles of energy and water into the context of maintaining the viability of the cities in the Greater Mekong Subregion (GMS). Often the word “sustainability” is applied to studies of cities; however, there is nothing that is inherently self-sustaining in modern

cities. The word “viability” best describes what can be achieved in the long run for what can be considered humanity’s greatest creation: cities. Of course, there is a long list of desirable properties associated with the concept of sustainable cities. Overall, the concept of efficient resource use is fundamental. This is strongly related to urban metabolism and urban ecology. This paper takes a narrower look at the interconnection between urban water and sanitation and attempts to show how the viability, or sustainability, of the cities is likely affected by them.

Currently (2009), of the 20 cities in the world with more than 10 million people, 9 are in Asia, and based on United Nations projections (UNDESA, 2009) out of the 10 largest cities in the world by 2050 seven will be in Asia. Over the same period, the percentage of population that is urban will rise from 42% to 65%. These numbers are unprecedented, but just for one country, The People’s Republic of China (PRC), the urban population is predicted to rise to one billion by 2030 (McKinsey, 2009). The UN report forecasts that by 2025 the following Asian cities will be megacities; Tokyo (37 million), Delhi (29), Mumbai (26), Dhaka (21), Kolkata (20), Shanghai (20), Karachi (19), Beijing (15), Manila (15), Osaka-Kobe (11), Shenzhen (11), Chongqing (11), Guangzhou, Guangdong (11), Jakarta (11), and Lahore (10); none of these are GMS cities.

Economic and population growth place an ever-greater demand on energy and finite water resources. Many countries in Asia already face major threats to their ability to provide their people with safe drinking water and food security. Water resources face additional demands with the considerable amounts of water required for energy production to support continuing economic growth. Climate change greatly complicates the water-energy insecurity of many countries. In addition, the demand for food is growing rapidly worldwide and in Asia, but particularly rapidly in East Asia where water and energy are also scarce. Water and energy supplies and limits are crucial to understanding the environmental and ecosystem aspects of sustainable urban development.

2. Why the Focus on the Greater Mekong Subregion?

The overall security of the entire globe is intimately bound up with the success of Asia. Most commentaries on global development view the current era as a period

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when economic and social development will shift from its Western domination to be replaced by the unique development approaches and priorities of Asia. However, many of the same commentators (Goklany, 2007; Cai and Rosegrant, 2010; and Brown, 2011) see serious limitations to the continued economic development of Asia because of population and resource limits, particularly on water and energy.

The GMS, consisting of Cambodia, the Guangxi Zhuang Autonomous Region and Yunnan Province of the People's Republic of China (PRC), the Lao People's Democratic Republic (Lao PDR), Myanmar, Thailand, and Viet Nam, has a current population (in 2010) of about 320 million, of which less than 25% are urban. Nevertheless, there are 4 very large cities: Hanoi (6.5 million), Ho Chi Minh City (5.7 million), Bangkok (5.7 million), and Yangon (4.5 million); and 6 other large cities, Kunming (3.2 million), Haiphong (1.8 million), Phnom Penh (1.3 million), Mandalay (1.3 million), Naypyidaw (0.9 million), and Danang (0.8 million), in the one-million population range. Despite the relatively low rates of total population increase in the GMS region (ADB and UNEP, 2004) in comparison with other low-income regions of the world, the rate of increase in urban populations will be much larger because of the already high population densities in the rural areas. The increasing population has no place to go but to the cities.

The prospects of water shortages in Asia, alone, would be a serious resource-allocation problem, but it will be confounded by climate change and its attendant effects on the hydrology of continents, regions, and nations. Water and energy issues have traditionally been researched as single issues, not as an integrated web of opportunities and limitations, particularly in urban regions. The uncertainties of climate change complicate the resource-management challenges. Studies need to go beyond traditional views of a stationary world in which not only is climate known, but also the future economic and social developments are viewed in similar narrow terms.

