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Greater Mekong Subregion Development Studies

Journal of

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The *Journal of GMS Development Studies* is a multidisciplinary peer-reviewed publication that seeks to promote a better understanding of a broad range of development issues of the Greater Mekong Subregion (GMS). One volume is published each year by the Asian Development Bank (ADB) under the framework of the Phnom Penh Plan for Development Management (PPP), a region-wide capacity building program that supports knowledge products and services. The Journal is directed at GMS planners, policy makers, academics, and researchers who, in their unique capacities, continue to search for solutions to the many complex challenges of the subregion. By disseminating knowledge about the GMS, the Journal hopes to stimulate further thinking and debate on GMS issues, thus contributing to informed policy choices, responsive advocacy, and meticulous scholarship.

The Journal complements other components of the PPP. The PPP, which was initiated by the GMS countries in 2002 during the First GMS Summit in Phnom Penh, delivers several learning programs each year for senior- and middle-level development practitioners in the GMS. High-level officials are also provided the opportunity to keep abreast of cutting-edge concepts through short high-impact learning experiences. As a repository of scholarly works on the GMS, the Journal serves as a valuable resource for the PPP learning programs. It also serves as a platform for publishing research works by GMS research institutions, universities, and think tanks that are recipients of grants under the recently launched PPP research program. Other activities of the PPP include fellowship awards, learning resource centers, and institutional networking and development. The program is funded by ADB and the governments of France, New Zealand, the People's Republic of China, and the Republic of Korea.

The PPP was initiated under the framework of the GMS Program, wherein six countries that share the Mekong River—Cambodia, the People's Republic of China, the Lao People's Democratic Republic, Myanmar, Thailand, and Viet Nam—started a program of regional cooperation in 1992. The areas of cooperation under the program include agriculture, energy, environment, investment, telecommunications, tourism, trade, transport, and human resources development.

The Journal invites original contributions from scholars, researchers, and practitioners dealing with GMS issues. The articles should have a strong emphasis on the policy implications flowing from the analysis. Analytical book reviews will also be considered for publication. Articles submitted for publication will be peer-reviewed.

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In this issue….

In this issue of the *Journal of Greater Mekong Subregion Development Studies*, we feature five articles that concern some of the more pressing issues of cooperation in the Greater Mekong Subregion (GMS)—trade facilitation and trade logistics, the trade impact of cross-border transport infrastructure, tourism corridor development, and biofuels and rural renewable energy. The diversity of the topics tackled in this volume reflects the multifaceted challenges of regional cooperation. But it also highlights the immense potential that could be unleashed by addressing these challenges through the right combination of well-informed policy choices and successful program implementation.

Anna Strutt, Susan Stone, and Peter Minor, in their article Trade Facilitation in the Greater Mekong Subregion: Impacts of Reducing the Time to Trade, cite evidence to suggest that improvements in transport infrastructure and trade facilitation in the GMS can bring substantial gains to the subregion not only in lower transport and logistics costs but also through savings in time costs that can stimulate trade and economic growth. Using the Global Trade Analysis Project model, the authors estimate that even a fairly moderate decrease in the time taken to trade intraregionally is anticipated to bring strong benefits, with gains from reducing the time to import being particularly important. Reducing the time to trade within the subregion by 25% is expected to increase real gross domestic product (GDP) by 1%–2% for Cambodia, Myanmar, Lao People's Democratic Republic, and Viet Nam. For the larger economies of the People's Republic of China (PRC) and Thailand, the percentage gains in real GDP are relatively small, but translate into significant dollar increases in GDP of $350 million for Thailand and $734 million for the PRC.

The articles by Manabu Fujimura and Ruth Banomyong provide a more "on the ground" analysis of the critical link between connectivity and trade. In his article, Economic Integration in the GMS and Cross-Border Transport Infrastructure, Fujimura uses a gravity-type model to assess the impact of cross-border road infrastructure on regional trade—distinguishing the impact of cross-border road infrastructure from that of domestic road infrastructure. Overall, the analysis indicates that the development of GMS cross-border road infrastructure has had a discernible positive effect on regional trade and is a critical part of a broader effort to encourage regional integration. An interesting finding is that a 1% increase in road density in GMS border regions would increase the volume of trade in major commodities by 0.6%–1.4%. Fujimura provides six case studies of local economic corridors and discusses the development of transport infrastructure and its economic impact along each route.

The article Logistics Development in the Greater Mekong Subregion: A Study of the North–South Economic Corridor by Ruth Banomyong argues that an efficient logistics system is essential to move the traded goods efficiently across borders. The author assesses the macro-logistics system along the North–South Economic Corridor, one branch of which extends from Kunming in the PRC to Bangkok, Thailand. He observes that although infrastructure connectivity in the corridor is almost complete, border crossings remain the weakest link in the macro-logistics system. An integrated approach is needed to combine solutions to physical infrastructure issues with adherence to rules and regulations. We know too well that the lack of standardized and harmonized border and transit trade procedures currently constrains the development of a macro-logistics system that can satisfy customers, and control or even lower the costs involved.

Building from the concept of economic corridors in the GMS, Ramon Benedicto A. Alampay and Ludwig G. Rieder, in their article Developing Tourism in the Greater Mekong Subregion's Economic Corridors, describe an approach to the development of community-based tourism attractions along transport corridors. Using one segment of the GMS North–South Economic Corridor as a case study, the authors contrast this new approach with tourism corridor strategies in other parts of the world. While the development model emphasizes a holistic approach to developing attractions in the country, it also identifies opportunities for continued subregional cooperation to support the newly developed sites. The tourism development framework for the GMS corridors seeks to develop tourist facilities for attraction along the corridors to give travelers reasons to stop and stay. The GMS economic corridor strategy acknowledges that infrastructure and product development will not be sufficient to ensure the sustainability of the program. Thus, capacity-building and institutional support mechanisms are also built into the strategy.

The final article in this volume, Biofuels and Rural Renewable Energy in the Greater Mekong Subregion: Issues, Challenges and Opportunities, addresses the issues and challenges surrounding biofuels and rural renewable energy in the GMS. Given the projected long-term scarcity of fossil fuels, concerns with energy security, and problems associated with carbon emissions, coauthors Roehlano M. Briones and Mahfuzuddin Ahmed predict that the transition to farmed energy may well be the next frontier in the transformation of agriculture. The article analyzes the biofuels controversy and difficult trade-offs to be made between food, feed, and fuel. While there are no cases of widespread and sustained commercialization of biofuels in the subregion, its business potential and economic benefits are undeniable. These include income and employment opportunities for small farmers, accelerating rural development, enhanced energy security, foreign exchange savings, and clean development from reducing fossil fuel emissions and reliance on traditional fuels. The authors caution, however, that the risks to society, the environment, and food security are real. The diversion of agricultural resources from food to energy production remains a difficult trade-off, particularly under the current regime of volatile world food prices. Much depends on a judicious choice of crop to be used for feedstock, technology employed, adequacy of supporting infrastructure, and enforcement of land-use policies.

We hope these articles will contribute to a better understanding of key issues in the GMS. They will possibly also stimulate thought on related issues in other subregional initiatives. We are grateful to the authors for their contribution to the promotion of scholarship and learning in the GMS which are both hallmarks of the Phnom Penh Plan for Development Management.

Arjun Thapan
Editor-in-Chief

Trade Facilitation in the Greater Mekong Subregion: Impacts of Reducing the Time to Trade

Anna Strutt, Susan Stone, and Peter Minor[1]

Abstract

The importance of trade facilitation and reducing the time to trade is gaining increasing recognition. Significant efforts are being made in the Greater Mekong Subregion (GMS) to promote improvements in this area of economic integration. This paper uses newly available databases to explore potential gains to the GMS (including the People's Republic of China [PRC]) from reducing the time taken to export and import. The results suggest that even a moderate reduction in the time taken to trade intraregionally is likely to bring strong economic benefits to the subregion. Reducing the time to trade within the subregion by 25% is expected to increase real gross domestic product by 1%–2% for Cambodia, Lao People's Democratic Republic (Lao PDR), Myanmar, and Viet Nam. For the larger economies of the PRC and Thailand, the percentage gains are relatively small but translate into significant dollar increases: $350 million for Thailand and $734 million for the PRC. The gains to Viet Nam and Thailand are particularly reliant on improved trade facilitation with the PRC, but this is not the case for Cambodia, Lao PDR, and Myanmar. There is evidence that such trade facilitation efforts may improve export diversification, particularly for the relatively poor economies. Real exports within the subregion are also expected to increase for all countries, again with particularly high dollar value increases for the PRC and Thailand.

Trade Facilitation in the Greater Mekong Subregion

International trade is vital to economic growth and development in the world economy, with the key role of trade facilitation increasingly recognized. Multilateral and regional trade liberalization efforts have led to significant tariff reductions worldwide and improved trade facilitation offers further opportunities to maximize the benefits of greater access to international markets. The potential gains from improved trade facilitation may be even larger than those available from removing remaining tariffs. This approach has the advantage of avoiding potential resistance

[1] University of Waikato, Asian Development Bank Institute, and Nathan Associates Inc., respectively. Corresponding author: astrutt@waikato.ac.nz . The authors are very grateful for comments and suggestions from reviewers.

from local producers and government authorities, which may depend on these tariff revenues. Substantial efforts are being made to improve trade facilitation in the Greater Mekong Subregion (GMS).[2] In this paper, we use newly available databases to explore the potential impacts of these improvements in the GMS.

There is no universally accepted definition of trade facilitation. It is a concept that has evolved and broadened over time. The most common focus of trade facilitation is on improving the logistics of moving goods through ports and customs. Broadly defined, trade facilitation covers the whole arena in which trade transactions take place, including transparency of regulation, harmonization of standards, and conformance to international regulations (Wilson et al. 2003). The definition of trade facilitation adopted in this paper is "the set of policies that reduce the costs of importing and exporting" (Shepherd and Wilson 2008). Thus, trade facilitation, in this view, can be thought of as reducing a broad set of obstacles—whether deliberate or unintended—that restrict flows of exports and imports.

Many studies have demonstrated the strong linkages between trade facilitation and trade volumes. Shepherd and Wilson (2008) showed that Association of Southeast Asian Nations (ASEAN) countries have much to gain from improved trade facilitation, particularly from improved transport infrastructure and information technology affecting timing issues, such as document preparation and inland transport. They found that reducing applied tariffs to the regional average increased intraregional trade by 2%, while improving competition among internet service providers increased intraregional trade by 5.7%.[3] Other estimates suggest that the gains from trade facilitation may be almost as high or even higher than the gains from trade liberalization, with particularly strong benefits for developing countries (Wilson et al. 2003; Hertel and Keeney 2006). Engman (2005) reviewed a range of studies and found positive linkages between trade facilitation and trade in all of the studies examined. Developing countries were found to have particularly high gains in relative terms, reflecting their typically less efficient customs administrations and ports. "Trade facilitation is largely considered to be a win–win solution for traders in developed and developing countries alike" (Engman 2005). However, trade facilitation requires economic and political resources, and the effectiveness of any particular intervention depends on a number of variables, best considered on a case-by-case basis. For example, enhanced trade facilitation may not have the desired result if corruption prevents the benefits from accruing in a systematic and expected fashion (Francois and Manchin 2007).

Where a constructive business and governance environment is in place, there appear to be positive linkages between trade facilitation, trade flows, government revenue, and foreign direct investment (Engman 2005; Francois and Manchin 2007). Many countries have inefficient border procedures that harm traders by causing delayed and unreliable delivery and costly customs clearance. Weak and inefficient customs procedures give rise to negative impacts, including smuggling; corruption, and tax collection problems; slow, unpredicatable delivery of inventories; and the subsequent need to hold high stock levels (Engman 2005; Banomyong

[2] The GMS comprises Cambodia, Lao People's Democratic Republic, Myanmar, Thailand and Viet Nam, as well as Yunnan Province and Guangxi Zhuang Autonomous Region of the People's Republic of China (PRC). However, because of data limitations in this study, we are restricted to analysis of the GMS countries and all of the PRC.

[3] These simulations reduced tariffs in the PRC; Indonesia; Malaysia; Philippines; Taipei,China; Thailand; and Viet Nam to the regional average and increased internet service provider sector competition in the PRC, Indonesia, Thailand, and Viet Nam to the regional average.

2007). While some countries fear that faster movement of shipments across borders may increase smuggling and decrease customs revenues, "[t]rade facilitation is not about impeding or diminishing individual government's power and sovereign right to protect their borders…[it is a means of] making the necessary work of customs and other authorities cheaper and more efficient" (SWEPRO 2003).[4] Indeed, experience from a number of countries indicates that trade facilitation may have a positive effect on customs revenue collection, with particularly significant increases possible for countries with weak customs administrations (Engman 2005).

While benefits are possible, trade facilitation can involve substantial resource costs. Therefore, before investing, it is important to assess where the priorities are likely to be and whether the necessary business and governance environment is in place to provide full uptake of the benefits. Wilson et al. (2003) used a gravity model to estimate the average importance, over a cross section of countries, of four indicators of trade facilitation: (i) port efficiency, (ii) customs environment, (iii) regulatory environment, and (iv) e-business use. Their results showed that customs and e-business use affect trade—but to a lesser extent than port efficiency and the regulatory environment. While individual country outcomes are sure to differ (Francois and Manchin 2007), the suggestion is that identification of key areas of inefficiency will help guide the best use of limited resources. Some areas of trade facilitation, including improving policies associated with customs clearance, may cost much less than new roads and ports. However, even large expenditures may result in little gain to trade if rampant corruption or a poor business environment persists. Such threshold effects need to be considered on a case-by-case basis in the countries considering this policy option. For example, an analysis of the business-enabling environment may reveal that there is little interest in investment in a country due to obscure investment and property right laws, inflexible labor conditions, or excessive corruption.

The importance of infrastructure development is well recognized in the GMS. The transport sector was one of the first areas of cooperation under the GMS Economic Cooperation Program, which began in 1992. At the time, most of the subregion's infrastructure was of a very poor quality (Ishida 2007). The GMS Economic Cooperation Program aims to open borders and to improve connections to make trade easier, spur development, and strengthen the region's ability to compete in a dynamic global environment. Major efforts have been made to develop the infrastructure linking the GMS and beyond, through ambitious economic corridor projects supported by several international agencies, including the Asian Development Bank (ADB), in the expectation that they will lead to improved opportunities and economic development.

GMS countries have recognized that physical infrastructure, like that provided by the corridors, is a necessary—though not sufficient—condition for increased trade within the subregion. Reduction of the nonphysical barriers to cross-border trade is also needed (UNESCAP 2002; ADB 2005). In 1999, the Lao People's Democratic Republic (Lao PDR), Thailand, and Viet Nam entered into a cross-border transport agreement (CBTA) and were later joined by Cambodia, the People's Republic of China (PRC), and Myanmar.[5] The CBTA entered into force when all six members ratified it in December 2003, with full implementation expected to be completed in 2008. The CBTA is a comprehensive agreement covering many aspects of cross-border trade facilitation, including border-crossing formalities and single-window customs

[4] This was also the conclusion of a nonpartisan review of all the World Bank *Doing Business* indicators (see www.doingbusiness.org).

[5] See www.adb.org/GMS/Cross-Border

inspections; cross-border movement of people engaged in transport; the establishment of transit traffic regimes, including exemptions from customs and other inspections; the exchange of commercial traffic rights; and the setting of infrastructure standards, such as for roads, bridges, signs, and signals. The CBTA, in conjunction with transport corridor development, has the potential to improve timeliness and costs of goods transport throughout the subregion.

Reduced Trade Times for the Greater Mekong Subregion

The rapid rise of trade worldwide has been driven by improved market access, marked by falling tariffs and duties, as well as falling transport costs and the rapid extension of transportation networks (Hummels 2007). However, many developing countries have not enjoyed the same rapid expansion in trade, in part due to high transport costs and the lack of viable transport networks. The lack of facilities, both physical (including roads and ports) and supportive (including customs facilitation and appropriate regulations) has limited the ability of these economies to engage in international trade effectively.

Hummels (2001) estimated that each day saved in shipping time is equivalent to a 0.8% ad valorem tariff on average for all merchandise trade, with each additional day reducing the probability of the United States (US) sourcing products from that country by 1.0%–1.5%. Others have also found that each additional day of delay prior to a product being shipped reduces trade by approximately 1% on average (Djankov et al. 2008). However, Hummels et al. (2007a) showed that the value of time in trade varies across different products.

Trade transaction costs (TTCs), including customs protocols, duties, and other costs of doing business overseas, may be categorized into directly incurred costs and indirect costs. Direct costs are relatively clear to traders and include such charges as documentation costs, customs fees, port charges, and informal payments. However, indirect costs, including the cost of carrying inventory and product depreciation, may be much less clear (Minor and Tsigas 2008). Empirical estimates of TTCs vary substantially, but direct and indirect costs are each likely to amount to 1%–15% of the value of traded goods (Walkenhorst and Yasui 2005).

In addition, the inconsistency and lack of transparency associated with indirect costs increases perceptions of risk and reduces firms' willingness to deal in these markets. No empirical studies have systematically measured the importance of inconsistency in trade procedures and timing of trade, but regular interviews with producers illustrate that it is exactly this type of problem that concerns them most. Uncertainties reduce the potential benefits of lower average trade transactions times, because companies must still plan for the inevitable uncertainty of highly variable transaction times.

TTCs and their impacts differ according to the economy, types of traders, and type of good (Walkenhorst and Yasui 2005). Economies with higher per capita incomes tend to have more efficient border processes. However, it is certainly possible for relatively poor economies to improve the quality of border services and perform well (Walkenhorst and Yasui 2005). Furthermore, delays in transit times abroad may have particularly adverse effects on landlocked countries (Djankov et al. 2008), such as the Lao PDR. The characteristics of traders also determine the impact and importance of TTCs, with small and medium firms tending to conduct fewer international transactions, leading to such disadvantages as a limited customs track record, relatively few specialized personnel to deal with trade formalities, and weaker financial reserves to cope with problems like unforeseen stock delays (Walkenhorst and Yasui 2005). The average

cost of a transaction is larger for smaller firms, so they tend to outsource the work or not to engage in international trade.

Delays have particularly adverse impacts on time-sensitive goods. Perishable products like flowers and some foods deteriorate rapidly and face relatively high costs from delays. Delays also tend to be particularly costly for fashion and high-technology items (Minor and Tsigas 2008). Timely delivery allows retailers to respond to demand fluctuations without holding expensive inventories (Evans and Harrigan 2005).

Greater Mekong Subregion Countries and Data

Some efforts have been made to quantify the effects of both TTCs and overall transport costs in the GMS, and these studies have generally focused on time and cost savings from various infrastructure projects. Some have attempted to include such measures as harmonization of customs procedures and transport regulations as a result of the CBTA. As with many developing countries, information in the subregion can be incomplete.[6] Nonetheless, given the information collected in these studies, an indication of potential time and shipping costs reductions from infrastructure investment and improved trade facilitation can be estimated.

The economic corridors in the GMS have led to improved connectivity and integration with neighboring countries, resulting in an overall reduction in travel time and transport costs. Since 2001, there has been an estimated 75% reduction in travel time between Dansavanh and Khanthabouly in the Lao PDR in the East-West Economic Corridor (Luanglatbandith 2007). Banomyong (2007) found major improvements in both shipping costs and time savings with full implementation of the North-South Economic Corridor, with time savings estimates averaging 25%–55%.

The Japan External Trade Organization (JETRO) provides business support services, including collection of market intelligence for Japanese companies operating overseas. Based on surveys of Japanese firms operating in the subregion, JETRO found that with improvements in the land transport network of the Lao PDR, Thailand, and Viet Nam, transit times could be reduced by 25% (JETRO 2005). The study focused primarily on physical infrastructure, such as roads and bridges, but also contained information on customs harmonization and truck regulations.

A broader, more indicative approach to determining potential gains of the GMS economic corridors can be found in the Nathan Associates report on ASEAN logistics (Nathan Associates Inc. 2007). Transporting goods by road between the Lao PDR and the Thailand border was found to cost shippers four times more than the international norm. National logistics costs relative to gross domestic product (GDP) were approximately 8% for Singapore, but closer to 20% for Thailand and Viet Nam. Across ASEAN, export logistics costs for some products expressed on a free-on-board (fob) basis were as high as 25%, consisting of procurement 17%, inventory holding 10%, warehousing 11%, transport 28%, and export processing 34% (Nathan Associates Inc. 2007). The highest cost categories, transport and export processing, have been directly targeted through the GMS Transport Strategy and the CBTA.