Becoming aware of these complex interactions, many countries have spent huge amounts of financial resources to improve their water security. Modern examples of such concerns include Israel's National Water Carrier, the Central Valley Project in California, the PRC's current work on the South-North Water Diversions, and India's attempts to interlink some river basins to bring water to water-scarce regions.

Less well known is the competition for water that exists between the demands for food and energy. For example in the PRC, 76% of the water withdrawn for industrial use was used in the generation of electricity; coal-powered generation is the number one consumer of water in the PRC's industrial sector. So as rapid economic growth leads to large increases in the demand for energy and increased food consumption, countries like the PRC and India find themselves in a serious bind; already their existing water resources are almost fully committed to agriculture and food production, leaving little available for meeting increasing urban and industrial demands. The case of the PRC is particularly severe and the Government is taking it very seriously, not only with massive water diversions (over \$60 billion) but also by beginning to implement water-saving technologies in both the water sector and the energy sector.

According to Goklany (2007) and Brown (2011), access to water and energy will be the major constraints on moving toward a sustainable planet by 2050. The big consumer of water is agriculture and its ability to feed the global populations is in doubt without major improvement in water-use efficiency in agriculture. This paper focuses more on water access in urban areas and its energy implications than on the conflicts over water for agricultural uses. Many of the destination cities of rural-urban migrants, however, are already badly served, having unsafe drinking water and inadequate sanitation. Not only do the cities typically suffer inadequate supplies of potable water but also they will have to find rapidly expanding supplies for their future growth—not an easy task given the industrial and agricultural demands being placed on the same resource base.

Generally, the relationships among urban water and wastewater treatment and their impact on the amounts of energy and types of energy infrastructure needed to meet these growing demands are poorly understood. Urban water has high embedded energy content, using as much as 1.65 kilowatt-hours per cubic meter supplied (NRDC, 2004). Depending on the nature of the water supply options and the location of the resources, meeting the new water demands could increase the total urban energy demands by 10%–15% and electrical energy by as much as 30%. In the United States, for example, as much as one quarter to one half of the electricity used by cities is consumed at municipal water and wastewater treatment facilities. Unfortunately, many of the modern ways of increasing water availability, such as by recycling, greatly increase the embedded energy

demanded. It is commonly accepted that 40% of the cost of desalination and water recovery using reverse osmosis is due to energy. This paper assesses the current energy demanded by urban water in the GMS, predicts how large the future demands could be, and reviews technical options for resolving the urban water-energy nexus in the GMS.

3. Energy Use for Water and Wastewater Management

The amounts and types of energy used in the provision of urban water supply and wastewater disposal depend to a large extent on the current water-use behavior of the populations and the nature of the technologies for supply and disposal. For low-income areas, the per capita water use could be as low as 50 liters per day (lpcd), with only 70% of the population being covered by the water systems and as low as 20% with access to sanitation systems. Working toward attaining the Millennium Development Goals (MDGs) could increase the coverage into the 90% range and increase the demand to 100 lpcd or above. Thus, even without any population increase, the total water demands placed on the GMS urban systems could increase greatly. Rapid population growth will greatly exacerbate the problem.

4. Future Urban Water-Based Demands for Energy

Water supply coverage in the GMS varies widely by country and province. Table 1 reports the most recent United Nations population forecasts (UNDESA, 2011)

for the countries of the GMS split by total and urban populations. The table presents population forecasts to 2030 based on 2010 as the starting point. The table suggests that the urban population in the GMS could reach over 150 million. This is quite small in comparison with the PRC's one billion urban dwellers predicted for 2030 by McKinsey (2009); nevertheless, it represents an almost doubling of the urban population in GMS. This huge increase will severely stress the already weak urban infrastructure and could cause water shortages and sanitation breakdowns leading to major epidemics and possibly social unrest.

Kallidaikurichi and Rao (2010) review the data on the adequacy of drinking water in 23 Asian countries. They spent a great deal of effort on developing the best available database for the region, but were critical of the quality of available national and local data for serious policy analysis. Their book developed an index of drinking water adequacy, which could be used for ranking countries from the point of view of access to safe drinking water; they did not include the associated energy inputs. McIntosh (1993, 1997) assessed water management in 50 utilities in Asia for the Asian Development Bank (ADB). He was able to assemble better quality at a more detailed level than Kallidaikurichi and Rao (2010). His compilation of economic data reveals that the majority of the utilities were unable to cover their operational costs from tariffs alone.

In the most recent summary of progress toward meeting the MDG goals, UN-ESCAP (2010) reported on data from 2008 and projected these forward to the 2015 deadline. Thailand outperformed all of the other GMS countries in both water-supply coverage of the population (98%) and

Table 1: Total and Urban Populations, 2010–2030

Country	Urban Population Assuming % Urban for 2020 and 2030								
	2010 Population (million)			2020 Population (million)			2030 Population (million)		
	Total	Urban %	Urban Total	Total	Urban %	Urban Total	Total	Urban %	Urban Total
Cambodia	14.14	21.41	3.03	15.89	27	4.21	17.36	34	5.87
PRC									
Guangxi	47.19	24.01	11.33	53.17	28	14.64	59.90	32	18.91
Yunnan	44.83	24.00	10.76	50.51	28	13.91	56.91	32	17.97
Lao PDR	6.20	34.45	2.14	7.05	48	3.38	7.75	61	4.70
Myanmar	47.96	35.42	16.99	51.69	44	22.57	54.33	53	28.55
Thailand	69.12	33.48	23.14	72.09	39	27.81	73.32	46	33.62
Viet Nam	87.85	30.79	27.05	99.36	37	36.27	101.48	42	42.59
Total	317.29		94.43	349.75		122.79	371.07		152.21

Source: UNDESA (2011); Yunnan and Guangxi projected from ADB-UNEP (2004).

sanitation (96%). Viet Nam had improved its performance markedly for water supply (up to 94%) but still lagged in basic sanitation coverage (75%). Cambodia, Lao PDR, and Myanmar were improving rapidly in water-supply coverage, but still lagged on sanitation coverage. For Guangxi and Yunnan in the PRC, data in Seetharam and Rao (2010) were used for our projection model. Those economies appear to be progressing quite well toward attaining the 2015 MDGs.

5. Modeling the Future Urban Water-Energy Nexus

In order to assess the magnitudes of potential conflict among urban water use, urban energy use, and temporal development patterns, I constructed a simple simulation for the water and energy uses for the largest 10 cities in the GMS and for each of the national entities. As with Seetharam and Rao (2010), major data gaps were found. Obvious sources, such as AQUASTAT of the United Nations Food and Agriculture Organization (FAO), the World Bank's rapid assessment framework (ESMAP, 2010), ADB/UNEP (2004), the International Energy Agency's energy data (IEA, 2008), and the Pacific Institute's global water data (Gleick, 2009) were all utilized to assemble a workable database for initial estimations. The Southeast Asian Water Utilities Network's databases on energy use in water and wastewater utilities in Southeast Asia (SEAWUN, 2005, 2007) were very helpful sources. It should be understood, however, that the combination of data from different sources and slightly different dates can be misleading.

Results are given in Table 2; projections of urban water and wastewater supply and treatment by country are made from a 2010 base year until 2020 and 2030. The table reflects the increasing population sizes based on ADB/UNEP (2004) forecasts, on estimates of current water consumption, and estimates of percentage coverage of the population by municipal water supply and sewerage. For future dates, I assumed that the countries are on a path toward meeting the MDGs in terms of coverage and increasing per capita use. Table 2 shows the joint effect of increasing urban populations, increasing coverage by water systems, and increasing per capita use. Over the 20-year interval there is a two-and-one-half times increase in the demand for water services! This should be a wake-up call for urban planners and governments in the GMS countries—recall from Table 1 that there is only a 60% increase of the urban populations over the same period.