Table 1 presents the time it takes to ship along two corridors in the GMS versus international norms, as reported in the Nathan Associates study. The report cites three main

[6] Edmunds and Fujimura (2008) discussed the problem of undocumented trade between GMS economies. Informal trade appears to account for a significant share, perhaps 20%–30%, of all cross-border trade in the GMS (Athukorala 2007).

areas of concern for poor corridor performance: (i) insufficient funding for road maintenance on international routes, (ii) below par standards for international truck facilities at border crossing and transloading areas, and (iii) a lack of agreements allowing trucks to travel easily from one country to another with transit goods. These are all areas covered under the CBTA. Customs had particularly good performance for both corridors examined, while other areas were rated fair or even poor. If full implementation of the CBTA, along with the economic transport strategy, can bring the GMS transport network on par with well-performing transport networks in Asia, time savings—according to these numbers—would be 43% along the Vientiane–Laem Chabang Corridor and 42% along the Da Nang–Mukdahan Corridor (Nathan Associates Inc. 2007).

Table 1: Time to Shipper[a]

	Vientiane–Laem Chabang Corridor		Danang–Mukdaharn Corridor	
	Actual	**Norm[b]**	**Actual**	**Norm[b]**
Import Formalities	n/a	n/a	10 days	2–3 days
Port and Terminal	3.5 days	3–5 days	0.5 days	0.5–2.0 days
Seaport Customs	0.5 hours	0.5–1.5 hours	1 day	1–3 days
Rail Transport	3.5 hours	2.5–3.5 hours	n/a	n/a
Inland Clearance	2.5 days	1–2 days	n/a	n/a
Road Transport	16 hours	12–15 hours	10.5 hours	0.5–1.0 day
River Crossing	n/a	n/a	3.5 hours	2–4 hours
Transloading	2 hours	2–4 hours	2 hours	2–4 hours
Inland Customs	3 hours	2–4 hours	1 hour	2–4 hours
Export Formalities	12 days	3–5 days	n/a	n/a
Total[c]	18.5 days	10.5 days average	12 days	7 days average

[a] n/a = not applicable.
[b] Based on Nathan Associates data on international standards for given task/distance.
[c] Total does not add up because selected components of total logistics costs only are reported.
Source: Adapted from Nathan Associates (2007).

ADB has also conducted studies on the impact of economic corridors in the GMS. The first (ADB 2007a), a detailed study of part of the East–West Economic Corridor, analyzed the effects of the Second Mekong International Bridge, Mekong Bridge access roads, Road 9 rehabilitation, Highway 1 periodic maintenance, and Da Nang port improvement on the Lao PDR and Viet Nam. The report found that transit times were reduced by around 25%. The second study (ADB 2007b), on improvements to highways between Phnom Penh in Cambodia and Ho Chi Minh City in Viet Nam, found that travel time from Phnom Penh to the border was reduced by 30%, with similar reductions in Viet Nam. Finally, some preliminary work evaluating the entire East–West Economic Corridor by ADB (ADB 2008) showed that while Thailand is relatively efficient

in its trade facilitating environment, it is still far behind in almost all the national logistics performance indicators of high-performing countries, such as Singapore. Estimates suggest that when the East–West Economic Corridor is completed and policies have been implemented, travel time along the corridor will be halved.

The evidence above suggests that improvements in transport infrastructure and trade facilitation in the GMS can bring substantial gains to the subregion not only in lower transport and logistics costs, but also—key to our current study—through savings in time costs that can stimulate trade and economic growth. Reported time savings generally fall within the range of 25%–50%.

Costs of Time Delays in Trade

The World Bank's *Doing Business* database provides benchmarks for certain types of products and trade routes regarding the time and costs associated with crossing borders (World Bank 2008).[7] Table 2 presents summary statistics for the number of days taken to export and import in the GMS, along with average data for high-income Asia and Pacific countries (HIAP) for comparison.[8] In the absence of specific data for Myanmar, we apply the average of the two most similar countries in terms of per capita incomes, Cambodia and the Lao PDR. There are significant differences in the time involved in conducting trade within the GMS. The Lao PDR is reported to take an average of 17 days for both exports and imports, while the best performer in the GMS appears to be Thailand, taking 8 days to export and 6 days to import. However, even Thailand is a poor performer relative to the HIAP country average of 6.1 days for exports and 4.9 days for imports, as shown in the final column of Table 2.

Table 2 also illustrates that export delays are typically less than import delays for the GMS. Port handling time and inland transport delays are significantly longer for all GMS countries than the HIAP country average. The Lao PDR appears to face particularly long delays with inland transportation, which tends to be slower when countries are physically large and when infrastructure is of poor quality. Port delays can be due to a port's inefficiency and also infrequent service, which is particularly likely to affect smaller, poorer nations (Hummels et al. 2007b). The Lao PDR, being landlocked, benefits from efficient port handling in other countries. However, Cambodia faces much longer than average delays for its imports. Customs delays in the GMS are also longer than the HIAP country average, with the exception of Thailand. These customs delays may be aggravated by poor procedures, excessive inspection of cargo, communication problems, and/or corruption. The Lao PDR appears to have particularly long delays with customs procedures on importing.

The work of Hummels (2001) and Hummels et al. (2007a) indicated that the value of time in trade varies across products imported into the US. For some commodities, time has only a

[7] To create comparable data, the *Doing Business* report selects certain benchmark products and import regimes, as well as geographic corridors; this method has been questioned since it does not always represent the majority of products and trade regimes for a country. An important exception in the GMS countries is the presence of extensive free trade zone regimes, which often vary from the standard benchmark products and corridors but make up the majority of trade.

[8] These data do not include time taken for document preparation since this may be able to progress in advance of the shipment commencing.

Table 2: Time for Procedures to Import and Export: Greater Mekong Subregion, People's Republic of China, and High-Income Asia and Pacific Countries[a]
(number of days)

	Cambodia	Lao PDR	Myanmar	Thailand	Viet Nam	PRC	HIAP[b]
Days to Export							
Customs	3.0	3.0	3.0	1.0	5.0	2.0	1.6
Port Handling	3.0	4.0	3.5	4.0	3.0	2.0	2.2
Inland Transport	2.0	10.0	6.0	3.0	4.0	3.0	2.3
Total	**8.0**	**17.0**	**12.5**	**8.0**	**12.0**	**7.0**	**6.1**
Days to Import							
Customs	3.0	8.0	5.5	2.0	5.0	4.0	2.1
Port Handling	5.0	2.0	3.5	2.0	4.0	2.0	1.5
Inland Transport	4.0	7.0	5.5	2.0	2.0	3.0	1.4
Total	**12.0**	**17.0**	**14.5**	**6.0**	**11.0**	**9.0**	**4.9**

HIAP = high-income Asia and Pacific countries, Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China.

[a] Myanmar data are not available; therefore, we assume the time taken for import and export procedures is equal to the average time for Cambodia and the Lao PDR.

[b] High-income East Asia and Pacific estimate from Minor and Tsigas (2008).

Source: World Bank (2008).

minimal impact, such as for bulk goods or commodities. However, products that experience rapid depreciation of market values have much higher time values. Hummels et al. (2007a) provided a guide to the importance of time in trade, based on the types of goods that a country trades, which is a distinctly important factor when estimating country-specific costs and benefits of trade delays. To illustrate the relative importance of time to developing countries,[9] Hummels et al. (2007a) calculated the tariff equivalents for import and export waiting times by country and product. They found that for developing countries, the tariff equivalents, because of their own export delays, are higher than developed-country tariffs that they face, suggesting that trade facilitation should be a priority for developing countries.

[9] Data are available at www.doingbusiness.org

Modeling Approach and Data Employed

The Global Trade Analysis Project Model and Database

We use the Global Trade Analysis Project (GTAP) model and database[10] to examine the impact of reducing the time to trade in the GMS. The GTAP model, computable general equilibrium (CGE), is well-suited to the task of measuring the impacts of trade facilitation, because it explicitly accounts for all sectors in an economy and the interactions between them. This framework is used to quantify how the costs and benefits of improved trade facilitation—specifically the time to cross borders—are transmitted between economies and markets, as well as to quantify the anticipated overall economic impact.

The model used here is comparative, static, and assumes perfectly competitive markets with constant returns to scale, as in the standard version of the GTAP model (Hertel 1997). The behavior of private individuals, firms, and governments is modeled, along with responses to changing resource and market conditions. Consumers maximize welfare, subject to their budget limitations, and firms maximize profits using the limited resources available in the economy. Armington elasticities allow differentiation between imports from different countries in the GMS and elsewhere, specifying the extent to which substitution is possible between imports from various sources, as well as substitution between imports and domestic production. When the impact of trade facilitation is simulated, prices and quantities of marketed commodities, along with impacts on economic welfare and GDP, are all determined within the model.[11]

We use the GTAP version 7 database,[12] covering 113 countries or regions and 57 sectors, with a base year of 2004. This version of the GTAP database includes all the GMS countries.[13] While the PRC is included in the GTAP database, Yunnan Province and Guangxi Zhuang Autonomous Region are not differentiated from the larger PRC. Therefore, we include the PRC in the analysis. In the following results, we refer to the GMSC, which includes all the PRC along with the other five GMS countries.[14] We aggregate the data over the 20 sectors indicated in Table 3, which are then further aggregated for reporting the main findings. The standard GTAP database is augmented with a database of tariff equivalents for time in trade specifically made for GTAP and introduced by Minor and Tsigas (2008). This database specifies the value of time in trade by country and commodity at the GTAP sector level to explore the potential impacts of reductions in the time to trade for the GMS.[15]

[10] See www.gtap.org for detailed descriptions of the GTAP model and database.
[11] The model is solved using GEMPACK software (Harrison and Pearson 1996), using the RunGTAP interface.
[12] Version released August 2008.
[13] The GTAP database has been used to model the GMS, however in previous versions, Cambodia, Lao PDR and Myanmar were aggregated into one composite region, significantly limiting the insights that could be gained for the region (Strutt and Lim 2005).
[14] Differentiated from the GMS, which includes only Yunnan Province and Guangzi Zhuang Autonomous Region.
[15] The database is based on Hummels et al. (2007a) estimates of time values and, therefore, follows that analysis closely.

Table 3: Commodity Aggregation

Aggregated Sectors for Reporting	Sectors Modeled
Raw Agricultural	Rice (paddy and processed)
	Vegetables and fruit
	Other crops
	Live animals
Processed Foods	Animal products
	Other (processed) foods
Fish and Forestry	Forestry
	Fisheries
Minerals	Oil
	Gas
	Coal and other minerals
Textiles, Apparel, and Leather	Textiles
	(Wearing) Apparel
	Leather (products)
Other Manufactures	Wood and paper products
	Electronics (equipment and machinery)
	Other manufactures
	(Transport) Vehicles
Services	Transport services: air, water, other
	Other services

Source: Authors.

Value of Time Delays

We assume that the ad valorem equivalent tariff for time delays in exporting or importing within the subregion is equal to the per day value (Hummels et al. 2007a), combined with the average time delay for that country (World Bank 2008).[16] Table 4 reports the tariff equivalent cost of export delays for the GMS, including all of the PRC (GMSC), while Table 5 reports the cost of import delays. As shown in Table 4, there are significant differences by country and product for the value of time in trade. Delays for exports tend to impose relatively high costs on agricultural products, such as vegetables, fruits, and processed foods. In these trade-weighted data, the highest value of time for exports is that of vegetables and fruit exported from Thailand to the GMSC, almost 26%. Exports of some manufactured products are also particularly sensitive to

[16] However, this relationship may not be linear in practice. For example an extra day of waiting was found to have smaller marginal effects on trade flows when the time requirements were already high (Persson 2007).

delays, with costs in excess of 10% for some countries. The Lao PDR tends to have particularly high costs, largely because of long delays—averaging 17 days—for exports (Table 2). Consistent with Hummels et al. (2007a), Table 4 indicates that bulk products tend to be less time-sensitive than products that deteriorate rapidly and complex manufactures that tend to be time-sensitive.

Table 5 reports the average tariff equivalents of import times. These average tariff equivalents tend to be higher than for exports but exceptions are not unusual. As with exports, delays for imports tend to have relatively high costs for processed foods and in these trade-weighted data, the highest average value of time for imports is almost 28% in the case of vegetables and fruit imported into the PRC. Particularly high values are also noted for processed foods and a range of manufactured products.

Table 4: Trade-Weighted Average Tariff Equivalent of Time for Exports to the Greater Mekong Subregion, Including the People's Republic of China[a]

Sectors[b]	Cambodia	Lao PDR	Myanmar	Thailand	Viet Nam	PRC
Rice	0.0	0.8	0.6	0.4	0.6	0.4
Vegetables and Fruit	2.9	11.0	1.4	25.7	23.3	0.9
Other Crops	0.2	0.2	0.2	0.2	0.2	0.5
Animals	0.5	0.5	0.3	1.4	3.5	2.4
Animal Products	4.5	2.7	0.0	0.1	0.5	0.8
Other Foods	1.4	23.8	3.9	8.5	4.3	5.5
Forestry	0.2	1.9	0.0	1.7	0.0	0.4
Fisheries	1.1	16.1	1.3	2.0	4.0	7.2
Coal, Other Minerals	0.1	0.5	4.0	2.4	0.1	2.2
Textiles	1.2	12.1	2.4	6.1	5.9	5.1
Apparel	6.8	12.6	8.9	5.8	9.0	5.2
Leather	8.7	6.8	3.7	3.4	4.3	4.5
Wood and Paper	6.2	13.2	9.9	9.4	10.1	5.8
Electronics	10.1	11.0	8.0	4.2	5.9	4.7
Other Manufactures	0.5	3.8	0.6	10.5	7.3	6.8
Vehicles	9.4	15.6	10.0	10.0	10.2	10.7

Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China.

[a] The values for some of the services and extraction sectors are zero and not included here.

[b] Further details of these sectors are in Table 3.

Source: Authors' calculations from data in Minor and Tsigas (2008).

Table 5: Trade-Weighted Average Tariff Equivalent of Time for Imports from the Greater Mekong Subregion, Including the People's Republic of China (%)[a]

Sectors[b]	Cambodia	Lao PDR	Myanmar	Thailand	Viet Nam	PRC
Rice	0.6	0.9	0.7	0.3	0.6	0.5
Vegetables and Fruit	0.5	0.9	1.7	0.8	1.5	27.9
Other Crops	0.1	1.6	5.2	0.2	0.5	0.2
Animals	1.3	0.2	8.9	1.1	6.3	2.5
Animal Products	0.2	0.0	0.3	1.7	0.5	0.5
Other Foods	12.5	21.8	9.2	5.0	20.3	4.6
Forestry	4.4	0.6	4.5	0.1	1.4	0.0
Fisheries	4.4	9.3	5.3	1.0	2.4	2.1
Coal, Other Minerals	5.4	18.4	18.5	0.5	4.4	0.7
Textiles	8.6	16.9	9.0	4.2	8.4	6.3
Apparel	12.2	14.1	10.4	4.5	7.5	7.2
Leather	10.4	10.4	8.9	3.1	6.5	3.6
Wood and Paper	16.6	15.4	14.6	4.7	13.4	9.3
Electronics	11.7	17.1	13.0	3.7	7.7	4.5
Other Manufactures	13.1	21.9	17.5	4.1	14.2	10.9
Vehicles	12.3	23.1	33.7	5.1	15.9	10.3

Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China.

[a] The values for some of the services and extraction sectors are zero and not included here.

[b] Further details of these sectors are in Table 3.

Source: Authors' calculations from data in Minor and Tsigas (2008).

Modeling Reduced Delays

It has been suggested that the direct costs of trade, including documentation and information requirements, can be modeled as logistics duties (Decreux and Fontagné 2006). However, the focus in this study is on the indirect effects of trade and these are best modeled as shifts in the demand for goods that capture the inefficiencies of time lost in transit (Hertel et al. 2001, Fox et al. 2003, Minor and Tsigas 2008). In particular, we model trade facilitation as a shift in preferences for products that are shipped on a timelier basis.

Improved trade facilitation, which leads to faster delivery times, allows traders to limit depreciation costs by positioning products—fashion, technology goods, or fresh produce—in the marketplace to obtain their maximum value from the consumer. For many goods, consumers and producers are willing to pay more for goods with shorter lead times, other things held constant; the reduction in shipping time to market at constant prices results in increased demand.

We follow this iceberg approach whereby the Armington function is shifted by the ad valorem tariff equivalent of the reduction in time to cross borders (Minor and Tsigas 2008).

We model a reduction of 25% in the time taken to trade for exports and imports within the GMSC.[17] This 25% reduction is broadly consistent with the estimated time reductions cited in the studies of the GMS above.[18] In fact, this reduction in time costs may be viewed as conservative, falling at the lower end of the estimated potential reductions in time surveyed above. Table 6 illustrates the new average number of days to export and import. These are, in almost all cases, still well above the average high-income Organisation for Economic Co-operation and Development (OECD) country averages of 4.7 days for exports and 5.5 days for imports (Hummels et al. 2007a). We begin by modeling this time reduction only for exports, followed by only imports, then for both exports and imports simultaneously.

Table 6: Initial and Post-simulation Average Times Taken for Export and Import Procedures, Greater Mekong Subregion, Including the People's Republic of China

	Cambodia	Lao PDR	Myanmar	Thailand	Viet Nam	PRC
Days to Export						
Initial Estimate	8.0	17.0	12.5	8.0	12.0	7.0
After 25% Reduction	6.0	12.8	9.4	6.0	9.0	5.3
Days to Import						
Initial Estimate	12.0	17.0	14.5	6.0	11.0	9.0
After 25% Reduction	9.0	12.8	10.9	4.5	8.3	6.8

Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China.

Source: Authors' calculations, based on data from Table 2.

Impacts of Reduced Time Delays for Trade

The overall effects of a fairly moderate 25% reduction in the time to export or import are shown in Table 7. Gains in economic welfare for the subregion from reducing the time to export are estimated to exceed $1.0 billion,[19] with regional GDP estimated to increase by approximately $800 million. The subregional gains from reducing the time to import by the same amount are even greater than the gains from export time reductions. Economic welfare in the import simulation is estimated to increase by over $1.3 billion, with regional GDP increasing by over $1 billion. The gains from reducing the time to import and export are not evenly spread, with the

[17] Fixing the ratio of the regional trade balances to regional income.

[18] It can be argued that including the impacts of improved trade facilitation with the PRC will significantly overestimate the benefits from improved trade facilitation in the GMS. Therefore, we take particular care when analyzing results to decompose the impacts due to improved trade facilitation with the PRC. Particular caution also needs to be taken in interpreting results for Myanmar, given that no country-specific data were available for import and export delays, as discussed earlier.

[19] As measured by an equivalent variation income (Hertel 1997).

largest increases going to the PRC, Thailand, and Viet Nam—the largest economies. However, if we examine the percentage increases in the GDP, we find that the smaller economies of Cambodia, Lao PDR, and Myanmar tend to gain the most in relative terms. In this simulation, a reduction in the time to export increases the GDP by between 0.1% in Thailand and 0.6% in the Lao PDR. When the time to import is reduced, GDP increases by between 0.1% in Thailand and 1.3% in the Lao PDR.

Table 7: Impact of 25% Reduction in Time to Export or Import, Greater Mekong Subregion, Including the People's Republic of China

	Export Time Reduction			Import Time Reduction		
	Welfare ($ million)	GDP (%)	GDP ($ million)	Welfare ($ million)	GDP (%)	GDP ($ million)
Cambodia	27.1	0.6	28.1	42.0	0.9	43.6
Lao PDR	20.8	0.6	15.1	36.7	1.3	32.2
Myanmar	43.0	0.5	40.3	80.0	1.0	79.4
Thailand	356.3	0.1	173.7	386.7	0.1	165.5
Viet Nam	212.9	0.5	207.8	309.4	0.7	316.3
PRC	406.7	0.0	335.9	466.8	0.0	371.1

GDP = gross domestic product, Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China.

Source: Authors' simulations.

Given the trade facilitation measures being undertaken in the GMS, it is likely that time to export and import will both decrease. Therefore, we focus particularly on our third simulation that combines the impact of a 25% reduction in both import and export times within the GMSC. Table 8 reports the aggregate results under this scenario. The total increases in economic welfare and real output approximate the summation of the two previous simulations, as expected. Welfare increases range from $58 million for the smallest economy of the Lao PDR to over $766 million for Thailand. In terms of GDP, all countries, with the exception of Thailand and the PRC, are expected to increase real GDP by more than 1%. The largest percentage increases in GDP accrue to Cambodia, Myanmar, and particularly the Lao PDR, which would have an almost 2% increase in GDP.

It is important to keep in mind that only Yunnan Province and Guangxi Zhuang Autonomous Region in the PRC are part of the GMS. However, our database only allows us to incorporate and report results for the whole PRC. Therefore, we also decompose the contribution made by improved trade facilitation with the PRC. Two columns in Table 8 detail this relative contribution, indicating the extent to which results for each country are driven by the inclusion of improved trade facilitation with the PRC. A slight welfare loss is likely to occur in the PRC if it does not improve facilitation of trade along with the GMS countries. For other GMS countries, the impact of improved trade facilitation with the PRC is rather mixed. The increase in welfare would be at least 70% lower in Thailand and Viet Nam without the inclusion of

better facilitation with the PRC. The welfare gain for Cambodia and the Lao PDR is much less dependent on the PRC. Results for increases in real GDP are similar, with the smaller and less integrated economies of the Lao PDR and Cambodia being much more reliant on the gains from improved trade facilitation efforts with other GMS countries than with the PRC. For these two countries, improved trade facilitation with Thailand tends to drive results.