Similar patterns are observed in Table 3, which considers the 10 largest cities in the GMS. The urban populations are projected by the United Nations only until 2025. This table shows a 50% increase in populations from 2010 to 2025, and a twofold increase in urban water used for water supply and sanitation. This implies that there will be large increases in urban growth outside these major cities.

One important question is what are the energy and total resource implications of the shifts in demands for water supply and wastewater treatment? Table 4 shows the implications of the demand increases on the water resource base itself and on the current electrical energy

Table 2: Urban Water Use, 2010–2030

Country	Water Use (million cubic meters per year)											
	2010 Urban water use				2020 Urban water use				2030 Urban water use			
	Total mcm	Water %	Waste %	lpcd	Total mcm	Water %	Waste %	lpcd	Total mcm	Water %	Waste %	lpcd
Cambodia	23.20	81	67	21	92.29	90	90	60	214.26	100	100	100
PRC												
Guangxi	1,004.91	96	99	243	1,325.03	100	100	248	1,725.72	100	100	250
Yunnan	471.29	97	99	120	939.14	100	100	185	1,639.76	100	100	250
Lao PDR	54.57	72	86	70	104.90	75	75	85	171.51	75	90	100
Myanmar	124.03	75	86	20	411.90	86	86	50	729.32	75	90	70
Thailand	1,022.07	99	95	121	1,623.99	100	100	160	2,454.55	100	100	200
Viet Nam	2,152.05	99	94	218	3,110.97	100	100	235	3,885.88	100	100	250
Total	4,852.12				7,608.22				10,821.00			

lpcd = liters per capita per day

mcm = million cubic meters

Source: For 2010, AQUASTAT FAO, 2005; coverage and per capita usage based on Millennium Development Goals.

Table 3: Populations and Water Demands of Big Cities, 2010–2025

Big Cities	Population (million)			Water use (mcm)		
	2010	2020	2025	2010	2020	2025
	Bangkok ^{a, b, c}	6.98	7.90	8.47	308.10	461.48
Danang	0.84	1.15	1.29	66.68	98.30	117.80
Haiphong ^d	1.97	2.43	2.72	156.75	208.60	248.38
Hanoi ^{a, b}	6.50	7.62	8.43	517.21	653.61	769.24
Ho Chi Minh ^{a, d}	6.17	8.07	8.96	490.71	691.95	817.33
Kunming	3.12	3.69	3.92	136.48	249.23	357.24
Mandalay	1.03	1.33	1.48	7.55	24.29	37.92
Naypyidaw	1.02	1.33	1.50	7.48	24.35	38.30
Phnom Penh ^{a, c}	1.56	2.09	2.43	39.91	64.94	88.59
Yangon	4.35	5.46	6.02	31.76	99.57	153.86
Total	33.54	41.07	45.22	1,762.63	2,576.32	3,246.97

mcm = million cubic meters

Note: Hanoi 2020–2025, estimated by author.

a World Bank's Rapid Assessment list (ESMAP, 2010)

b Asian Green City Index list (Siemens, 2011)

c SEAWUN list (2005)

d SEAWUN lists (2005, 2007)

supply for each of the countries (there were no data available for Guangxi and Yunnan). The water supply and sanitation (WSS) water demanded in 2030 will range from 164% of total 2005 municipal and industrial water use for Cambodia to 19% for Myanmar. For the water-sector energy demands as percentages of 2008 electric supply, the 2030 results imply only 1.6% for Thailand and 11.6% for Cambodia (there were no available data for Lao PDR). These results imply that as countries like Cambodia, Lao PDR and Viet Nam become more economically developed, there will be increasing conflicts between agricultural and non-agricultural water use, but

their urban electrical energy use behavior will become closer to that of the industrialized world.

This situation is seen much more clearly in Table 5, which predicts the electrical energy use for the urban water sectors in the 10 large cities in the GMS. The 2030 WSS as a percentage of the 2010 energy use for the cities as a whole takes on some alarming proportions—an average of 15%, with some cities (Mandalay, Phnom Penh, and Yangon), indicating that major attention will have to be given to improving the energy efficiency of the water sector.²

Table 4: Water and Energy in 2030 as a Percentage of Current Total Water and Energy Use

Country	Available Water km ³	2005 M&I Water Use mcm	Urban % 2030/2005	Available Electricity gwh	2030 Elec WSS gwh	% of 2008 Electricity Supply
Cambodia	476	130	164.81	1,835	214.26	11.68
Lao PDR	334	300	57.17	N.A.	171.51	N.A.
Myanmar	1,046	3,820	19.09	6,672	729.32	10.93
Thailand	410	5,500	44.63	149,032	2,454.55	1.65
Viet Nam	891	4,270	91.00	76,269	3,885.88	5.09

gwh = gigawatt hour

km³ = cubic kilometer

M&I = municipal and industrial

mcm = million cubic meters

N.A. = not available

WSS = water supply and sanitation

Note: no data available for Guangxi and Yunnan.

Uses average energy usage of 1.0 kwh/cubic meter for entire water/waste cycle.

Source: FAO, 2010; International Energy Agency (IEA) statistics, 2011.

² *Basis for calculating energy intensity.* For estimating the energy intensity of water and wastewater, the following reports were used; for the sake of simplicity a figure of 1.0 kwhe/cubic meter for combined water and waste supply and treatment was used. Cheng (2011) calculates the electrical energy requirement for providing 35 mgd of 0.22 kwhe/cubic meter for water supply alone; the World Bank's Rapid Assessment Framework (ESMAP, 2010) gives a range of 0.1–0.59 kwhe/cubic meter for potable water and 0.21–0.59 kwhe/cubic meter for wastewater; NRDC (2004) reports 0.77 kwhe/cubic meter for potable and waste treatment, and distribution; and the New York State Energy and Research Development Authority (2008) reports a national average of 0.36 kwhe/cubic meter for potable water supply, 1.25 kwhe/cubic meter for secondary treatment, and 1.78 kwhe/cubic meter for tertiary.

Table 5: Energy Use for Water and Wastewater in Major GMS Cities, 2010–2025

Big Cities	Annual Energy Use for Water and Wastewater Together							
	kwh/capita/year	2010 gwh	2010 WSS	2010 %	2020 WSS	2020 %	2025 WSS	2025 %
Bangkok ^{a, b, c}	2157	12,294.90	308.10	2.51	461.48	3.75	618.31	5.03
Danang	728	610.06	66.68	10.93	98.30	16.11	117.80	19.31
Haiphong ^d	728	1,310.40	156.75	11.96	208.60	15.92	248.38	18.95
Hanoi ^{a, b}	1000	6,500.00	517.21	7.96	653.61	10.06	769.24	11.83
Ho Chi Minh ^{a, d}	728	4,171.44	490.71	11.76	691.95	16.59	817.33	19.59
Kunming	2000	6,400.00	136.48	2.13	249.23	3.89	357.24	5.58
Mandalay	100	125.00	7.55	6.04	24.29	19.43	37.92	30.33
Naypyidaw	200	186.00	7.48	4.02	24.35	13.09	38.30	20.59
Phnom Penh ^{a, c}	93	123.69	39.91	32.27	64.94	52.50	88.59	71.62
Yangon	100	453.00	31.76	7.01	99.57	21.98	153.86	33.97
Total		32,174.49	1,762.63		2,576.32		3,246.97	

kwh = kilowatt hour

gwh = gigawatt hour

WWS = water supply and sanitation

Note: Hanoi 2020–2025 estimated by author. Assume Danang same per capita as Ho Chi Minh.

a World Bank's Rapid Assessment list (ESMAP, 2010)

b Asian Green City Index list (Siemens, 2011)

c SEAWUN (2005)

d SEAWUN lists (2005, 2007)

6. Improving the Efficiency of Urban Water and Energy: Sustainable Cities

When dealing with the approaches to solving the problems of sustainable water resources for urban areas, the type of problem addressed and the scale of the potential solutions must be defined clearly. There is a large and growing literature and databases on sustainable cities. Much of the literature (Hao *et al.*, 2010), however, focuses on smart buildings rather than entire cities. Moreover, the discussion tends to focus on new buildings rather than retrofit of the existing building stock of old traditional infrastructure. The literature also bifurcates into those specializing in actual here-and-now cases and those promoting future potential developments.