Table 8: Impact of 25% Reduction in Time to Trade (Exports and Imports), Greater Mekong Subregion, Including the People's Republic of China

	Welfare		GDP		
	Total ($ million)	**Contribution of including PRC** (%)[a]	**Total** (%)	**Total** ($ million)	**Contribution of including PRC** (%)[a]
Cambodia	70.6	30.9	1.5	73.2	36.4
Lao PDR	57.7	16.8	1.9	47.4	18.3
Myanmar	125.4	55.2	1.6	122.2	55.6
Thailand	765.9	75.5	0.2	349.0	80.7
Viet Nam	540.5	70.9	1.3	543.1	70.5
PRC	899.1	104.4	0.0	734.3	100.6

GDP = gross domestic product, Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China.

[a] Values in excess of 100% imply that without the participation of the PRC, gains would turn to declines.

Source: Authors' simulations.

The impact on sector exports will differ for each country, depending in part on the initial level of the time delay costs (Tables 3 and 4) as well as interactions with other sectors and regions provided for in the model structure. Table 9 shows the impact on intra-GMSC exports as increased value of real exports from each GMSC country to all other GMSC countries. The value of intra-GMS exports in all countries is expected to increase, with the PRC and Thailand increasing exports by over $2 billion and $3 billion, respectively.

Of more interest than the overall increase is the differential impact by sector. We find that the relatively poor countries—Cambodia, Lao PDR, and Myanmar—experience a reduction in intraregional exports of raw agricultural commodities, including crops, live animals, fish (processed and frozen), and forestry. Intraregional exports of manufactured products, on the other hand, tend to increase due to the high tariff equivalent times for exports and imports for these products (Tables 4 and Table 5). This appears consistent with previous work by Dennis and Shepherd (2007), which suggests that export diversification is likely in the event of reduction in direct trade transportation costs. For example, in sub-Saharan Africa, long delays in exporting result in decreased exports of higher value-added manufactures and increased dependence on basic commodities (Minor and Tsigas 2008). For the PRC, Thailand, and Viet Nam, this is not the case. However, if we review total changes in exports by sector from the GMS to the whole world, Table 10 indicates that all improved trade facilitation within the subregion is expected

to lead to GMS countries reducing exports of raw agricultural and processed food products. Results for the textiles, apparel, and leather products are mixed. However, all GMS countries may increase their total world exports of other manufactured products with reductions in time to trade, suggesting useful opportunities for export diversification and growth.

Table 9: Impact of 25% Reduction in Time to Trade on Real Exports within the Greater Mekong Subregion, Including the People's Republic of China
($ million)

	Cambodia	Lao PDR	Myanmar	Thailand	Viet Nam	PRC
Raw Agricultural	(0.22)	(1.21)	(2.37)	80.20	8.80	6.90
Processed Foods	0.03	0.04	0.37	74.20	4.10	23.80
Fisheries and Forestry	(0.03)	(1.45)	(4.06)	0.10	(0.40)	0.30
Minerals	0.12	0.14	(5.89)	(1.50)	(7.20)	2.20
Textiles, Apparel, Leather	1.25	0.27	0.22	112.20	21.60	324.10
Other Manufactures	4.57	9.32	18.64	2,789.00	149.10	1,711.00
Services	(0.65)	(0.27)	0.11	(12.10)	(0.70)	7.00
Total	**5.07**	**6.83**	**7.01**	**3,042.10**	**175.30**	**2,075.30**

Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China.

Source: Authors' simulations.

Table 10: Impact of 25% Reduction in Time to Trade on Total Real Exports to the World, by Sector (%)

	Cambodia	Lao PDR	Myanmar	Thailand	Viet Nam	PRC
Raw Agricultural	(4.3)	(13.3)	(0.4)	(0.8)	(9.3)	0.1
Processed Foods	(2.7)	(13.2)	(0.0)	(5.0)	(19.2)	0.1
Fisheries and Forestry	(2.5)	(14.2)	(5.5)	(2.5)	(0.6)	(0.2)
Minerals	3.5	8.4	(1.2)	(0.2)	(3.2)	(0.1)
Textiles, Apparel, Leather	1.6	(5.0)	0.4	(1.9)	29.1	0.1
Other Manufactures	3.5	7.4	0.0	22.8	57.0	0.2
Services	(2.7)	(4.5)	0.0	(12.1)	(9.4)	(0.2)

Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China.

Source: Authors' simulations.

Discussion

This study shows that trade facilitation efforts, including reducing time delays for exports and imports, are likely to be very important to the GMS. Even a fairly moderate decrease in the time taken to trade intraregionally is anticipated to bring strong benefits, with gains from reducing the time to import being particularly important. Reducing the time to trade within the subregion by 25% is expected to increase real GDP by 1%–2% for Cambodia, Myanmar, Lao PDR, and Viet Nam. For the larger economies of the PRC and Thailand, the percentage gains in real GDP are relatively small, but translate into significant dollar increases in GDP of $350 million for Thailand and $734 million for the PRC. Real exports within the subregion are expected to increase for all countries, again with particularly high dollar value increases for the PRC and Thailand. Because only a small part of the PRC is included in the GMS, it was important to separate the impact of including the PRC in the analysis. The gains to Thailand and Viet Nam are particularly reliant on improved trade facilitation with the PRC, but this is not the case for Cambodia, Lao PDR, and Myanmar.

Hummels et al. (2007a) questioned whether lengthy delays imposed on exporters and importers in developing countries tend to bias production toward exporting lower value-added products. If this is the case, improved trade facilitation may encourage export diversification. We find evidence to support this in the GMS. When the time to trade decreases, increased export diversification is evident within the subregion, particularly for the relatively poor economies, which tend to move away from exporting raw agricultural products in favor of more manufactured exports.

We have used newly available global trade and time cost databases to explore the impact of reducing the time to trade in the GMS. However, there are limitations to the current study. For example, only changes in trade of goods currently traded are included and the impacts on extensive margins—i.e., the range of goods being traded—are not modeled. This means that the results underestimate some potentially significant positive impacts (Persson 2008).

Neither potential problems that improved regional infrastructure and trade facilitation may bring[20] nor impacts on such issues as regional poverty have been discussed.[21] Further, the overall impact of trade facilitation will depend in part on what happens in other countries: "[a]n economy's trade will change not only through its own trade facilitation reforms, but also the reforms of its trading partners" (Wilson et al. 2005). Minor and Tsigas (2008) showed that the competitive advantage of reducing time to trade may be lowered when other countries also reduce trade delays. Examining the impact of reduced time in trade between the GMS and the rest of the world, along with how improved trade faciliation in other regions will affect the GMS, will be an interesting topic for further research.

[20] See Stone and Strutt (2009) for discussion of some of the potential negative impacts.

[21] A study that addresses the impact of GMS infrastructure, including on poverty levels, is currently being undertaken for the Asian Development Bank Institute by Tom Hertel, Susan Stone, and Anna Strutt.

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Economic Integration in the Greater Mekong Subregion and Cross-Border Transport Infrastructure

Manabu Fujimura[1]

Abstract

This paper examines the past trends, current situation, and future prospects of economic integration in the Greater Mekong Subregion (GMS), with particular focus on progress in regional trade in the GMS and the role of cross-border transport infrastructure. First, progress in trade integration among the GMS member economies is described. While GMS members are in different developmental stages and had different initial conditions, regional economic integration has advanced noticeably in recent years, reflected in the increased share of intra-GMS trade and dependence of GMS economies on external trade. Second, an empirical analysis based on a gravity model of the impact of cross-border road infrastructure on regional trade shows that development of cross-border road infrastructure—distinct from domestic road infrastructure—has had a positive effect on intra-GMS trade. Third, the paper provides six case studies of local economic corridors and discusses the development of transport infrastructure and its economic impact and prospects along each route. Some general implications drawn from the case studies are: (i) the expansion of trade and economic integration requires a specific size of economies (or markets) at expected "nodes" along the corridor; (ii) expansion also requires some form of resource complementarity between such nodes, e.g., between resource richness and availability of processing technology, or between labor abundance and capital abundance; and (iii) integration requires cooperation among the concerned governments, both in physical and nonphysical aspects of cross-border transport infrastructure.

Introduction

Recent empirical literature in economic geography indicates the importance of reducing transport and logistics costs in international trade and economic development. Reduced transport costs across borders not only induce regional trade but also regional foreign direct investment (FDI) associated with intrafirm supply chain management. Increases in such FDI can, in turn, further increase regional trade. This leads to a cycle of cross-border infrastructure

[1] Department of Economics, Aoyama Gakuin University, 4-4-25 Shibuya, Shibuya-ku, Tokyo 150-8366 Japan.

development, trade, and investment that fosters higher economic growth. This line of reasoning is behind many initiatives of development assistance and economic cooperation in the Greater Mekong Subregion (GMS).[2] In fact, the Asian Development Bank (ADB) expects that out of the total investment requirement of $29.3 billion[3] in support of the GMS Economic Cooperation Program up to 2015, as much as $20 billion will be allocated to the transport sector.[4] However, despite the positive contribution to be made by transport infrastructure on GMS economies, there is a dearth of empirical investigation on the impact of specifically cross-border transport infrastructure. This paper tries to fill this gap to some extent.

Section 2 of this paper describes GMS member economies' progress in trade integration. Section 3 discusses the results of an empirical analysis based on a gravity model that investigates the impact of cross-border road infrastructure on regional trade. Section 4 provides six case studies on local economic corridors and discusses the development of cross-border transport infrastructure and its economic integration impact and future prospects along each route. Section 5 provides some concluding remarks.

Trade Integration in the Greater Mekong Subregion

Since the 1980s, all GMS members—except Thailand—have been under a transition from some form of central planning to a market-friendly economic system, and benefits have started to emerge (Table 1). In particular, the economies of Yunnan Province and Guangxi Zhuang Autonomous Region (hereafter called Yunnan and Guanxi, respectively) of the People's Republic of China (PRC) grew rapidly in parallel with PRC-wide growth, and their per capita gross regional products are now around $1,000, which is, however, still about half the national level. Viet Nam has embarked on industrialization helped by surging FDI; its per capita gross domestic product (GDP) grew to $835 in 2007 and was about $960 in 2008 as projected by the Ministry of Planning and Investment (Saigon *Times*). Cambodia and the Lao People's Democratic Republic (Lao PDR), with their per capita GDPs of over $500 by 2006, are now seeing emerging urban middle classes (Asia *Times*). These economies are growing faster than Thailand's in recent years, resulting in some degree of convergence in the GMS, in which lower-income economies are catching up with higher-income economies. One cautionary note for Yunnan and Guangxi is that while their economies are growing fast, the areas are also experiencing high population growth rates of 7%–8%.

Although GMS member economies are in different developmental stages and each has unique conditions, subregional economic integration has been advancing in recent years (tables 2, 3, 4, and 5). The share of intra-GMS trade in total trade amount has increased from about 4% in 2000 to 7% in 2006. With the exception of Cambodia, GMS members have increased their trade dependence on themselves. However, it should be noted that a common problem concerning trade data in the subregion is that of undocumented trade and smuggling. The limited evidence available regarding the magnitude of smuggling suggests that a significant portion of intra-GMS trade is unrecorded by government officials, with a broad range of 30%–50% of the

[2] The GMS comprises Cambodia, Lao People's Democratic Republic, Myanmar, Thailand, and Viet Nam, as well as Yunnan Province and Guangxi Zhuang Autonomous Region of the People's Republic of China.

[3] In this paper, "$" refers to US dollars.

[4] Asian Development Bank. GMS Development Matrix. www.adb.org/GMS/Projects/devmatrix.asp (accessed June 2008)

Table 1: Basic Indicators for Greater Mekong Subregion Economies

	Population 2006 (million)	Population Growth Rate 2006 (%)	GDP or GRP 2006 ($ billion)	Per Capita GDP or GRP 2006 ($)
Cambodia	14.2	2.4	7.26	513
Lao PDR	5.7	1.8	2.87	536
Myanmar	56.5	2.0	–	160
Viet Nam	84.2	1.3	60.88	723
Thailand	65.2	0.8	206.25	3,162
Yunnan	44.8	6.9	42.35	956
Guangxi	47.2	8.3	49.59	1,069

– = no data, GDP = gross domestic product, GRP = gross regional product, Lao PDR = Lao People's Democratic Republic.

Note: GDP and per capita GDP figures for Guangxi, Lao PDR, and Yunnan are for 2005. Per capita GDP for Myanmar is an estimate by the International Monetary Fund for 2005.

Sources: ADB. 2006. Key Indicators 2006. Manila; and statistical yearbooks for Yunnan and Guangxi.

value of the recorded trade (ADB 2004, p. 14). Including these undocumented trade flows, trade integration in the subregion might be progressing even faster.

Cambodia's dependence on GMS members for its exports is small due to the dominant role of its garment exports to the United States and Europe. Yet much of its industrial and intermediate product imports come from Thailand, making its import dependence on the GMS around 20%. Additionally, although Thailand's outward-oriented development in earlier years led to having major trading partners outside the GMS, the GMS share of its exports and imports increased from 3% and 1%, respectively, in 2000 to 5% and 3%, respectively, in 2006. The share of Viet Nam's trade within the GMS increased during the same period, particularly imports at 8%–10%.

The Lao PDR, landlocked and surrounded by other GMS economies, is by far the most dependent on the GMS for its trade. The GMS made up 65% of the Lao PDR's exports and 78% of its imports in 2006. In particular, the Lao PDR has had a close trade relationship with Thailand across the Mekong River, and electricity sales to Thailand have been added to traditional exports, such as timber and wood. Imports from Thailand range from petroleum products, consumer goods, and machinery to electrical appliances. The flow of goods and people between the Lao PDR and Thailand will accelerate as more bridges are built over the Mekong River (discussed further in section 4).

Myanmar is also heavily dependent on the GMS for its trade, with 54% of its exports and 66% of its imports conducted within the subregion in 2006. The GMS share of Myanmar's exports jumped from 19% in 2000 as its garment exports to the United States halted due to sanctions and the sale of natural gas to Thailand commenced. Imports from the PRC and Thailand increased after 2000, and these countries have replaced Japan as Myanmar's major trading partners. As with the Lao PDR, Myanmar's exports to the PRC have been dominated by logs and wood products, but when PRC-sponsored natural gas fields start production,

Myanmar's export structure will change dramatically. Myanmar's imports from the PRC come mainly through Yunnan and include machinery, motorcycles, fuel, steel, and other industrial products. Myanmar's increasing trade dependence on the GMS, however, is not a result of realizing its full potential for trading with extraregional countries—particularly its abundant and inexpensive labor force—but rather a result of its development satus, leading to a potential overreliance on natural resources.

The importance of the GMS in Yunnan and Guangxi's trade has also increased. The GMS share of Yunnan's exports and imports increased from 36% and 14%, respectively, in 2000 to 68% and 23%, respectively, in 2006. Likewise, the GMS share of Guangxi's exports and imports increased from 16% and 17% in 2000 to 22% and 24%, respectively, in the same period. Myanmar has a long land border with Yunnan and, therefore, has been the most important trading partner in the GMS for Yunnan. However, Yunnan's trade with Lao PDR, Thailand, and Viet Nam has been gaining importance as land transport infrastructure improves. Guangxi's most important trading partner in the GMS is Viet Nam, again due to a long shared land border.

Overall, intra-GMS trade is expanding in a "vertical" (inter-industry) pattern in which Cambodia, Lao PDR, Myanmar, and Viet Nam export natural resources and primary products to Guangxi, Thailand, and Yunnan, and import industrial products. However, this structure might change in the future as land transport infrastructure develops and induces more intra-GMS FDI activities. For example, manufacturing firms in the PRC and Thailand may shift part of their production cycle to the other four GMS countries, which would lead to an increase in "horizontal" intra-industry trade.

Impact of Cross-Border Road Infrastructure on Regional Trade in the Greater Mekong Subregion

The overview of regional trade in the GMS suggests the importance of geographic conditions in determining trade partners and patterns. In addition, recent literature in economic geography provides wide-ranging evidence of an association between geography and trade. A country's geographic conditions, such as the development of transport infrastructure, distance to major international markets, length of borders shared with neighboring countries, and whether a country has coasts or is landlocked, influence the costs of transport and therefore trade volume. Land transport is normally more costly than sea transport per unit distance. Therefore, landlocked countries like the Lao PDR tend to suffer from higher transport costs and are constrained in international trade. For relatively small economies in the GMS, high transport costs denote difficulty in importing capital and intermediate goods necessary for industrialization as well as in sending products abroad. Geographic disadvantages and poor transport infrastructure can also deter FDI, which, in turn, constrains trade further. Even with sound macroeconomic management, geographic disadvantages could rule out the outward-oriented development path that East Asian countries—such as Japan and the Republic of Korea—followed. Export-oriented industrialization depends on reduction of transport costs, because high transport costs can negate the advantages of low labor costs.

Drawing on Edmonds and Fujimura (2008), this section summarizes findings on empirical relationships between the level of development in cross-border road infrastructure and trade volume among GMS economies. The author drew from Limao and Venables (2001) and applied a gravity-type model to bilateral trade flows for each pair of trading GMS economies. Following

Table 2: Intra-Greater Mekong Subregion Exports, 2000
($ million)

Origin	By Destination									
	Cambodia	Lao PDR	Myanmar	Viet Nam	Thailand	Yunnan	Guangxi	GMS	Total Exports	Share of GMS (%)
Cambodia	×	3	0	19	23	0	–	45	1,123	4.0
Lao PDR	0.04	×	–	96	69	6	–	171	330	51.8
Myanmar	0.10	–	×	3	233	70	–	306	1,646	18.6
Viet Nam	142.00	71	6	×	372	8	69	668	14,483	4.6
Thailand	347.00	381	504	838	×	8	22	2,100	68,963	3.1
Yunnan	0.70	13	293	93	24	×	NA	424	1,175	36.1
Guangxi	–	–	–	222	23	NA	×	245	1,493	16.4
GMS Total	490.00	468	803	1,271	744	92	91	3,959	89,213	4.4

– = no data, GMS = Greater Mekong Subregion, Lao PDR = Lao People's Democratic Republic, NA = not applicable.

Sources: International Monetary Fund. Direction of Trade Statistics Yearbook: www.imfstatistics.org/DOT/ (accessed January 2008), and statistical yearbooks for Yunnan and Guangxi.

Table 3: Intra-Greater Mekong Subregion Exports, 2006
($ million)

	By Destination									
Origin	**Cambodia**	**Lao PDR**	**Myanmar**	**Viet Nam**	**Thailand**	**Yunnan**	**Guangxi**	**GMS**	**Total Exports**	**Share of GMS (%)**
Cambodia	×	0.3	0.03	75	15	0.1	–	90	3,562	2.5
Lao PDR	0.9	×	–	107	455	13.0	–	576	882	65.3
Myanmar	0.1	–	×	51	2,135	224.0	–	2,410	4,500	53.6
Viet Nam	245.0	83.0	15.00	×	822	53.0	717	1,935	39,605	4.9
Thailand	1,235.0	1,025.0	761.00	3,098	×	16.0	30	6,165	130,790	4.7
Yunnan	0.6	65.0	541.00	208	96	×	NA	911	1,342	67.9
Guangxi	–	–	–	750	51	NA	×	801	3,599	22.3
GMS Total	1,482.0	1,173.0	1,317.00	4,289	3,574	306.0	747	12,888	184,280	7.0

– = no data, GMS = Greater Mekong Subregion, Lao PDR = Lao People's Democratic Republic, NA = not applicable.

Note: Figures for Yunnan are for 2005.

Sources: International Monetary Fund. Direction of Trade Statistics Yearbook: www.imfstatistics.org/DOT/ (accessed January 2008), and statistical yearbooks for Yunnan and Guangxi.

Table 4: Intra-Greater Mekong Subregion Imports, 2000
($ million)

	By Origin									
Destination	**Cambodia**	**Lao PDR**	**Myanmar**	**Viet Nam**	**Thailand**	**Yunnan**	**Guangxi**	**GMS**	**Total Imports**	**Share of GMS (%)**
Cambodia	×	0.04	0.13	92	222	0.7	–	315	1,425	22.1
Lao PDR	3	×	–	78	419	13.0	–	513	690	74.3
Myanmar	0	–	×	6	555	293.0	–	854	2,402	35.6
Viet Nam	37	106.00	3.00	×	811	93.0	222	1,272	15,637	8.1
Thailand	8	76.00	256.00	331	×	24.0	23	718	61,923	1.2
Yunnan	0	6.00	70.00	8	8	×	NA	92	638	14.4
Guangxi	–	–	–	69	22	NA	×	91	545	16.7
GMS Total	48	188.00	330.00	584	2,037	423.0	245	3,856	83,261	4.6

– = no data, GMS = Greater Mekong Subregion, Lao PDR = Lao People's Democratic Republic, NA = not applicable.