Unfortunately, many of cases reported are still largely hypothetical. Hard data on actual cases are difficult to find. For example, hypothetical cases like Qingdao and Dongtan, near Shanghai, are widely discussed (Hao *et al.*, 2010) and promoted because of their widespread integrated energy-water-transport systems approaches, but cases like The Solaire in Battery Park City, New York, or Dockside Green in Victoria, Canada, which have successfully integrated buildings, or multiple buildings with new construction and the rehabilitation of existing cities, receive little attention. While future-oriented studies are helpful in structuring future possibilities, performance data from actual experiences are more useful guidelines as to what is realistically possible.

The examples of Solaire and Qingdao are illustrative of the wide discrepancy between the empirically based data and the hypothetical data used in future-oriented studies. The Solaire has consistently achieved a 48% water-consumption reduction in comparison with comparable residential buildings in New York City and a 56% reduction in wastewater discharge. This water and wastewater reduction is achieved by a combination of wastewater reuse and water conservation where nonpotable water is distributed in closed-loop systems for uses that include toilet flushing, cooling tower make-up, laundry, and irrigation. Each building in The Solaire development is unique and the exact components vary somewhat, but the overall program of wastewater and rainwater reuse remains the same. The Qingdao Eco-city is repeatedly quoted as an excellent approach to making cities more sustainable with 85% water savings and 100% energy savings. Unfortunately, like most of the future-oriented cases, the basis for the calculations is often optimistic or unrealistic. Wherever possible, I recommend that actual performance of integrated water and waste-recycling data be used instead of the hypothetical data.

Hao *et al.* (2010) provide a critical review of city-scale developments aimed at improving the actual water and energy nexus. Hammarby Sjöstad (Sweden) actually has been developed; Dongtan, planned near Shanghai (PRC), is apparently one of the first comprehensive conceptual eco-city developments. The final population was planned to be 500,000 around 2050. However, its construction

is currently on hold. For Qingdao (PRC), eco-blocks are the foundational units in Fraker's (2008) concept of the eco-city. A super block is a typical high-rise residential development in the PRC, usually 100–200 ha with 2,000–10,000 residential units housing 6,000–30,000 people. The PRC is now building 10–15 super blocks per day. Two well-funded projects underway are in Tianjin (PRC) with \$9.7 billion invested and Masdar (United Arab Emirates), with an expected funding of \$22 billion. Two projects already developed in the United States are Treasure Island and Sonoma Mountain Village, both in California.

Table 6, from Hao *et al.* (2010), pulls together some of the salient facts about water and energy conservation in these projects. Note the huge differences between the water savings claimed for the three projects actually developed (Hammarby, Treasure Island, and Sonoma Valley) and those in planning stages. The energy savings reported for the developed projects are remarkably close to those predicted for the remaining projects, implying that energy conservation is inherently easier to accomplish than water conservation at the household and project level. Table 6 also shows the very large range of costs per unit. Fraker (2008) claims that the sustainability initiatives embedded in Qingdao would increase the capital costs by 5%–10% but the value of annual operation and maintenance savings would give payback within 10 years.