Sources: International Monetary Fund. Direction of Trade Statistics Yearbook: www.imfstatistics.org/DOT (accessed January 2008) and statistical yearbooks for Yunnan and Guangxi.

Table 5: Intra-Greater Mekong Subregion Imports, 2006
($ million)

	By Origin									
Destination	**Cambodia**	**Lao PDR**	**Myanmar**	**Viet Nam**	**Thailand**	**Yunnan**	**Guangxi**	**GMS**	**Total Imports**	**Share of GMS (%)**
Cambodia	×	1	0.1	270	415	0.6	–	687	4,236	16.2
Lao PDR	0.30	×	–	86	1,128	65.0	–	1,279	1,633	78.3
Myanmar	0.04	–	×	16	837	541.0	–	1,394	2,100	66.4
Viet Nam	83.00	118	57.0	×	3,408	208.0	750	4,624	44,410	10.4
Thailand	35.00	500	2,348.0	904	×	96.0	51	3,934	128,636	3.1
Yunnan	0.10	13	224.0	53	16	×	–	306	1,318	23.2
Guangxi	–	–	–	717	30	–	×	747	3,075	24.3
GMS Total	118.00	632	2,629.0	2,046	5,834	910.0	801	12,971	185,408	7.0

– = no data, GMS = Greater Mekong Subregion, Lao PDR = Lao People's Democratic Republic.

Note: Figures for Yunnan are for 2005.

Sources: International Monetary Fund. Direction of Trade Statistics Yearbook: www.imfstatistics.org/DOT/ (accessed January 2008), and statistical yearbooks for Yunnan and Guangxi.

the empirical approach common to gravity model regressions, the volume of bilateral trade was regarded as dependent on economic size (typically GDP), population size, and geographic characteristics, such as distance between the major markets. Using this basic relationship, explanatory variables for road infrastructure were added to the model. Gravity models were often estimated with a few other variables to characterize the geographic characteristics and proximity of economies besides distance (e.g., sharing land borders, being landlocked, having small island status) or cultural–historical ties (e.g., shared language, dominance by common colonial power). However, these variables were not included in the author's estimates due to the statistical constraints explained below.

The dataset used in the analysis covers each pair of six GMS economies, excluding Guangxi (due to data limitation) over 1981–2003. In all, 30 economy pairs can be formed across the six GMS economies, making the maximum number of observations 690 (30 × 23). Due to the relatively small number of GMS economies and limited number of years for which most data are available, missing data problems were widespread and created challenges in model estimation.

For trade flow data, two measures were employed: one based on total bilateral trade reported in the International Monetary Fund Direction of Trade Statistics (IMF-DOTS) database (except for Yunnan, for which data were taken from Yunnan statistical yearbooks), and the other based on major exports transported via land or river. For the latter measure, up to five commodities defined at the four-digit level in the United Nations Globally Harmonized System of Classification and Labelling of Chemicals that are considered largely transported via land (or ferry, where river transport dominates) were identified, and their export values reported in the United Nations Commodity Trade Statistics (UNCOMTRADE) database were added to form the measure of major exports via land.[5] Using this measure is preferred to using total bilateral trade, because cross-border road infrastructure was expected to be more important in determining the volume of overland trade flows than that of total trade, which includes ocean-bound trade and is influenced by a greater variety of factors. However, using this preferred measure came at the cost of data scarcity and some unavoidable subjectivity in the selection of major goods due to vague customs data at overland points of entry. Therefore, the use of the total bilateral trade worked as a check on the sensitivity of estimates. It was assumed that omission of the value of unrecorded trade mentioned previously was unlikely to influence estimates due to the focus on international crossing points—as opposed to local border crossing points—in deriving the measure of cross-border road infrastructure.

Two separate measures were constructed for road infrastructure based on road density in GMS economies: one characterizing road density in border areas and the other characterizing road density in nonborder areas. In the author's analysis, "cross-border road infrastructure" was represented by the density of paved roads in the provinces/states containing international crossing point(s) to the corresponding GMS pair. "Domestic road infrastructure" was represented by the density of paved roads in the provinces/states that do not border any economy.[6] Figure 1

[5] Many GMS countries, particularly Cambodia, Lao PDR, and Myanmar, do not report trade figures to the UNCOMTRADE database; bilateral trade data between these countries are absent in the dataset that was used. Therefore, the analysis for intra-GMS trade is driven by the data available from the PRC, Thailand, and Viet Nam.

[6] Data sources (and data years available) were Council for Development of Cambodia for Cambodia (1995–2002), Department of Roads, Ministry of Communications, Transport, Post and Construction for Lao PDR (1992–2003); Department of Highways, Ministry of Transport for Thailand (1994–2003); and the transport section of statistical yearbooks for Myanmar (1984–1996), Viet Nam (1993–2002), and Yunnan (1990–2002).

displays the GMS road network and the international crossing points referenced in the dataset. For example, cross-border road infrastructure for Cambodia as an exporter and the Lao PDR as an importer is represented by the road density in Stung Treng Province, Cambodia and Champasak Province, Lao PDR, respectively. Similarly, the domestic road infrastructure in this case is represented by road density of all the other provinces in these economies, respectively.

The main findings from the econometric analysis are: (i) economy size appears to be a dominant driver of regional trade; (ii) the elasticity of trade in major exports, likely to be transported over land between GMS economies with respect to developments in cross-border road infrastructure, is estimated to be 0.6–1.4 (this means that a 1% increase in road density in GMS border regions would increase the volume of trade in major commodities by 0.6%–1.4%); (iii) when the variable of domestic road infrastructure is included in the gravity model separately, a positive association exists between the two with an estimated elasticity of about 1.0; (iv) when both variables of cross-border and domestic road infrastructure are included in the model, cross-border roads have a positive association and domestic roads have a negative association with trade flows (both major exports and total trade);[7] and (v) barriers to trade captured by weighted average tariff rates failed to yield significant associations with trade flows, which may suggest a relatively greater impact of unmeasured nontariff barriers.[8]

Despite the severe data constraints, the analysis indicates that the development of cross-border road infrastructure in the GMS has had a discernible positive effect on regional trade and is considered a critical part of a broader effort to encourage regional integration to benefit GMS economies, particularly those less endowed with natural seaports.

Technical details on this analysis can be found in Edmonds and Fujimura (2008). Many potential problems, such as omitted variables and measurement uncertainties due to the small sample size, cannot be dismissed. The results summarized in this paper are not the last word on empirical evidence. To the best of the author's knowledge, no similar study has been conducted before, implying that there is room to either validate or to refute these results with a better dataset that will be available in the future.

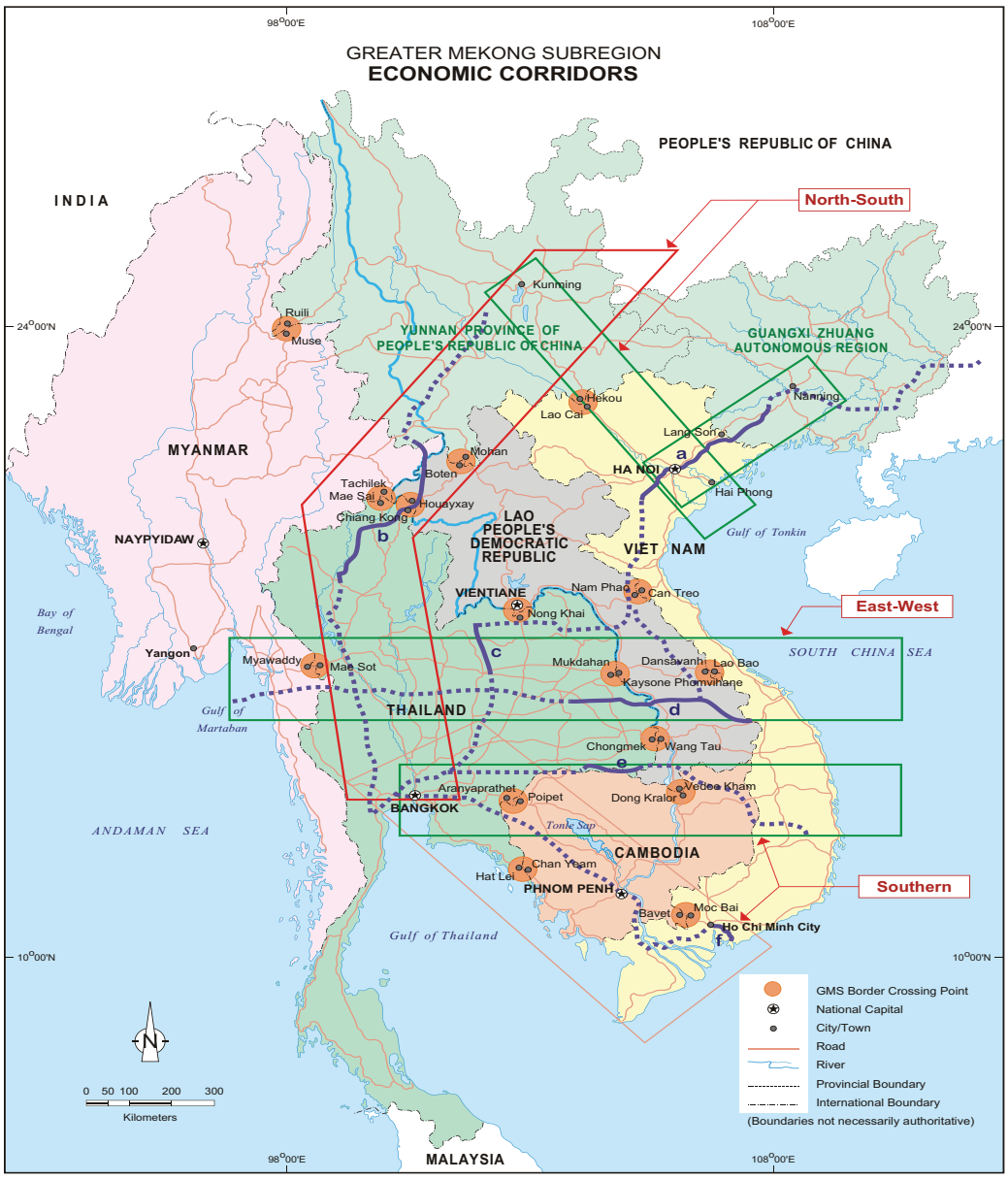
Case Studies of Local Economic Corridors and Their Economic Impacts

The previous section provided findings on the GMS-wide average association between cross-border transport infrastructure and regional trade. This section discusses more micro-level developments using case studies of six local economic corridors, based on the author's site visits in 2005 and 2007, supplemented by available secondary information. The naming of the corridors follows that of ADB where available, but some routes (e.g., the Middle Corridor) also are named by the author. The location of each route is indicated by a–f in Figure 1.

[7] There is a possibility that this result is caused by collinearity between the two road density variables, in which case, cross-border and domestic road developments could have complementary, not substitutive, impacts on regional trade.

[8] This result may be partly due to the fact that this measure was calculated from actual tariff revenues (divided by total import values) instead of statutory tariff rates. The actual duties are generally lower than those implied by statutory tariff rates.

Figure 1: Greater Mekong Subregion Road Network and Major International Crossing Points



Note: Blue lines and dots marked a–f are local economic corridors referred to in the text. a = Northern Viet Nam–Guangxi Zhuang Autonomous Region–Guangdong (North–South Corridor 1), b = Northern Thailand–Northwestern Lao People's Democratic Republic–Yunnan Province (North–South Corridor 2), c = Udon Thani/Nong Khai (Thailand)–Vientiane (Middle Corridor 1), d = Northeastern Thailand–Central and Southern Lao People's Democratic Republic–Central Viet Nam (East–West Corridor), e = Northeastern Thailand–Southern Lao People's Democratic Republic–Central and Southern Viet Nam (Middle Corridor 2), f = Bangkok–Phnom Penh–Ho Chi Minh City (Southern Corridor).

Source: Asian Development Bank; author's additions in blue.

Northern Viet Nam–Guangxi Zhuang Autonomous Region–Guangdong (North–South Corridor 1)

Since normalization of the PRC–Viet Nam relationship, economic integration along this route has been accelerating. Furthermore, Guangxi is becoming an important land link between southern coastal PRC—which is ever-growing with industrial clustering—and northern Viet Nam, which is also industrializing rapidly, helped by increased FDI. The Red River Delta surrounding Ha Noi has seen construction of many roads and bridges leading to the Noi Bai Airport and to PRC borders, making the area attractive for foreign investors who are thinking of production networks using both northern Viet Nam and southern coastal PRC. According to a test run done by a Japanese trading company, transporting a 12-square meter truckload between Guangzhou and Ha Noi by sea takes 4–6 days and costs $1,250, while doing so by land takes only 2 days but costs $1,800.[9] This indicates that further development in land transport will make it more attractive relative to sea transport for businesses by reducing overall transaction costs involved in the cross-border operation along this corridor.

Of the two land links between northern Viet Nam and Guangxi, the Ha Noi–Lang Son–Yougiguan route has a railway connection, but there is a problem of different gauges between the two countries. Yet now, with the paved and widened road between Ha Noi and Lang Son (NR1, part of which is expressway) and a shortened travel time of about 2.5 hours, road transport has become the dominant mode. There appear to be no significant structural bottlenecks on this route. Many factories and warehouses are being established along NR1 in northern Viet Nam toward the PRC border. Also, on the Guangxi side, road infrastructure has developed fast with tolled expressways between Yougiguan and Nannin (209 kilometers [km], taking about 2 hours) and expanding beyond to Guangdong (809 km, taking about 14 hours).

The other land link between northern Viet Nam and Guangxi is the route from Ha Noi via Cailan (NR18) and Halong to the Mong Cai–Dongxing border—about 316 km, taking over 7 hours by car. The road from Ha Noi is well-paved along the coast up to Hong Gai and Cam Pha. The rest of the way (about 130 km) is mostly narrow, winding, and badly maintained, with potholes in many parts, making the trip tiring and dangerous. Nonetheless, the number of buses and trucks seems greater than that near Lang Son. Unlike the other border of Dong Dang–Yougiguan, the two border cities of Mong Cai and Dongxing across Song Ka Long River seem to have formed a well-integrated and prospering economy. Residents on both sides cross the border bridge on a daily basis for shopping and selling local products. Many PRC products are carried into Mong Cai's morning markets by boats and motorcycles. While development in Mong Cai seems new and fast, including upscale hotels to accommodate tourists from the PRC, Dongxing City on the Guangxi side seems to have developed much earlier. Income level is presumably higher on the Guangxi side because Vietnamese street vendors were seen there.

Overland trade between northern Viet Nam and Guangxi would increase not only through natural increase of traffic flows but also by diversion from sea transport. The two main ports in northern Viet Nam, Hai Phong and Cailan, both have constraints. Hai Phong's port has easy access to Ha Noi (NR5), but it is a river port and is limited in the size of ships that can enter. Cailan's port is difficult to access because incoming ships must pass through Halong Bay (a tourist destination) and a shallow channel into Cailan Bay.

[9] Information from the Japan External Trade Organization.

Comparing the two routes mentioned above, overland trade along the Lang Son route would increase significantly as border regulations, such as on truck transshipment, become more liberalized.

Northern Thailand–Northwestern Lao People's Democratic Republic–Yunnan Province (North–South Corridor 2)

This route links Thailand's Chiang Rai Province and Yunnan through Lao PDR's Bokeo and Luang Namtha provinces, and constitutes part of the Bangkok–Kunming North–South Corridor. Soon, physical bottlenecks along this route will almost be eliminated by the completion of the Lao PDR portion of road upgrades (228 km) between Houayxai and Boten (R3 and part of R1), cofinanced one third each by the governments of the PRC and Thailand and ADB. Expected to be completed in 2011, the remaining bottleneck will be the third Mekong international bridge between Houayxai and Chiang Khong (Thailand), the cost of which will be shared equally by the governments of the PRC and Thailand. When the bridge is completed, the land link between Bangkok and Kunming will be a fully paved all-weather road. The completion of this corridor route will increase flows of goods and people between the PRC and Thailand, benefiting consumers, producers, and traders along this corridor. The volume of trade in timber, rubber (Chinese investments), and coal (Thai investments) will increase. Trade across the Lao PDR border in temperate produce (e.g., fruit and vegetables) from Yunnan and tropical crop produce (e.g., fruit) from Thailand is also expected to rise. Trade in consumer goods made in the PRC and high-end garments and machinery made in Thailand will also increase along this route.

Traffic in the Golden Triangle has been dominated by river transport on the Mekong River, mostly by ships from the PRC. Once the road and the bridge are completed, substantive portions of the river traffic could be diverted to land transport, which may negatively impact those whose livelihoods depend on river transport. However, towns and villages along the corridor, especially those in the two northwestern Lao PDR provinces and Yunnan's Xishuanbanna District, will benefit from the all-weather road access to public services and distant labor markets. With reduced transport costs, farmers who have been dependent on subsistence agriculture may seize opportunities for diversifying into higher-value crops. The number of tourists visiting this corridor will also grow, providing local residents with nonfarm income-earning opportunities.

There are additional potentially negative impacts of the road development, such as overexploitation of natural resources (e.g., rubber plantations), a higher risk of incidence of communicable diseases, and other socially deteriorating effects on vulnerable peoples, including minority hill tribes. These risks need to be mitigated to the extent possible.

Udon Thani/Nong Khai (Thailand)–Vientiane (Middle Corridor 1)

Though not a part of the ADB-initiated corridors, this route connects the local economies of Udon Thani and Nong Khai in northeastern Thailand and that surrounding the capital of the Lao PDR. The flow of people has increased since the completion of the first Mekong international bridge (financed by Australia) in 1994, and the local economies have been well integrated. This route is already a de facto economic corridor although short in distance, and the border between the Lao PDR and Thailand is close to major markets on both sides. Laotians go to Thailand for department store shopping while Thais visit the Lao PDR for tourism and shopping at duty-free stores.

As the capital, Vientiane's economy had a head start in development and is the largest market in the Lao PDR, attracting the largest proportion of FDI inflows. Less than 20 km of paved road in good condition connect the center of Vientiane to the Thanaleng border. On the Thai side, the Nong Khai border is only 50-minute drive away from the center of Udon Thani, where the local airport is located. For Bangkok residents to travel to Vientiane, it saves both time and money to take a domestic flight to Udon Thani and cross the bridge to Vientiane than to take an international flight from Suvarnabhumi Airport (Bangkok) to Wattay Airport (Vientianne). Although both the Lao PDR and Thailand require emigration and immigration checks at the international bridge, the officers on both sides appear to be skilled in processing the flow of people; frequent shuttle buses operate to and from the bridge and carry people efficiently.

Exports from the Lao PDR to Thailand that use this bridge are dominated by timber and wood products while imports are miscellaneous goods in small lots. The Lao PDR usually registers a trade deficit against Thailand. Since 2006, with Thai and French financial assistance, a cross-border railway has been under construction on the bridge. Once completed, it will accelerate the flow of goods on this route. So far, the flow of goods seems to be within the short economic corridor between Udon Thani and Vientiane. However, as the road network in the Lao PDR extends eastward into Viet Nam (R8 and NR8), it is conceivable that this corridor will be able to connect the economies of Vientiane and Ha Noi. In fact, a Japanese paper manufacturer plans to expand operations into central Lao PDR for tree planting and transport of wood chips along this route for export at Vinh Port in Viet Nam (JETRO *Daily*).

Northeastern Thailand–Central and Southern Lao People's Democratic Republic–Central Viet Nam (East–West Corridor)

This route constitutes the eastern one third of the East–West Corridor, which extends 1,446 km from Mawlamyine, Myanmar to Da Nang, Viet Nam. With the second Mekong international bridge (financed by Japan) between Mukdahan and Savannakhet completed in December 2006, the flows of goods and people across the river have been increasing. Between January and April 2007, the number of visitors to Savannakhet was close to 50,000, already far exceeding the rate of crossings on the first Mekong international bridge. The initial increase in visitors to the Lao PDR seems to be due to Thai tourists traveling to central Viet Nam (Souknilanh 2007), thanks to the completion of the Viet Nam portion of the corridor—including the opening of Hai Van Tunnel—and upgraded beach resorts at Hoian, Hue, and Mison. Tourist buses pick up and send off these tourists at Savannakhet. Moreover, it now takes only 5 hours to travel from Da Nang to Lao Bao, making it possible to move cargo from Da Nang to Mukdahan in 1 day.

Lao shoppers traveling to Thailand are also increasing in number due to enhanced travel convenience, with the bridge replacing ferries. To promote the flow of people across the border, a plan for joint use of Savannakhet Airport, which was built in 1998 but has been closed since 2004 due to low demand, is in place. The plan will expand the airport and allow Thai citizens to use it with some simplified border procedures.

The donor community expects the corridor's benefits to reach poorer peoples in central Lao PDR and Viet Nam who have been left behind in the countries' economic development. It is hoped that the upgraded road will induce investments and provide economic opportunities. At the Lao Bao–Densavanh border, the Government of Viet Nam established a duty-free zone with the aim of inducing further FDI and providing employment to ethnic minority peoples.

Savannakhet Province, through which the East–West Corridor passes, is the largest in the Lao PDR in terms of population (about 900,000), area, and endowment of natural resources. Its dominant exports have been timber and wood products to Thailand, a visible activity with many sawmills along R9. Additionally, an Australian investor is expanding operations for gold and copper mining in the province for export to Australia. In the manufacturing sector, there has been a gradual increase in investments along the corridor, including local garment factories, a cement factory, a beer brewery, a motorcycle assembly plant (a Republic of Korea investment), and a socks factory (a Japanese investment). Taking advantage of the new bridge, the Government of Lao PDR is developing the Savan–Xeno Special Economic Zone at two strategic sites, one at the bridge and the other at the intersection of R9 and R13.

For global firms thinking of investing in the GMS, the immediate significance of the second Mekong international bridge is the opening of a land transport route between Bangkok and Ha Noi, reducing cargo trips to a minimum of 2 days and providing an opportunity to restructure and streamline their supply-chain management between the two "node" economies. Many major logistics and forwarder companies have reportedly commenced services for the Bangkok–Ha Noi route using the new bridge. To promote business investments further by external manufactures, shippers, and traders, simplification of customs procedures and facilitation of transit trade are needed. On the former, a pilot project is ongoing at the Lao Bao–Densawan border, in which import and export customs inspections, immigration, and quarantine are to be done at a single window. On the latter, it was reported in September 2007 that the governments of Lao PDR, Thailand, and Viet Nam agreed to allow their trucks to travel freely in the three countries on the condition that Thai and Vietnamese trucks do not provide services to Lao PDR local traders. Currently, Lao PDR trucks can run in any of the three countries, Thai trucks can run on Lao PDR roads but not in Viet Nam, and Vietnamese trucks can run on Lao PDR roads but not in Thailand.

Northeastern Thailand–Southern Lao People's Democratic Republic–Central and Southern Viet Nam (Middle Corridor 2)

This route connects the local economies of Ubon Ratchathani in northeastern Thailand and Pakse in southern Lao PDR, and then extends southeastward to Viet Nam. This is also not part of the ADB-initiated economic corridors, but de facto economic integration along this route seems well advanced. The road access between Ubon Ratchathani and Pakse is very good, with a mostly two-lane, paved, all-weather road and a Mekong-crossing bridge (financed by Japan) close to Pakse. The two economies across the Chong Mek–Vangtau border (the only land border among seven major Thai–Lao PDR border points) seem well integrated. Citizens of both countries with temporary border passes can travel across the border without passports. Laotians shop for Thai rice and consumer goods in Chong Mek, while Thais buy alcoholic beverages and tobacco at the duty-free shop in Vangtau.

Pakse, the capital of Champasak Province, is located at a crossing point between the main road connecting Thailand (R16) and the main north–south trunk road (R13) in the Lao PDR. It has a large, lively central market (Talat Dao Heuang) where consumer goods from Thailand and Viet Nam, as well as local agricultural produce, are sold. The town of Paksong, 45 km east of Pakse and 1,100 meters high, serves as a gateway for high-value agricultural goods produced in Bolaven Plateau, such as coffee and vegetables. Coffee harvested in Bolaven Plateau is known

for its good quality. Large-scale producers, including Dao Heuang, mainly produce arabica coffee (which has high yield but is susceptible to diseases and requires intensive inputs), while small farmers produce robusta coffee exclusively. Much Lao PDR coffee is currently exported to Viet Nam for blending in Vietnamese brands of coffee or to Europe as a high-end brand (with a foreign nongovernment organization's help). Organic vegetables, especially cabbages, produced in Bolaven Plateau are also popular exports. Cabbages are grown in 2–3 hectare farms and exported mainly to Thailand where they are sold at higher prices than Thai local cabbages. However, due to organic farming, Bolaven cabbages carry a higher cost of production. With the established road link, the government of Champasak Province aims to add value to local products and market them mainly in Thailand.

It appears that this economic corridor is de facto extended to Viet Nam. The road from Paksong to Quy Nhon in Binh Dinh Province has been connected with Vietnamese aid, and travel time has been reduced to 6 hours. In fact, international route buses have been using this road since 2006 and are expected to make integration on this corridor trilateral, with Pakse being the center node.

Bangkok–Phnom Penh–Ho Chi Minh City (Southern Corridor)

This corridor has the potential to link two of the largest markets and industrial clusters in the GMS: Bangkok and Ho Chi Minh City. However, so far, the contribution of this land route to current GMS economic integration seems limited due to various bottlenecks as well as competition with alternative sea-bound transport. Firms located in Bangkok and Ho Chi Minh City have been looking outward separately instead of looking at each other—industrial products made around Bangkok are shipped out at Klong Toy or Laem Chabang ports, while those made around Ho Chi Minh City are shipped out at Saigon or Vuntau ports.

The road from the center of Ho Chi Minh City to the Cambodian border town of Moc Bai (80 km) is mostly paved, has four lanes, and takes only about 2 hours to traverse. There are many industrial estates along the road, decreasing in number toward the border. Neighboring provinces, such as Tay Ninh, Long An, Bin Duong, and Dong Nai, appear to be agriculture-based and have extensive rubber plantations. Currently, there does not appear to a noticeable cross-border industrial link along this route. However, on the Vietnamese side, the Moc Bai Border Economic Zone is being constructed. The Government of Viet Nam plans to make the surrounding area a special economic zone. There is an impressive duty-free hypermart, an outlet-sized establishment where Vietnamese customers can buy duty-free items, although with a quota per person. Passport-holding foreigners, as well as Cambodian citizens, also have access to this facility. On the Cambodian side, the border town of Bavet is also fast developing. Its customs facilities were completed in January 2006, and several casino hotels have opened to lure Vietnamese tourists. About 6 km from the border, the Manhattan Special Economic Zone developed by American investors has succeeded in hosting five foreign investors in mainly light manufacturing sectors. Some of them, with capital from Taipei,China, have relocated there to avoid antidumping measures faced in European Union markets.

Most of the road upgrades along the Southern Corridor have been completed. The remaining physical bottlenecks include upgrading the 61-km road between Phnom Penh and Neak Loeung, and constructing the bridge over the Mekong River near Neak Loeung (with Japanese aid and an expected completion date of 2010). Nonphysical bottlenecks include the absence of an easy transit cargo system (a similar situation to that of the East–West Corridor), less-than-transparent

border procedures in Cambodia, and cargo imbalance (e.g., little demand for cargo transport going from Phnom Penh to Bangkok or from Phnom Penh to Ho Chi Minh City, raising the logistics costs along these routes). In addition to these bottlenecks, the Southern Corridor route (about 900 km in total) faces competition with sea transport due to the limited geographic advantage of the former. A 2004 survey by a Japanese logistics firm showed that transporting a 20-foot container between Bangkok and Ho Chi Minh City by sea took 2–3 days and cost $580, while doing so by land took at least 2 days and cost $1,390.[10] Even when the physical and nonphysical bottlenecks are eliminated, the advantage of land transport along this corridor may be limited unless flows of traffic between Bangkok and Ho Chi Minh City become very smooth and time savings become significant.

Summary of Case Studies

Some of the corridors reviewed are more advanced in de facto economic integration than others due to historical and geographic factors. The earlier the development of the transport infrastructure, the higher the extent of the integration across borders. Some general points are that (i) integration does not happen immediately and requires a certain level of economic agglomeration and industrial clustering at "node" economies along the corridor; (ii) trade expansion requires resource complementarity between the nodes, which induces international businesses to integrate their activities along the corridor; and (iii) integration requires not only the construction of physical infrastructure but also the removal of nonphysical bottlenecks and coordination among the governments involved.

Table 6 summarizes the current status of the corridors reviewed with characterization in the gravity model framework used in section 3 and their future prospects. The "node" economies in the table are chosen based on the author's judgment regarding the current extent of economic integration.

[10] Information from the Japan External Trade Organization.

Concluding Remarks

Although GMS members are in different developmental stages and had different initial conditions, regional economic integration in the GMS has advanced noticeably in recent years. Although the intensity of regional trade in the GMS is not as impressive as in other parts of East Asia, including the PRC as a whole, Japan, and the Republic of Korea, the share of intra-GMS trade and the dependence on GMS economies' external trade on such trade have increased during 2000–2006. The results from the gravity model estimation using historical data from the GMS suggest that the development of cross-border road infrastructure, distinct from domestic road infrastructure, has had a positive effect on intra-GMS trade. Case studies of several local economic corridors indicate that some routes are more advanced than others in economic integration across borders.

Some general implications drawn from the case studies are: (i) the expansion of trade and economic integration requires a specific size of economies (or markets) at expected "nodes" along the corridor; (ii) expansion also requires some form of resource complementarity between such nodes, e.g., between resource richness and availability of processing technology, or between labor abundance and capital abundance; and (iii) integration requires cooperation among the concerned governments, both in physical and nonphysical aspects of cross-border transport infrastructure.

Dating back to 1957, economic cooperation in the Mekong area began when the Mekong River Commission was established to coordinate the interests of stakeholders in the Mekong water basin. Since then, the region has undergone a series of conflicts that postponed substantive progress in regional cooperation. Only after the mid-1990s when peace arrived has the region been able to discuss economic development for mutual benefit—under the catchphrase of "from battlefield to marketplace." The time has come for the people in the region to reap the benefits of peace dividends. With bilateral as well as multilateral assistance, GMS member governments have deepened their policy dialogues to advance the benefits of regional integration and cooperation. With accumulated experience in the cooperation thus far, the author is optimistic about the future of the region's overall prosperity in the long run, even with possible negative repercussions in some areas in the short run.

Table 6: Status of Economic Corridors and Their Future Prospects
(as of March 2008)

Corridor	Node 1	Node 2	Characterization	Visible Short-Run Prospect	Foreseeable Long-Run Prospect	Bottlenecks/ Required Improvements
North–South Corridor 1	Ha Noi	Southern coastal PRC	Large economic size on both ends; long distance (1,200–1,300 km) but fast development in road infrastructure	Gradual increase in flow of goods and people	Possibly fast economic integration	Road improvement on the Vietnamese side; simplification of border procedures
North–South Corridor 2	Chiang Rai (Thailand)	Xishuanbanna District (Yunnan Province)	Small but growing economies on both ends; medium distance (about 300 km)	Relatively fast increase in flow of goods and people	Possible integration with Bangkok to the south and Kunming to the north	Third international Mekong bridge; simplification of transit trade and border procedures
Middle Corridor 1	Udon Thani and Nong Khai (Thailand)	Vientiane (Lao PDR)	Small economies on both ends; short distance (100 km at most)	Already well integrated	Possible integration with Bangkok to the south and Ha Noi to the northeast	Road improvement along R8 in Lao PDR; simplification of border procedures

continued on next page

Table 6 continued

Corridor	Node 1	Node 2	Characterization	Visible Short-Run Prospect	Foreseeable Long-Run Prospect	Bottlenecks/ Required Improvements
East–West Corridor	Mukdahan–Savannakhet (Thailand–Lao PDR)	Hue and Da Nang (Viet Nam)	Small economies on both ends to date; medium distance (350–400 km)	Tourism impact proceeding	Possible integration with Bangkok to the south and Ha Noi to the north	Industrial accumulation at the two nodes; simplification of transit trade and border procedures
Middle Corridor 2	Ubon Ratchathani (Thailand)	Pakse (Lao PDR)	Small but growing economies on both ends; short distance (about 150 km)	Well integrated	Possible integration with north and central Viet Nam and northern Cambodia	Further simplification of border procedures
Southern Corridor	Ho Chi Minh City (Viet Nam)	Phnom Penh (Cambodia)	Growing economies on both ends; relatively short distance (about 250 km)	So far, integration limited to Ho Chi Minh City–Cambodia border	Uncertain prospect for integration from Bangkok through Phnom Penh to Ho Chi Minh City	Road improvement between Phnom Penh and Neak Loeung; nontransparent border procedures

km = kilometer, Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China.

Source: Author.

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Logistics Development in the North–South Economic Corridor of the Greater Mekong Subregion

Ruth Banomyong[1]

Abstract

Traders in the Greater Mekong Subregion require efficient logistics services that can move their goods to the right place, at the right time, in the right condition, and at the right price. It is, therefore, of great importance that regional links among neighboring countries are strengthened to facilitate trade and to develop logistics for better access to the global market. This is particularly true for the North–South Economic Corridor (NSEC), one branch of which extends from Kunming in the People's Republic of China to Bangkok, Thailand. This branch, which is the focus of this paper, has three separate subcorridors.

A methodology to assess the NSEC macro-logistics system and subcorridors was developed and validated with empirical and secondary data for the three subcorridors in the Kunming–Bangkok branch of the NSEC. Infrastructure connectivity in the NSEC is almost complete, but border crossings are still the weakest link in the macro-logistics system. An integrated approach is needed in order to solve this key problem. This approach should combine solutions to physical infrastructure issues with adherence to rules and regulations. The remaining challenge is how to transform the NSEC subcorridors into fully fledged economic subcorridors that can attract investment and generate economic activities in remote areas of the subcorridors, such as border crossings.

Introduction

The development of logistics services and communication technologies has revolutionized production and distribution processes, creating a global market. Shippers and consignees require efficient logistics services that can move their goods to the right place, at the right time, in the right condition, and at the right price. In the Greater Mekong Subregion (GMS),[2] it is, therefore,

[1] Centre for Logistics Research, Faculty of Commerce and Accountancy, Thammasat University, Bangkok, Thailand; e-mail: ruth@banomyong.com

[2] The GMS comprises Cambodia, Lao People's Democratic Republic, Myanmar, Thailand, and Viet Nam, as well as Yunnan Province and Guangxi Zhuang Autonomous Region of the People's Republic of China.

of great importance that links among neighboring countries are strengthened to facilitate trade and to develop logistics for better access to the global market. This is particularly true for the North–South Economic Corridor (NSEC), one branch of which extends from Kunming in the People's Republic of China to Bangkok, Thailand.

The NSEC has three subcorridors that link Kunming–Bangkok, Kunming–Ha Noi–Hai Phong, and Nanning–Ha Noi, respectively. The Kunming–Bangkok subcorridor travels through either the Lao People's Democratic Republic (Lao PDR) and Myanmar or along the Mekong River. Thailand does not share a land border with the People's Republic of China (PRC).

For some countries in the subregion, inadequate transport infrastructure and high logistics service costs have constrained economic corridor development and integration. Major infrastructure investments are already being undertaken by GMS countries, and more are planned, which will improve physical connectivity between neighboring countries. The improved infrastructure, coupled with expanded cross-border cooperation among GMS countries, will accelerate the process of integrating the subregion's economic corridors into the rest of the world and the global market.

Logistics Development Policy

Logistics is difficult to define because it is a constantly evolving concept. Logistics no longer concerns only the handling of materials or transport of materials; it has grown in scope to encompass the set of activities that facilitate the economic transactions associated with production and trade (Stock and Lambert 2001). These include customer service and support; demand forecasting and planning; facilities site selection, warehousing, and storage; inventory management; logistics communication and order processing; material handling and packaging; and reverse logistics, sourcing, and transport (Grant et al. 2006).

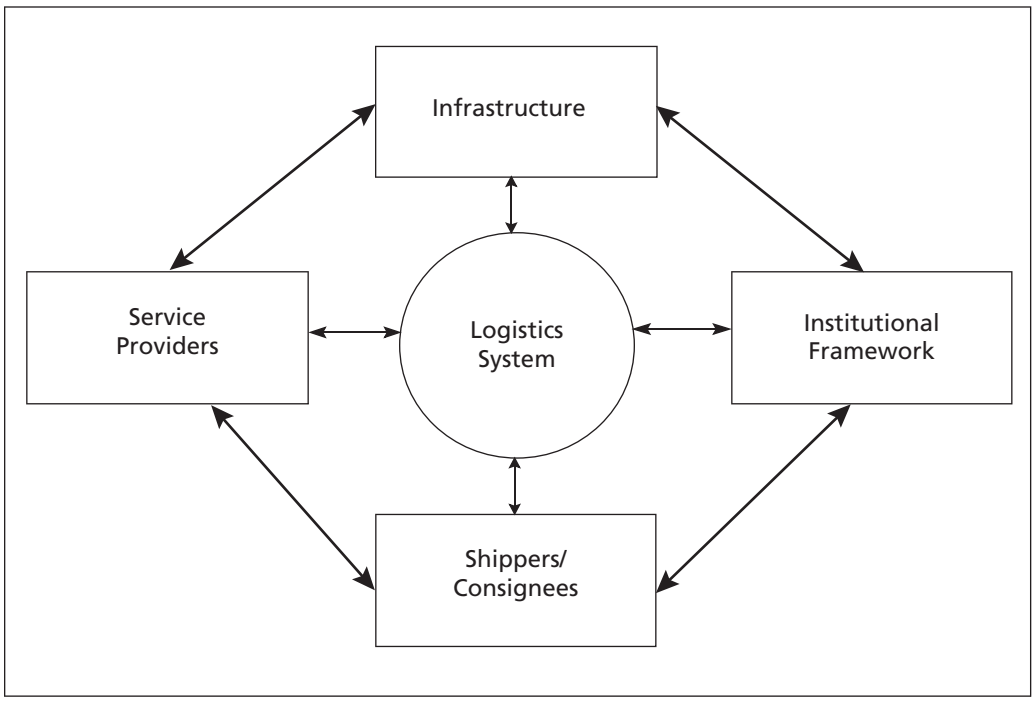
Logistics plays a key role in national and regional economies in two ways. First, it is one of the major expenditures for businesses, thereby affecting and being affected by other economic activities. Second, it supports the movement of a multitude of economic transactions; it is an important aspect of facilitating the sale of all goods and services.

Logistics is not just confined within national borders or markets, because within each country or region there are export and import firms that face specific logistics attributes that may be different from those experienced in the domestic market. In an international logistics system, many state agencies and—in particular—customs agencies play crucial roles in the efficiency of the logistics system. There is also heavy reliance on specialized service providers, such as freight forwarders or customs brokers, which can facilitate the flows of goods across borders. The biggest difference between domestic and international logistics is the environment in which the logistics system operates.

Logistics from a policy perspective is much more than just transport infrastructure development. A holistic approach that addresses the requirements of traders' needs, service providers' expertise, infrastructure capacity, and institutional framework is needed in order to develop national or regional logistics development policy.

A regional logistics system, like any other macro-logistics system, is composed of (i) shippers, traders, and consignees; (ii) public and private sector logistics service providers; (iii) provincial and national institutions, policies, and rules; and (iv) transport and communications infrastructure (Banomyong et al. 2007).

Figure 1: Logistics System Components



A useful working definition of logistics development policy is: a policy that involves the planning, facilitating, implementing, integrating and controlling the efficient, effective flow and storage of freight, people and information within and between logistics systems, for the purpose of enhancing traders' competitiveness in order to increase national and/or regional competitive advantage.

Figure 1 shows how these four components combine to determine the performance of each part of the logistics system in terms of cost efficiency, responsiveness, reliability, and security. These three performance indicators reflect both on the level of integration of the logistics system and logistics services capability within a system, such as the NSEC. The sum of these factors determines the competitiveness of the NSEC logistics system.

This paper describes the methodology used to assess the status quo of the NSEC macro-logistics system for the three subcorridors in the Kunming–Bangkok branch of the NSEC, as a prerequisite for setting up logistics development policies.

Economic Corridor Development

The purpose of a transport corridor is to link areas physically that were not previously connected within a country or a region. A logistics corridor focuses not only on the physical connection but also on how the flow and storage of freight, people, and vehicles are optimized in the corridor with the support of capable service providers and a facilitating institutional environment provided by relevant agencies.

The main stakeholders involved are shippers and consignees using the various routes along the corridors, service providers offering different types of logistics services, and government agencies involved in the infrastructure as well as the rules and regulations on movement and storage of freight along the logistics corridor.

The potential strength of logistics corridors lies primarily in the possibilities that they offer in confronting the concerns and interests of all relevant stakeholders, public and private, who can focus on policies and initiatives to cater to specific routes and border crossings. They, thus, offer the possibility of tackling logistics issues in a holistic manner (institutional, administrative, and infrastructural), initiating and effecting changes that may otherwise be difficult to achieve at a wider national and/or regional level.

In an economic corridor, economic development will not be concentrated solely in large cities located along the corridor. Investment and economic development will need to reach smaller towns and rural areas along its route. Incentives to attract private sector investment need to be reviewed and harmonized between different countries along the economic corridor to facilitate economic activities in less-developed areas of the corridor. The success of an economic corridor will depend on the attraction of investment. Attraction of investment, in turn, relies on appropriate infrastructure and facilitation policies.

It is impossible to establish economic corridors at the outset. There is a gradual evolutionary phase that must be followed if their establishment is to be sustainable. The stages of development are shown in Table 1.