7. Conclusions

The simple models used in this paper show some unexpected results. First despite the relatively low rates of total population growth in the region, urban populations are likely to increase substantially by 2030, but the large cities in the region will experience a modest increase of about 30%. This implies that there will be big population increases in the smaller cities and towns in the region. The really surprising result is that in the face of this population increase there will be an almost tripling increase in the demands for urban water supply and management because of increasing development and the push toward attainment of the MDGs. This implies for Viet Nam a doubling of available water just for urban (M&I) uses, and as low as a 20% increase for Myanmar. For Viet Nam it may be difficult to meet the needs of agriculture and other water users if it needs so much for urban uses. Based on the electricity available in 2008, the 2030 electricity demands just for urban water supply and wastewater could amount to as much as 12% for Cambodia and 5% for Viet Nam.

For the current large cities in GMS, the electricity demands for the urban water sector could be as much as 71% of the 2010 electricity supplied for Phnom Penh, and as low as 5% for Bangkok. Of course, each city and country

Table 6: Water and Energy Performance in Eco-cities

City	Population Total	Population Density #/ha	Water Use lpcd	% Water		% Energy Savings	Green Area m ² /person	Cost \$/unit ^b
				Reclamation & Recycle	Water System ^a			
Hammarby Sjöstad	30,000	133	100	0	Linear	50	40	200,000
Dongtan	500,000 (80,000) ^c	160	200	43	Linear centralized	100	100	~40,000
Qingdao	1500 ^d	430	160	85	Closed loop	100	~15	?
Tianjin	350,000 (50,000) ^c	117	160	60	Partially closed	15	15	60,000–70,000
Masdar	50,000	135	160	80	Closed loop	100	<10	1 million
Treasure Island	13,500	75 total area 150 built	264	25	Mostly linear	60	75	550,000
Sonoma Valley	5,000	62	185	22	Linear centralized	100	20	525,000

a Linear system is a once-through flow system from which a portion of used water may be reclaimed and used for another use (e.g., drinking water for irrigation); closed system returns highly treated reclaimed water back for reuse

b Based on average 2.5 members per household

c Phase I

d Qingdao eco-block

Source: Hao *et al.* (2010, Table 2.8).

is currently embarked on extensive expansion of their electricity supply capacity, such that electricity capacity will grow along with the demands. Unfortunately, this is not the case with water supply. There are some serious limits on water availability, hence the need to conserve water in this sector. This may be quite difficult given the pressures to expand the actual quantities of water supplied and broaden the coverage of the systems.

The analysis presented in this paper has two major problems. First and foremost is the absence of reliable data on urban water and electricity use. Equally important is that the model does not really reflect the economic behavior of the consumers who ultimately drive the systems. Nevertheless, this simple model does provide some confidence that there can be a sustainable urban future in the GMS without resort to the fancy integrated water and energy solution promoted in Hao et al. (2010), provided that careful attention be paid to the water management in the cities. One major concern, however, is the potential reduction in water available for agriculture in all the countries in the GMS region; this needs careful study.

For the sake of comparison, consider that London, which was the 30th largest city in 2010 with 8.6 million, did not make it onto the United Nations list of top 30 by 2025. In 2002, London was the subject of a comprehensive study on its resources flow and urban footprint (Chartered Institution of Wastes Management, 2002). For the year 2000 with a population of 7.4 million, Londoners consumed 154,400 gigawatt hours (gwh) of energy (including 85,494 gwh as actual electricity use), 49 million tons of materials (of which 27.8 million tons were used in the construction sector), generated 27.8 million tons of waste, and consumed 6.9 million tons of food, and 876 million cubic meters of water. This was translated by the study into an ecological footprint of 49 million global hectares³ (the equivalent size of Spain) comprised of 44% for materials and waste, 41% for food, 10% for energy, and only 0.3% for water.

It is apparent that the study did not consider the almost 800 million cubic meters of wastewater as 800 million tons of “waste.” Had it done so, water may have been a larger contributor to the ecological footprint. Nevertheless, the contribution of food was extremely important. In the context of the GMS, the food component would be directly related to land and water use in the urban hinterland of

the cities. The inclusion of food in this paper would have certainly highlighted the conflicts for land, water, and energy, which would overwhelm the narrow view taken in this paper.

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³ The global hectare is a measure of bio-capacity.

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