Table 1: Corridor Development Level

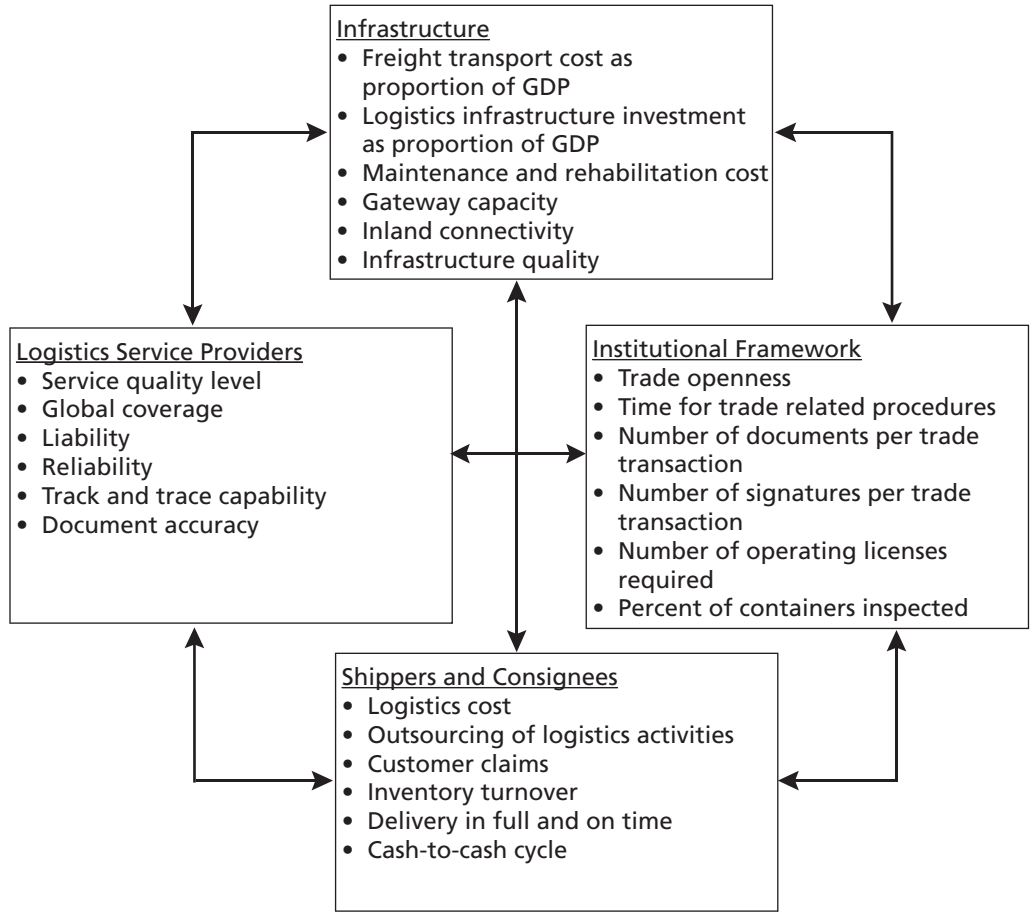
Stage	Corridor	Definition
Level 1	Transport corridor	Corridor that physically links an area or region
Level 2	Multimodal transport corridor	Corridor that physically links an area or region through the integration of various modes of transport
Level 3	Logistics corridor	Corridor that not only physically links an area or a region but also harmonizes the corridor institutional framework to facilitate the efficient movement and storage of freight, people, and related information
Level 4	Economic corridor	Corridor that is able to attract investment and generate economic activities along the less-developed area or region; physical links and logistics facilitation must first be in place

Source: Banomyong, R., P. Cook, and P. Kent. 2008. Formulating regional logistics development policy: the case of ASEAN. *International Journal of Logistics Research & Applications*, Vol. 11, No. 5, pp. 359–379.

Methodology

In order to formulate adequate NSEC logistics development policies, a specific methodology was needed in order to describe the current logistics situation in the NSEC. The methodology used a scorecard (Figure 2) based on the four components of a logistics system—infrastructure, institutional framework, service providers, and traders—to evaluate the system's capability as well as its strengths and weaknesses.

Figure 2: Logistics Macro-Level Scorecard



GDP = gross domestic product.

Not all proposed data for the scorecard could be gathered, and some proposed indicators were found to be inappropriate when trying to measure logistics components in the NSEC. This was particularly true for indicators related to shippers and consignees. New performance measures had to be selected to describe the overall macro-logistics capability of the countries in the NSEC. These are shown in the Findings section (see Figure 4). Therefore, a snapshot methodology was used in conjunction with the overall assessment to provide an indication of specific logistics system performance. This methodology used a detailed logistical activity map of specific products moving within the logistics corridor. A template for the data needed to draw the logistics cost and time map is shown in Table 2. This table is similar to a simplified process activity map.

Data collected for a particular product along a logistics corridor can then be graphically illustrated in a logistics corridor cost-and-time model, which helps describe the cost and time components of movement from origin to destination by each available route and mode as well as illustrate the delays at borders or other inspection points up to the destination within the corridor.

Table 2: Template for Simplified Process Activity Map

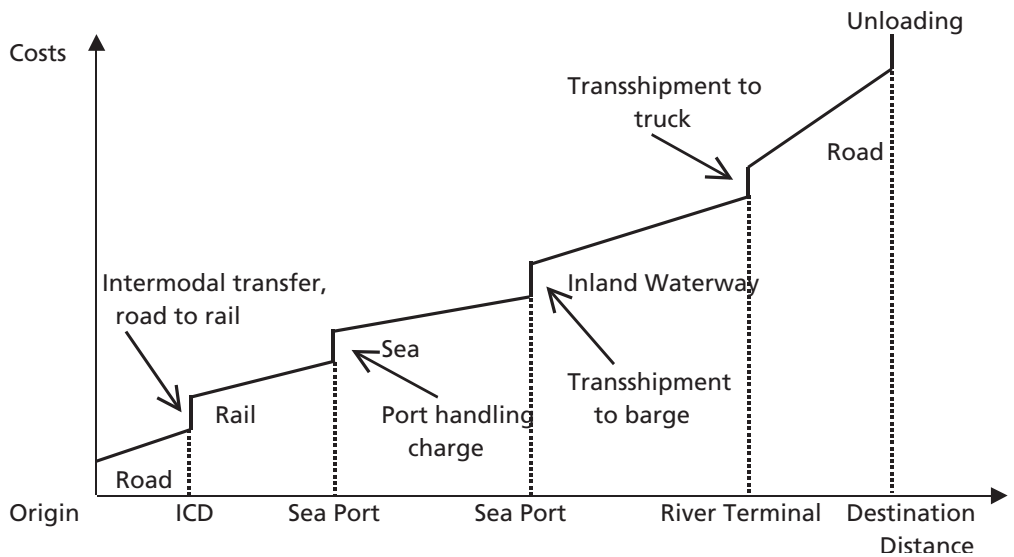
Activity Number	Average Time	Range of Time	Average Cost	Range of Cost	Actors	Documents/ Operations	Distance (cumulative)
1							
2							
3							

Source: Author.

The choice of transport mode(s) has a direct impact on the efficiency of logistics channels and systems. Depending on the mode chosen, the overall performance of the corridor will be affected (Liberatore and Miller 1995). Simple cost-distance models of road versus rail are commonly found (Fowkes et al. 1989, Marlow and Boerne 1992) for national movements, or sea versus air (Hayuth 1985, Jung and Beresford 1994) for longer, intercontinental routes. As the choice of logistics corridor is of vital importance to the success of a country's international trade, various models have also been created (Beresford and Dubey 1990, Min 1991, Barnhart and Ratliff 1993, Yan et al. 1995, Beresford 1999) to help logistics decision makers choose the most effective logistics channel—one that not only minimizes cost and risk, but also satisfies various on-time service requirements.

The corridor cost model presented here includes both transport (e.g., road, rail, inland waterway, maritime) and intermodal transfer (e.g., ports, rail freight terminals, inland clearance depots) as cost components (Figure 3). This model has been adapted from one that was made by Beresford and Dubey (1990) and later improved by Beresford (1999).

Figure 3: Corridor Cost Model



ICD = inland clearance depot.

The model assumptions were based on the premise that unit costs of transport vary between modes, with the steepness of the cost curves reflecting the fact that, for volume movements, sea transport should be the cheapest per ton-kilometer, road transport should normally be the most expensive (at least over a certain distance), and waterway and rail costs should be intermediate. At ports and inland terminals, a freight handling charge is levied without any material progress being made along the supply chain; a vertical step in the cost curve represents the costs incurred there.

Similarly, by plotting time against distance, the relative speed of transit transport for each leg (or mode) can be compared, and the bottlenecks at transshipment points can be identified. As a rule, the higher the vertical step, the more likely that the border crossing or the nodal link is a bottleneck in the logistics corridor.

The corridor cost model used in this paper is subject to limitations with regard to reliability. The significance of reliability or uncertainty for a decision situation depends on the cost of reversing a commitment once made. When high uncertainty is coupled with high cost, uncertainty needs to be acknowledged and allowed for in the analysis.

Risk means both uncertainty and the results of uncertainty. That is, risk refers to a lack of predictability about structure, outcomes, or consequences in a decision or planning situation. In this case, how certain can the decision maker be that goods will arrive safely at a destination via a chosen logistics corridor? The term "perception of reliability" is used here to denote a method to develop a comprehensive understanding and awareness of the risks associated with the decision involved in the selection of logistics corridors (Vidal and Goetschalckx 2000).

The measurement of uncertainty for each mode of transport, intermodal transfer, border crossing, and other nodal activities uses a perception of reliability index based on a five point scale: *1* is perceived to be not reliable, *2* is perceived to be not very reliable, *3* is perceived to be fairly reliable, *4* is perceived to be reliable, and *5* is perceived to be very reliable. This index tries to capture some of the uncertainties involved in the selection of each logistics corridor. These ratings reflect the subjective values of the decision makers and related stakeholders.

The index was derived from the field of political science, especially political instability methodology. Qualitative predictive research in political instability focuses on intuition, judgment, and Delphi forecasting. Intuitive qualitative forecasting is central to a systematic analysis. All the persons interviewed for this study were knowledgeable about international trade transactions, transport operations, documentary procedures, and rules and regulations in their respective countries or region. The respondents "intuitively" assigned a rating for each factor based on the their immersion in the history; culture; politics; and experience in trading practices, transport operations, and administrative procedures of their own country and—to a certain extent—of their own region.

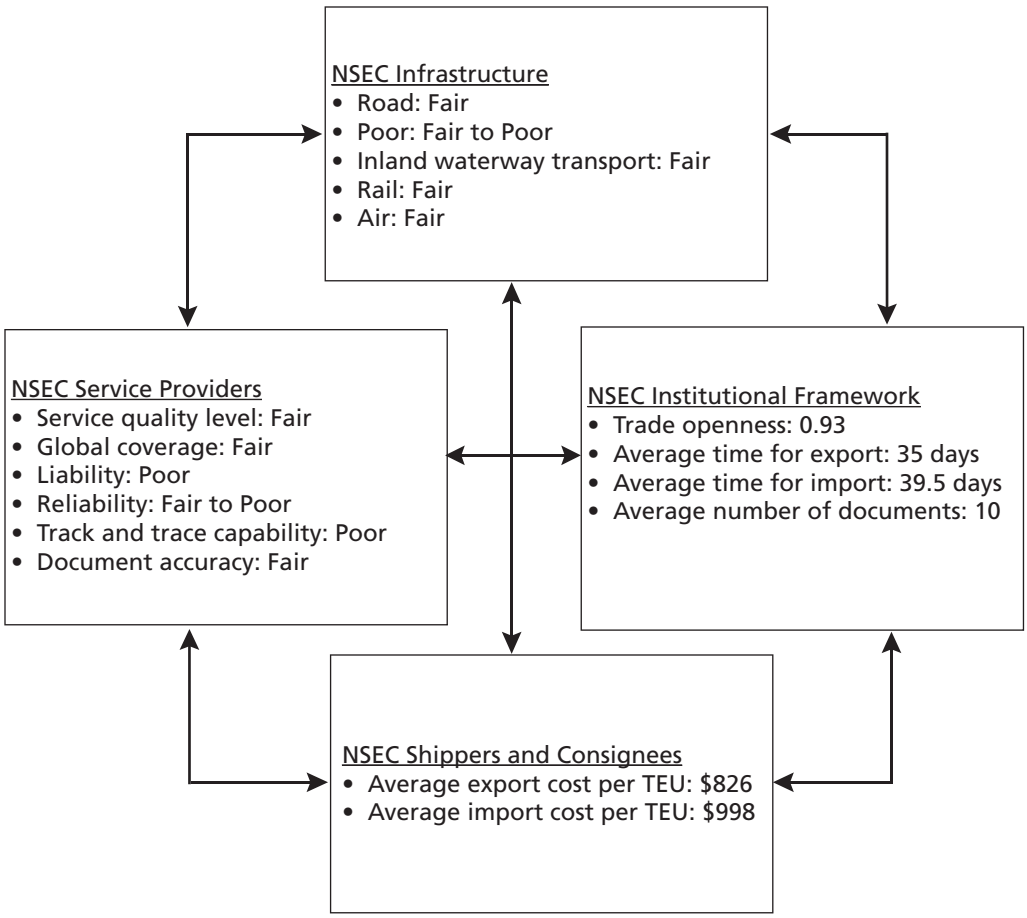
The perception of reliability indices for each logistics corridor were derived from unstructured interviews held with transport and logistics providers as well as shippers and consignees. During numerous interviews, the author asked groups of respondents to assign a rating for each mode of transport, border crossing, and nodal links along a particular corridor by consensus. This is why only integer numbers appear for each mode of transport or nodal link while fractions appear for the total confidence index. A route's total perception of reliability index is calculated from the average of all the perception of reliability ratings on that particular route. It is acknowledged that there might be a problem with consensus ratings, because it was sometimes difficult for respondents with divergent views to express them openly.

Findings

Logistics Scorecard and Corridor Assessment Level

The indicators used to develop a macro-logistics scorecard and their respective values for the NSEC are shown in Figure 4.

Figure 4: North–South Economic Corridor Macro-Logistics Scorecard



NSEC = North–South Economic Corridor, TEU = twenty equivalent unit (i.e., a 20-foot container)

Source: Compiled from industry and secondary data.

An assessment of the Kunming–Bangkok subcorridor of the NSEC (Table 3) shows that there are currently no level 4 or established economic subcorridors yet in place. An overall assessment level for the various subroutes in the Kunming–Bangkok corridor was limited to the weakest link, level 1, which means that there are currently only transport subcorridors in place.

Table 3: Level Assessment of North–South Economic Corridor Route No. 3, Bangkok–Kunming

From	To	Level
Bangkok	Chiang Rai	3
Chiang Rai	Mae Sai	3
Chiang Rai	Chiang Saen	3
Chiang Rai	Chiang Khong	3
Mae Sai/Tachileik	Mongla/Daluo	1
Daluo	Kunming	3
Chiang Saen	Jinghong	2
Jinghong	Kunming	3
Chiang Khong/Hoeuy Xay	Bo Ten/Bo Harn	1
Bo Harn	Kunming	3
Overall Level		**1**

Source: Compiled from industry data.

Bangkok–Kunming Expressway (Route No. 3)

The Kunming–Bangkok subcorridor is expected to become important infrastructure in the subregion. It will function as a land bridge between southern PRC and other GMS countries, particularly Thailand. Once the subcorridor is fully operational, significant impacts can be anticipated, such as shifts in transport mode and short- and long-term economic and sociological changes.

For the Kunming–Bangkok subcorridor, three routes currently connect the cities:

- Route No. 3 West (R3W): Bangkok–Chiang Rai–Mae Sai–Keng Tung–Mong La–Menghi–Yunjinghong–Kunming,
- Bangkok–Chiang Rai–Chiang Saen–Mekong River–Yunjinghong/Kuanlei–Kunming, and
- Route No. 3 East (R3E): Bangkok–Chiang Rai–Chiang Khong–Hoeuy Xay–Luang Namtha–Bo Ten–Bo Harn–Kunming.

The characteristics of the Kunming–Bangkok subcorridor are summarized in Table 4. The distances of these three routes are not significantly different. At present, the route via the Mekong River is the most popular; the R3W route is never used for "official" transit purposes due to the political situation and the transit fee in Myanmar.

Figures 5 and 6 describe graphically how cost and time increase along the three logistics subcorridors of the Kunming–Bangkok route based on 2006 data. The route via the Mekong

Table 4: Characteristics of Kunming–Bangkok Routes

Logistics Infrastructure		Route Choice (distance in kilometers) via Myanmar (R3W)	via Mekong River	via Lao PDR (R3E)
Bangkok– Chiang Rai	Four-lane highway	830	830	830
Chiang Rai–Mae Sai	Four-lane highway	60		
Chiang Rai–Chiang Saen	Two-lane highway		60	
Chiang Rai–Chiang Khong	Two-lane highway			110
R3W	Two-lane highway	253		
Mekong River	Mekong River ports		360	
R3E	Two-lane highway			228
R3W/R3: Daluo to Kunming	Six-, four-, and two-lane highway	674		
R3: Yunjinghong to Kunming	Six- and two-lane highway		534	
R3E/R3: Bo Ten/Bo Han to Kunming	Six-, four-, and two-lane highway			688
Total Length		**1,817**	**1,784**	**1,856**

Lao PDR = Lao People's Democratic Republic, R3 = Route No. 3, R3E = Route No. 3 East, R3W = Route No. 3 West.

Note: Approximate distances after all projects are completed.

Source: Author.

River has the lowest total cost but takes the longest time. The route via Myanmar has the highest uncertainty from a user's perspective.

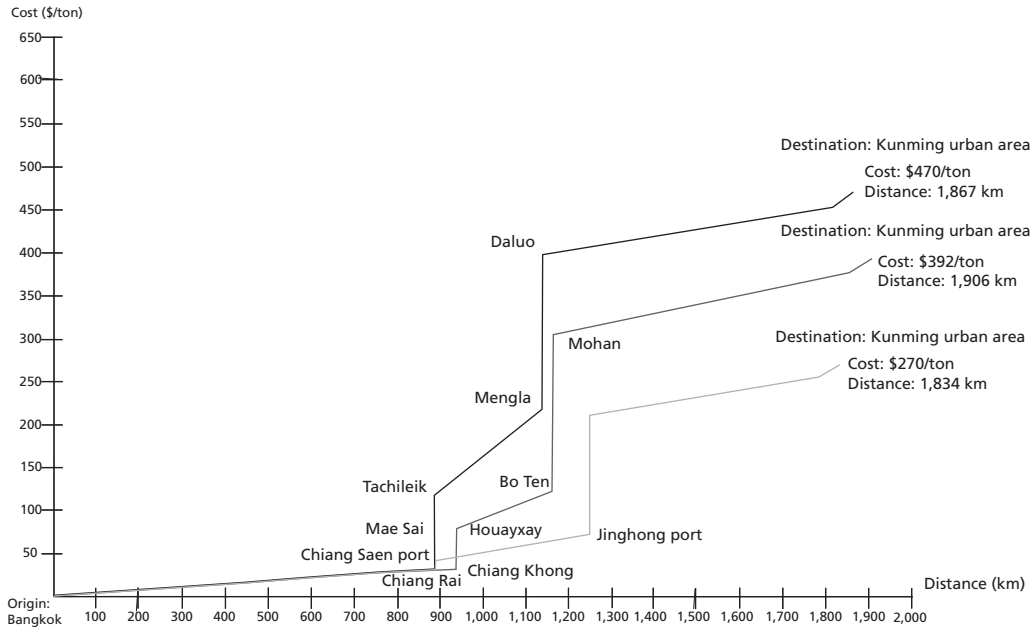
Border crossings seem to be where there is the highest cost and time increase without any movement of goods. This clearly shows that actual transport in itself is not a major impediment, but effectiveness and efficiency very much depend on how costly and how quickly borders can be crossed. The full implementation of the GMS Cross Border Transport Agreement (CBTA)[3] would play a crucial role in the reduction of border crossing cost and time.

Tables 5 and 6 provide more details on border crossing charges as a proportion of total transit and border crossing costs in 2006. The pure transport cost on all three routes is less than the border crossing and transit charges. This shows that transport, even though a critical component of the subcorridor cost, is not the biggest factor.

Tables 7 and 8 show the proportion of total transport and border crossing time. Transport takes more than 80% of total subcorridor time, but when the infrastructure is completed, this will probably be reduced.

[3] The CBTA is a regional transport and transit agreement that is supposed to facilitate the movement of people, freight, and vehicles within the GMS. One of the CBTA's main contributions is the requirement for single-stop inspections at border crossings. Single-stop inspections will reduce costs and time during border crossings.

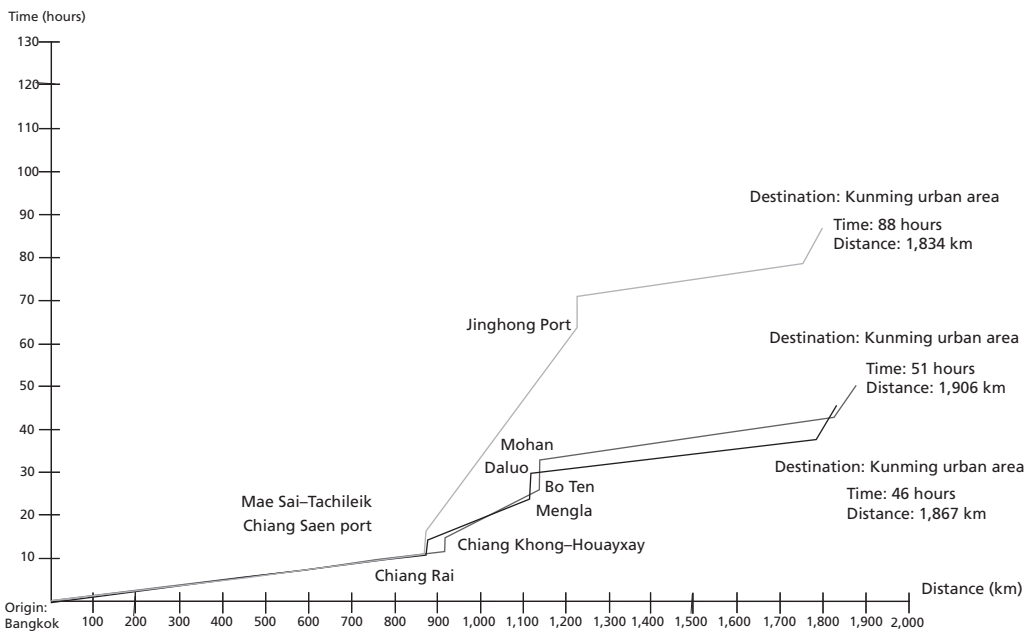
Figure 5: Cost Model of Route No. 3 from Bangkok to Kunming, 2006



km = kilometers.

Source: Compiled from industry data.

Figure 6: Time Model of Route No. 3 from Bangkok to Kunming, 2006



km = kilometers.

Source: Compiled from industry data.

Table 5: Route No. 3 Cost Summary, 2006

Route	Transport and Distribution (%)	Border Crossing and Transit Fees (%)
R3W	42	58
R3E	40	60
Via Mekong River	(Road) 32 (River) 15	53

R3E = Route No. 3 East, R3W = Route No. 3 West.

Source: Author.

Table 6: Route No. 3 Border Cost Summary, 2006

Route	Border 1, Thailand (%)	Border 2, Lao PDR and Myanmar (%)	Border 3, Lao PDR and Myanmar (%)	Border 4, PRC (%)	Total Border Cost (%)
R3W	Mae Sai, 1	Tachileik, 33	Monglar, 15	Daluo, 51	100 ($271.00 per ton)
R3E	Chiang Khong, 2	Hoeuy Xay, 20	Bo Ten, 18	Bo Harn, 60	100 ($232.00 per ton)
Via Mekong River	Chiang Saen, 3	NA	NA	Zinghong, 97	100 ($141.50 per ton)

Lao PDR = Lao People's Democratic republic, NA = not applicable, PRC = People's Republic of China, R3E = Route No. 3 East, R3W = Route No. 3 West.

Source: Author.

Table 7: Route No. 3 Time Summary, 2006

Route	Transport and Distribution Time (%)	Border Crossing Time (%)
R3W	80	20
R3E	85	15
Via Mekong River	(Road) 32 (River) 54	14

R3E = Route No. 3 East, R3W = Route No. 3 West.

Source: Author.

Table 8: Route No. 3 Border Time Summary, 2006

Route	Border 1, Thailand (%)	Border 2, Lao PDR and Myanmar (%)	Border 3, Lao PDR and Myanmar (%)	Border 4, PRC (%)	Total Time Spent at Borders (%)
R3W	Mae Sai, 12.0	Tachileik, 22.0	Monglar, 22	Daluo, 44	100 (9 hours)
R3E	Chiang Khong, 12.5	Hoeuy Xay, 12.5	Bo Ten, 25	Bo Harn, 50	100 (8 hours)
Via Mekong River	Chiang Saen, 46.0	NA	NA	Zinghong, 54	100 (13 hours)

Lao PDR = Lao People's Democratic Republic, NA = not applicable, PRC = People's Republic of China, R3E = Route No. 3 East, R3W = Route No. 3 West.

Source: Author.

Table 9: North–South Economic Corridor Cost, Time, and Perception of Reliability Summary, 2006

Routing	Cost/Ton ($)	Time (hours)	Distance (kilometers)	Perception of Reliability[a] (score out of 5)
R3W via Myanmar	470	45	1,867	3.0
R3E via Lao PDR	392	51	1,906	3.2
R3 via Mekong River	271	112	1,834	3.4
Hai Phong–Kunming	87	58	885	2.7
Nanning–Ha Noi	27	19	440	3.0

Lao PDR = Lao People's Democratic Republic, R3E = Route No. 3 East, R3W = Route No. 3 West.

[a] Reliability scale: 1 = perceived to be not reliable, 2 = perceived to be not very reliable, 3 = perceived to be fairly reliable, 4 = perceived to be reliable, and 5 = perceived to be very reliable.

Table 9 provides a summary of the cost, time, and perception of reliability status on the NSEC for 2006. Perceptions of reliability by stakeholders fall short of *reliable* in all routes examined.

Discussion

By 2015, the physical and institutional infrastructure are expected to be in place. The projected numbers above are based on that assumption; border time and costs are within the scope of the intended output of the CBTA arrangements. Freight charges may increase or decrease, but the key logistics bottlenecks—the border crossings—still need to be addressed. Time is

of the essence, because infrastructure development is moving much quicker than institutional arrangements between countries.

The lack of standardized and harmonized border and transit trade procedures is the weakest link in the NSEC subcorridors, and special attention must be given to border issues. This lack, together with weak infrastructure links, is currently hindering the development of a macro-logistics system that can satisfy customers while controlling or even lowering all the total costs involved. The infrastructure links are the backbone of logistics development in the NSEC, and upgrading the infrastructure must occur in conjunction with the facilitation of trade, transit, and transport services to create an effective and efficient integrated logistics system in the NSEC.

Transit trade is currently minimal compared to border trade, but transit can become an important component of trade along the NSEC (Than 2005). However, border trade must not be forgotten, and border facilities to support the expansion of border trade are needed.

An integrated approach is needed in order to solve these problems. Such an approach should combine solutions to the physical or "hardware" infrastructure aspect with solutions to the "software" rules and regulation aspect. Most problems involved in the development of logistics systems for cross-border and transit trade are related to the import, export, and transit processes of GMS countries. Infrastructure is considered a constraint, but the impact may not seem important due to the relatively low volumes involved as well as a commitment by member countries to link the subcorridors physically and institutionally by 2015.

The perception of reliability index and ratings is only accurate as long as the national and regional environment does not change. It is very important to assess and monitor the situation along the NSEC continually. Turmoil in a country, changes in national or regional policies, or infrastructure upgrading can have a significant impact on the selection of a particular logistics corridor. If changes occur, there will be a need to reevaluate which logistics corridor is the most effective and efficient under the new circumstances.

The challenge remains on how to transform these future logistics corridors into fully fledged economic corridors that can attract investment and generate economic activities in remote areas of the corridors, such as at border crossings.

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Developing Tourism in the Greater Mekong Subregion Economic Corridors

Ramon Benedicto A. Alampay[1] and Ludwig G. Rieder[2]

Abstract

Economic corridors are growing in importance as solutions to common regional problems around the globe. In the Greater Mekong Subregion (GMS), the identified economic corridors cross transnational areas with potential for natural or cultural heritage-based tourism activity. In this paper, we describe an approach to the development of community-based tourism attractions based on the concepts of transport-based economic corridors. Using one segment of the GMS North–South Economic Corridor as a case study, we contrast this new approach with tourism corridor strategies in other parts of the world. While the development model emphasizes a holistic approach to the development of attractions at the country level, it also identifies opportunities for continued subregional cooperation to support the newly developed sites.

Introduction

Economic corridors have emerged as key manifestations of regionalism around the world. Trade corridors have been, or are being, established across national borders as solutions to common regional problems.

In the Greater Mekong Subregion (GMS), the economic corridor approach has been adopted as one of the main platforms for subregional development. The 8th GMS Ministerial Meeting in Manila in 1998 agreed to expand transport corridors in order to enhance economic activities and benefits in the subregion. The nodal points of these corridors would serve as centers of enterprise development, and the corridors themselves would link the GMS to major markets (GMS 1998). The economic corridor strategy also seeks to create new zones of economic activity between these urban nodes.

Where such transport corridors traverse geographic areas with natural and cultural heritage resources, they may present opportunities for developing tourism activities in these areas. In the process, tourism may contribute to economic, resource conservation, and other development objectives in the area.

[1] Assistant professor, University of the Philippines, Asian Institute of Tourism; randi.alampay@gmail.com
[2] Director, Asia Pacific Projects Inc.

This paper proposes an experimental approach to tourism development based on the concept of economic corridors. Using one segment of the GMS North–South Economic Corridor as a case study, it contrasts this new approach with regional corridor strategies for tourism development in other parts of the world.

Conceptual Framework

Corridors as Development Strategies

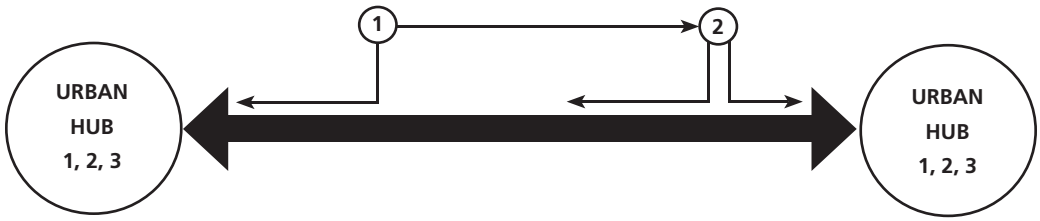
Corridors, as planning and development concepts, have generally been defined as "bundles of infrastructure that link two or more urban areas" (Priemus and Zonnefeld 2003). The areas may be connected using different modes (e.g., car, rail, ship, or air) for transporting both passengers and freight. Initially, corridors simply represented the shortest, most direct, and therefore, fastest transport link between two or more cities. From a planning perspective, transport corridors could be viewed as linear extensions of large cities—exemplified by the Ciudad Lineal model proposed by Spanish urbanist Soria y Mata (Priemus and Zonnefeld 2003). In this view, a transport corridor would serve as a high-speed medium to funnel social and economic activity between the two terminal cities.

In the 1990s, the popular concept of corridors began to be expanded to reflect broader concerns of different sectors. For public infrastructure agencies, the term continued to refer to an infrastructure axis. Spatial planners tended to use corridors as frameworks for urban planning. Finally, development agencies saw corridors as economic development axes where the infrastructure network strongly determined the economic activities of a particular zone (Priemus and Zonnefeld 2003). Attention also began to be given to the communities that formed nodes along the connecting transport infrastructure. Thus, the corridor concept evolved to describe not only a link between cities but also an economic development zone built on the backbone of that same transport infrastructure.

The geographic units or communities along these corridors perform one or more of three basic functions: production, transformation, or access (Bender 2001). As shown in Figure 1, communities along the corridor can have supply- or value-chain relationships with each other, as well as with the urban nodes at the ends of the corridor. Thus, producer and transformer communities can gain access to national and international markets through the corridor. At the same time, the corridor allows quicker access to production inputs for communities and urban centers that perform transformational or access functions.

The literature agrees that infrastructure is necessary but not sufficient for economic development along a corridor (Zonnefeld and Trip 2003). Each community—not just the end cities—becomes a potential focal point for transport exchange and economic activity. Improved transport and communications infrastructure ensure that these exchanges take place at high speed. However, the nodes along the corridors must be able to provide enough economic friction to slow down the corridor traffic. Only then will exchange activities occur in these intermediate nodes. Otherwise, the regional traffic—and the economic benefits from them—will simply ignore these transit points.

Figure 1: Transport Corridors and Economic Development



The transport corridor facilitates value-chain transactions between communities that (i) produce basic goods, (ii) transform the basic products into higher-value products, or (iii) provide national and international access to these products.

Source: Authors.

Corridor Development and Tourism

As a transport-based concept, corridors fit well with tourism. Tourism planning is often undertaken using a framework of tourism circuits and routes. Thus, a tourism corridor would be a linear resource—such as a scenic route or trail—channeling visitors to different attractions or destinations along a specified path (Wall 1997). Despite this, most of the ongoing tourism corridor programs are, in effect, cooperative regional marketing initiatives rather than infrastructure-based programs (Figure 2).

Figure 2: Tourism Corridors

Tourism corridor programs tend to focus on marketing and communications rather than infrastructure. Travelers are encouraged to visit a series of tourist destinations. The individual destinations can then be marketed collectively as a regional destination. Established or developed tourist destinations are emphasized. Small, undeveloped sites along the route are not given high marketing priority.

Source: Authors.

These tourism corridors often represent attempts to provide a regional marketing theme for the collection of attractions and destinations in a defined zone. Through this strategy, the individual member sites can be promoted as a unified tourism region or route. One example of this is the Saskatchewan–Manitoba Tourism Corridor in Canada (*Saskatchewan!* 2008). With funding from the Government of Canada, the program will develop marketing initiatives to attract year-round visitation to 31 municipalities and indigenous First Nations communities located around the Assiniboine River and its tributaries. Ultimately, the aim is to develop the corridor into a year-round recreational, tourism, economic, and conservation area.

Tourism corridors may also be defined according to heritage themes. Heritage-based corridors are particularly appropriate where a natural ecosystem or cultural influence spreads across a definable linear space or region. Box 1 provides some details about two notable transnational tourism corridors, the European Route of Brick Gothic (EuRoB) and the Great Silk Road.

Box 1: Current Examples of Transnational Tourism Corridors

European Route of Brick Gothic (EuRoB). Begun in 2002 with funding from the European Union, the corridor focuses on the brick Gothic heritage of the Baltic Sea region. The overall objective is to establish a sustainable and successful tourism route. Similar to most other heritage route and corridor initiatives, the EuRoB's main priorities cover research and documentation of the relevant cultural resources and development of a strategic marketing framework for the route. As the route becomes more institutionalized, it is expected that the brick Gothic identity will become more visible and more conspicuously incorporated into the tourism product of each particular point on the EuRoB. Thus, the strategy builds on the regional cultural heritage for stronger economic development through an intensified tourism industry.

The **Great Silk Road Initiative**, now involving 24 countries in Europe, Central Asia, and East Asia, is supported by the United Nations World Tourism Organization (UNWTO). The main activities of the Silk Road Tourism Project are regional cooperation, research, and tourism promotion. The project, as initially conceptualized by UNWTO, has been mainly oriented toward marketing and promotions. However, there are other initiatives for specific sections of the road that deal with more concrete development issues.

- The **Silk Road Initiative** (SRI) is a regional program, administered by the United Nations Development Programme, involving five countries: the People's Republic of China (PRC), Kazakhstan, Kyrgyz Republic, Tajikistan, and Uzbekistan. The SRI focuses on three main areas of regional cooperation and development: trade, investment, and tourism (in collaboration with UNWTO). On the tourism component, the SRI seeks to encourage the development of value-added tourism and ecotourism. For example, the United Nations Silk Road City Award encourages participating countries to fulfill criteria for sustainable development and cultural preservation. The SRI has also been promoting a "Silk Road visa" to make the movement of tourists into and within the region easier.

- **The Europe–Caucasus–Asia (TRASECA)** project is an independent but related project of the European Union in the Great Silk Road region. In contrast to the tourism-focused UNWTO and United Nations Development Programme projects, TRASECA is an infrastructure project, emphasizing traffic and communication between Europe and Asia.

Sources: EuRoB and UNTWO.

The most notable feature of transnational corridor development in the tourism industry has been the emphasis on cooperative marketing promotions. Tourism corridors like those mentioned above are used primarily as vehicles for regional cooperation in destination marketing. The corridors provide unifying themes, images, and symbols that the individual destinations can use to enhance their own marketing campaigns. In the cases of the EuRoB and the Great Silk Road, these unifying themes are based on shared cultural heritage. Thus, the regional initiative also performs a conservation function by protecting (or enhancing) cultural heritage resources and by educating stakeholders about the need for heritage conservation.

Overall, the implied economic impacts of these corridors will be to stimulate the existing tourism sector by enhancing the attractiveness and marketability of their respective destinations. The regional strategy is based on the principle of cumulative attraction, which says that "a given number of tourist attractions will do more business if they are located en route, in proximity, or in a logical sequence to each other, than if they are widely scattered" (Lue et al. 1993). Originally developed for the retail sector, cumulative attraction can also be defined in terms of a critical mass. Individual attractions may not provide enough reason for tourists to make a dedicated trip to visit them. However, a cluster or series of attractions that can be conveniently visited in sequence may generate enough pull (or attraction) to stimulate a regular flow of traffic to their region.

The tourist corridors cited so far share another common feature. In promoting themselves as regional destinations, they basically promote a spatial pattern of visitation described by Lue et al. (1993) as a regional tour. Tourists are encouraged to visit each destination on the route so that the complete regional experience can be appreciated. This is also the underlying principle for the United Nations World Tourism Organization's (UNWTO's) proposal to promote and develop a "heritage necklace", built around the world heritage sites of the subregion (UNWTO 2006).

For these kinds of corridors or circuits, the most relevant access is that related to information. Tourism to the attractions is already in place. Transport access, if not superior, is at least adequate for the meantime. The immediate concern is ensuring that prospective tourists and travel agents gain access to information about the destinations so that they can be encouraged to come. Thus, marketing and promotions are given higher priority.

However, in GMS economic corridors, the spatial pattern is more likely to be what Lue et al. (1993) described as "en route" rather than that of the regional tour.[3] Tourist interest will generally be focused on large population centers. Small attractions will be more likely visited only as side trips relative to the main urban destinations. Physical access is just as important as market access for these smaller attractions. Thus, transport infrastructure—in keeping with the general concept of economic trade corridors—must also be given priority. In addition, tourism product development will be necessary to ensure that the attractions offer enough experiences to warrant a detour from the main corridor.

The literature on this kind of tourism corridor, where tourism is but one component of an economic corridor, is still limited. Cases where a transport backbone allows previously undeveloped tourism sites to connect with national and international markets have not been fully researched. One such case could be the World Bank-funded Gansu Cultural and Natural Heritage Protection and Development Project in the Great Silk Road section of the People's

[3] Lue et al. (1993) developed a typology of multidestination travel to describe trips that involved visits to multiple destinations. In addition to single-destination trips, they identified four types of multidestination trips: (i) en route, (ii) radial, (iii) regional tour, and (iv) trip chaining.

Box 2: Gansu Cultural and Natural Heritage Protection and Development Project

This project seeks to generate benefits for local communities through the development of sustainable cultural tourism along the Great Silk Road in Gansu Province, People's Republic of China (PRC). The project involves nine key cultural and natural heritage sites in the province's six municipalities, including an institutional strengthening and capacity building component. Part of a $38.4 million World Bank loan will finance conservation work on the cultural heritage resources of the area, which include one of the PRC's four largest Buddhist cave complexes. The loan will also go toward paving roads inside the scenic area. This improved infrastructure will not only create new sightseeing routes, but also allow village residents to gain better access to markets and jobs. Although the project only started in 2008, the increased awareness of and interest in small-scale tourism to the area has already been credited with some incremental impacts. About 40 households in Houchan Village now offer homestay services. Since their opening—and with a new bus service to Tianshu, the closest city—per capita income in the village has risen from CNY600 ($84) to about CNY2,400 ($336).

Source: World Bank (2008).

Republic of China (PRC) (Box 2). However, the project has just commenced, and long-term impacts are unknown.

The GMS North–South Economic Corridor tourism strategy provides an opportunity to understand the opportunities and limitations of tourism in the framework of an infrastructure-based economic corridor.

Strategies for Tourism Sector Development in the Greater Mekong Subregion Economic Corridors

Economic Corridors in the Greater Mekong Subregion

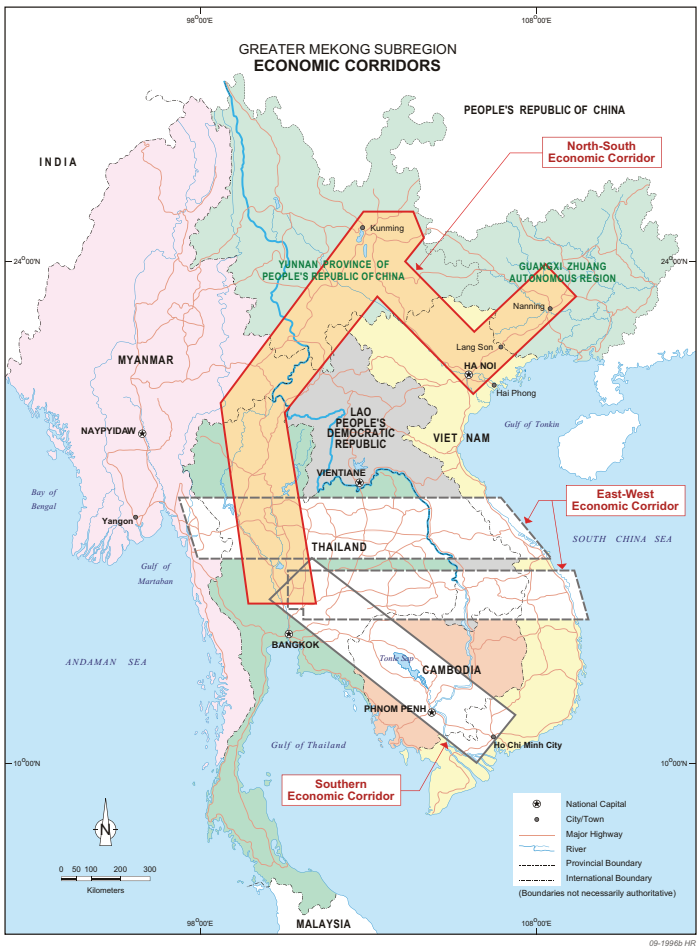
The economic corridor strategy for the GMS was first emphasized at the 8th GMS Ministerial Meeting in 1998. The strategy focused on an integrated approach within corridors to encourage effective private investment in trade, agricultural and industrial production, tourism, and other services. Economic corridors offer prospects for finding tangible solutions to local poverty and environmental management problems, as well as opportunities for building closer socioeconomic relations among the people of the subregion (Masviriyakul 2004).

Three priority projects have been identified under the GMS economic corridor strategy: (i) the East–West Economic Corridor from Yangon, Myanmar to Da Nang, Viet Nam, cutting through Thailand; (ii) the Southern Economic Corridor from Bangkok, Thailand to Ho Chi Minh City, Viet Nam, passing through southern Cambodia (including Phnom Penh); and (iii) the two-pronged North–South Economic Corridor. The first prong stretches from Yunnan Province in the PRC to Bangkok in Thailand, passing through Myanmar and the Lao People's Democratic Republic (Lao PDR), while the second links Yunnan Province with Ha Noi, Viet Nam via the Red River Valley (Figure 3).

The initial projects for each of these corridors have mainly involved the establishment of operational transport corridors. These have included the installation of infrastructure, as well as policy initiatives to facilitate the movement of goods, people, and vehicles along the new or improved physical connections.

Although the scope of economic development in GMS economic corridors is broadly inclusive, tourism has been identified as a flagship program offering significant opportunities for priming economic growth in the corridors. GMS economic corridors pass through highly scenic landscapes that contain a variety of natural, cultural, and historic tourism resources that, up to recently, have not been accessible to most tourist markets. Among the natural tourism resources in the corridors are several national protected areas[4] hosting a diversity of endemic plants and animals in a variety of ecosystems. These include upland and lowland rain forests (tropical and subtropical), coastal mangrove forests, seagrass beds, and coral reefs.

Figure 3: Economic Corridors in the Greater Mekong Subregion



Source: Asian Development Bank.

[4] These include the Nam Ha national protected area (Lao PDR) and the Mengla protected area and tropical botanical gardens (Yunnan Province) in the North–South Economic Corridor; the Nakai–Nam Thuen national protected area (Viet Nam) and the Phu Hin Bun national protected area (Lao PDR) in the East–West Corridor; and the Cardamom Mountains Rain Forests (Cambodia) and the coastal areas around Trat (Thailand) in the Southern Economic Corridor.

Among the cultural tourism resources of GMS economic corridors are various ethnic cultures, such as the Hani in Northeast Thailand and Lao PDR; the Karen of southeastern Myanmar; the Dai, Lahu, and Wa peoples of Yunnan Province; and the Hmong people of central Viet Nam. The unique customs and traditions of these cultures are represented in their arts and crafts, the architecture of their houses and villages, dance, musical instruments, songs, poems, and legends. In addition, there are many historic sites located in each of the economic corridors. Some examples are the war relics and battlefields along the historic demilitarized zone in Cambodia and the Imperial Palace in Hue, Viet Nam, which is listed as a world heritage site by the United Nations Educational, Scientific and Cultural Organization (UNESCO).

Tourism Development Initiatives for Greater Mekong Subregion Economic Corridors

Several recent initiatives have explored tourism development opportunities in GMS economic corridors. Some initial studies on the East–West Economic Corridor (ADB 2001; ECFA 2001) focused mainly on meeting the specific tourism service needs of future traffic moving along the corridor. However, they did not provide a strategic framework for transforming what is, in effect, a transport corridor into a transnational tourism zone.

The Asian Development Bank (ADB) sponsored the GMS Tourism Sector Strategy (2005), which identified GMS economic corridors as among the 29 priority tourism zones in the subregion and recommended the formulation of comprehensive tourism development programs for them. Subsequently, the 2006 ADB GMS Sustainable Tourism Development Project called for comprehensive, country-level frameworks to develop attraction points along the corridor segments in each country.[5]

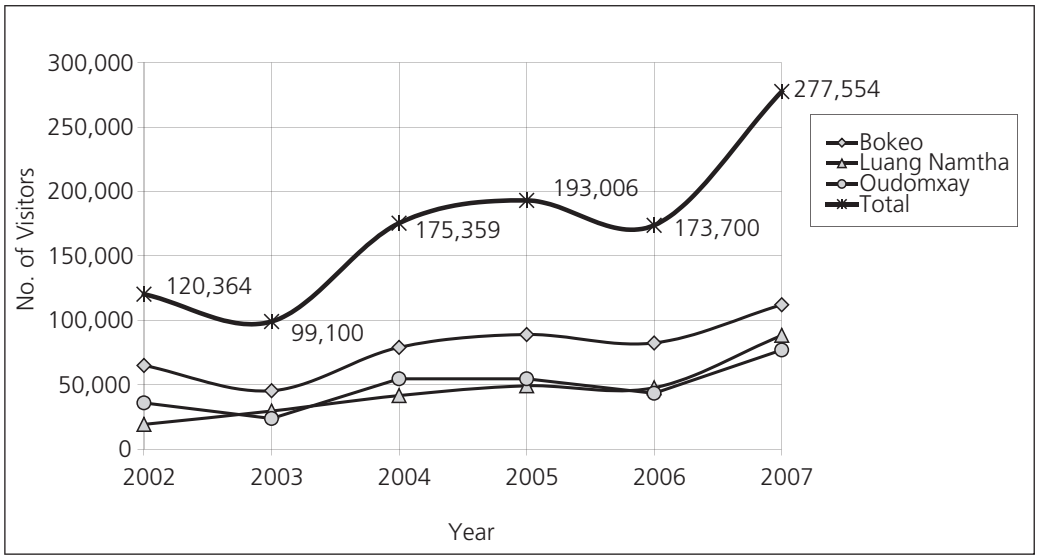
To date, tourism development in GMS economic corridors has been limited to relatively established tourism destinations, such as Chiang Rai and Sukhothai in Thailand, Luang Namtha and Savannakhet in Lao PDR, Xishuangbanna Prefecture in Yunnan Province, and Hue City in Viet Nam. However, with the completion of road transport works, opportunities for developing the tourism potential of the corridors can be identified.

The situation in the Lao PDR segment of the North–South Economic Corridor illustrates the tourism development challenges for various country segments of GMS economic corridors. Between 2002 and 2007, visitor arrivals to the provinces in the Lao PDR portion rose from 120,364 to 277,554 (Figure 4). This translated to an annual average rate of growth of 18.2% in 2002–2007, albeit from a relatively low base. These significant increases reflect the growing travel to the area from Thailand resulting from the completion of the road works in the corridor, as well as the increasing popularity of Luang Namtha for ecotourism.

However, few tourists stop to visit sites of interest along the corridor because basic access infrastructure and facilities are not in place. Thus, there are few opportunities for local communities to participate in and capture economic benefits from corridor tourism. In addition, there is a risk that unmanaged exploitation of the tourism assets will lead to economic opportunities being captured by outsiders while local communities continue to be marginalized, remain poor, and lose stewardship over natural resources and cultural values at the sites.

[5] There are a total of 15 country segments for the three GMS economic corridors.

Figure 4: Visitor Arrivals in Lao People's Democratic Republic Provinces on the North–South Economic Corridor



Source: Lao National Tourism Authority. Tourism Statistics 2007.

Thus, there was a need for a tourism development framework to address the lack of "friction" along the corridor segments. Due to the absence of tourist facilities and support services at the attraction sites, prospective tourists would not have any reason to stop or slow down as they traveled along the economic corridors. The tourism development framework developed for GMS economic corridors involves a strategy that focuses first on developing tourist facilities for attractions on the corridor segment, beginning with sites that are relatively easy to access from the main road corridor—and where the benefits of tourism can be quickly developed for local communities. Once the initial phase of development has been completed and become operationally stabile, development can be extended to sites further away from the main road.

However, to ensure the sustainability of the attraction points, a more holistic approach to tourism development was needed. The general approach adopted for the development of tourism attractions along GMS economic corridors involves four main areas of intervention: (i) tourism product development, (ii) capacity building, (iii) institutional support, and (iv) facilitation of traffic in the corridor segments involving international border crossings.

Tourism product development along GMS economic corridors mainly revolves around the provision of facilities and services at identified attraction sites in the various country segments. These include tourism site infrastructure, such as parking and landscaping, trails, viewing points, picnic areas, public amenities, tourist information centers, and sanitation and attraction access facilities. In addition, most of the identified attractions require "last-mile" road access to link them to the main center on the corridors, as well as roadside signage and kiosks to provide directions and basic information to tourists.

Capacity building is needed on several levels. First, the communities need to be prepared through tourism awareness seminars and formation of tourism stakeholders' associations. At the same time, awareness raising to discourage trade in wildlife and rare plants will also be

needed. Training on hospitality service, site-specific tour guiding, food and beverage production, handicraft production and marketing, and other tourism value-chain activities must be provided so that residents can take advantage of the employment and entrepreneurship opportunities afforded by tourism. Finally, managers of tourism sites will need training to increase their skills and ability to manage their respective sites properly.

The product development and capacity-building initiatives will be implemented on a country-by-country basis. However, individual attractions will still require institutional support on a regionally cooperative basis. Although each site will need to develop self-contained marketing and promotions plans, these will have to be integrated into broader corridor-wide tourism marketing and promotions programs. Similarly, it will be necessary to establish a partnership-based institutional framework that can coordinate the planning, development, and implementation of the tourism plans with the other country segments in the corridor. The corridor-wide management group would be comprised of key public sector, community, and private sector representatives.

Finally, border facilities along the identified tourism segments must be upgraded and regulatory practices updated in order to make the movement of people and tourist vehicles easier across the borders on GMS economic corridors.

Two country segments, the Lao PDR portion of the North–South Economic Corridor and the Viet Nam segment of the East–West Economic Corridor, have been identified as the pilot areas for implementing this tourism development approach. The following section presents the Lao PDR segment of the North–South Economic Corridor as an example of the general strategy for developing tourism along GMS economic corridors.

Tourism Development on the Lao People's Democratic Republic Segment of the North–South Economic Corridor

Under ADB's Sustainable Tourism Development Project, initial design work has already been undertaken for the Lao PDR segment of the North–South Economic Corridor. It is intended to serve as a pilot case from which other corridor segments in the GMS can learn. However, more than being a pilot project site, this area is typical of GMS priority areas for progress toward achieving Millennium Development Goals. Compared to the country as a whole, the area is characterized by higher rural populations and poverty incidence, as well as much lower literacy rates. Significant levels of under- and unemployment exist in the area as a result of the lack of additional economic opportunities caused by the area's relative inaccessibility in the past. Thus, the Lao PDR segment of the North–South Economic Corridor provides a good opportunity to demonstrate the overall approach to tourism development along GMS economic corridors within the framework of Millennium Development Goals.

Overview of the Corridor Segment

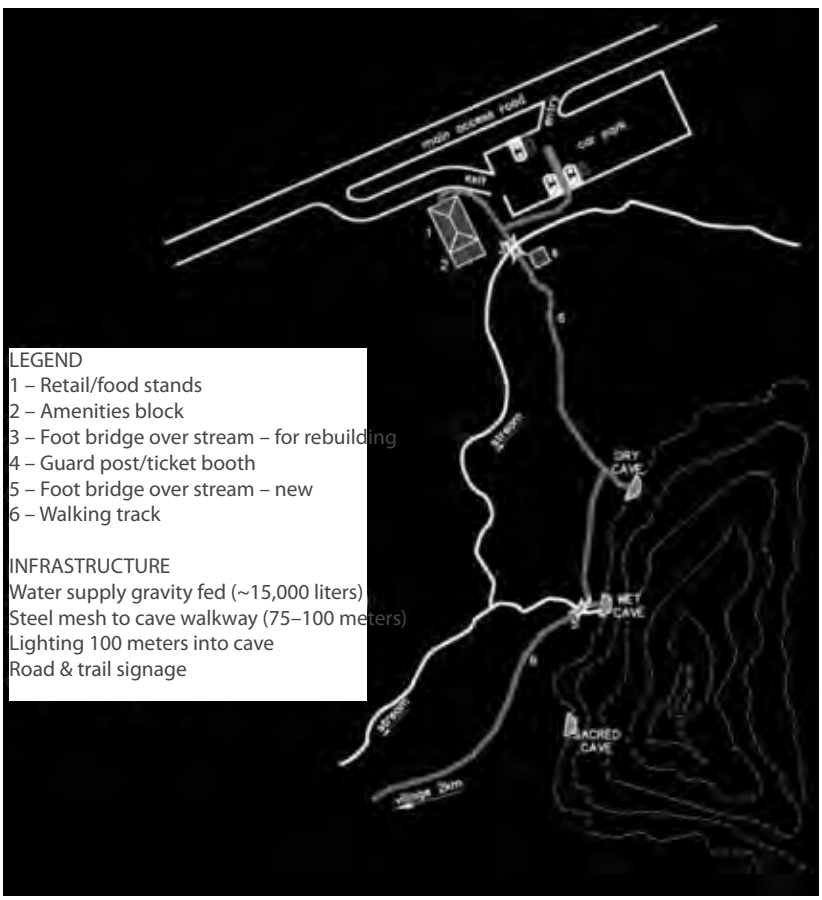
The Lao PDR segment of the North–South Economic Corridor comprises a 200-kilometer (km) stretch, encompassing the three northern provinces of Luang Namtha, Bokeo, and Oudomxay. The segment connects Yunnan Province to Thailand at two immigration checkpoints: Botan, opposite Mohan in Yunnan Province; and Huay Xai, opposite Chiang Rai in Thailand. In addition

to road access, the segment is serviced by small airports in each of the three provinces. As of 2006, it was estimated that there were roughly 555,000 people living in the area, a large majority of whom (87%) lived in rural areas. The per capita gross domestic product in the area is roughly $300,[6] about half the national average, with a poverty rate of almost 60% for the entire zone.

The main tourist assets in the corridor segment include such natural attractions as the Nam Ha national protected area, the Nam Eng karst cave complex, and the Bor Kung Nature Park; and cultural and historic features, such as ethnic minority cultures, Vat Mahaphot, and ancient historic landscapes. Five sites have been prioritized as part of the initial phase of the master plan. These sites were identified as being highly attractive to the market and require minimal access and support infrastructure. Moreover, the sites have the potential to provide significant benefits to local communities and could support private sector investment.

The five sites encompass four villages (Chalensouk, Nam Eng, Dong Vieng, Tieow, and Nam Pae), with a combined population of approximately 1,600, plus one scenic viewpoint. Four of the proposed sites are located in one of the country's 72 poorest districts. The main tourism

Figure 5: Proposed Development of the Nam Eng Cave Complex



Source: Authors.

[6] In this paper, "$" refers to US dollars.

assets are generally located within 1–2 km of the road, requiring modest investments in access and site infrastructure. However, other, more attractive sites are further away. These other sites may require larger investments in access and small-scale tourism infrastructure in the future. Figure 5 illustrates the proposed development plan for one specific attraction on the corridor segment: the Nam Eng cave complex.

Developing Tourist Attractions on the Corridor

The cave complex (locally known as the Kao Rao Cave) is situated 48 km south of Luang Namtha in Vieng Phoukha District; approximately 2 km from the complex is an ethnic Khmu village that has 75 households with a population of 442. There are three caves at the site, two of which are accessible to tourists. The caves are set in a pleasant forested environment at the base of a large limestone massif 300 meters from the main roadway. The caves (one dry, the other wet) are each about 3 km long. Both are in good condition with a number of interesting features. Through the European Union's community-based ecotourism program, the villagers have already began to organize guided tours into the dry cave, but receive only about 50 visitors per year because access to the site is currently very difficult.

The main elements of the plan for the Nam Eng cave complex will be installed in the other attractions on the segment as well. At the entrance to each site, parking areas will be constructed to allow for both individual self-driven vehicles as well as tourist coaches. The parking areas will include concession areas where villagers can sell food, beverages, and local handicrafts to tourists. These areas will also provide basic tourist amenities such as toilets, water supply, and sanitation. Basic infrastructure to provide access to the attractions, such as footbridges and walking trails or tracks, will be constructed. In addition, the development plan calls for small-scale infrastructure (e.g., water supply and steel mesh) for the protection of the heritage resources, as well as their proper interpretation (e.g., lighting inside the caves, and road and trail signage).

Building Local Capacity to Manage the Attractions

The overall strategy for the tourism corridor is based on the principle that local communities must be given opportunities for entrepreneurship and employment, yet retain stewardship and a voice in how the sites are managed. This will happen only if the communities are empowered with the skills and competencies needed to sustain the operation and management of the various sites.

The plans call for site managers to receive tourism management training to increase their skills and ability to manage the sites properly as well as to supervise the sites' tour guides, tour operators, and vendors. In addition, site-specific tour guide training (including a foreign language component) will be offered to members of local communities in order to provide them with higher-earning on-site employment opportunities.

In addition, community preparation and livelihood support programs will be implemented in the areas surrounding each attraction site. These will focus on enhancing value-chain opportunities for local farmers and producers, as well as raise local awareness on issues related to the sustainable development of the attractions.

Managing the Attractions

The tourist facilities developed under this project will be managed by a North–South Economic Corridor management committee consisting of representatives from the provincial and district tourism offices, the management unit of the Nam Ha national protected area, and community leaders from the involved villages.

Cost-recovery mechanisms will be installed in each site. In general, these will be in the form of entrance or admission fees with differential rates for international and domestic tourists (about $1.00 for foreign visitors; $0.50 for domestic visitors per day). Other revenue sources include parking fees (scaled for buses, vans and cars, and motorbikes), concession fees for market stalls or gift shops, concession fees for pay toilets, and optional tours and guide fees. Revenue from the set of attractions on the corridor will then be divided between the North–South Economic Corridor management committee (to cover operations and maintenance of the sites), a village development fund for the involved villages, and the provincial or district treasury.

Tourist Demand Forecasts for Attractions in the Corridor Segment

The volume of international and domestic tourism that the attractions along the North–South Economic Corridor could expect to draw will be a function of (i) the expected volume of growth in the international and domestic tourists explicitly destined for the sites in the corridor, (ii) the expected volume of transit tourists from the PRC and Thailand upon completion of the current road works, (iii) the relative interest of the markets for the attractions, and (iv) the way the attractions are marketed and promoted to the tourist markets. Based on a review of these factors, Table 1 gives the forecast of the total potential markets for corridor tourism in the Lao PDR segment.

Table 1: Total Estimated Demand for Tourist Attractions on the Corridor Segment

	2007	2010	2011	2012	2013	2014	2015
Destination Markets							
International	249,799	413,452	446,532	482,254	520,836	562,501	607,503
Domestic	27,755	48,284	51,180	54,252	57,505	60,957	64,616
Subtotal	**277,554**	**461,736**	**497,712**	**536,506**	**578,341**	**623,458**	**672,119**
Passing Tourist Traffic							
Tour Bus Passengers	0	60,607	70,600	82,241	95,802	111,600	130,002
Scheduled Bus Passengers	0	9,637	10,949	12,441	14,135	16,061	18,249
Subtotal	**0**	**70,244**	**81,549**	**94,682**	**109,937**	**127,661**	**148,251**
Total Tourist Market	**277,554**	**531,980**	**579,261**	**631,188**	**688,278**	**751,119**	**820,370**

Source: ADB (2007a).

Marketing and promotions of the corridor segment and especially the tourism sites will be essential in order to achieve substantial market penetration of the destination-based and transit tourism markets potentially available. This will need to be coordinated across the tourist attractions and facilities along the corridor segment by the proposed tourism marketing and promotions association. It will entail the provision of information at the two border points (with the PRC and Thailand, respectively), road signage, outdoor advertising signs, and inclusion in guidebooks and publications on things to see and do in the area. In the main source markets, it will involve working with tour operators and the travel trade to include the sites in their tour programs when passing through the area, and publicity in the travel media. Tour operator and travel agency familiarizations will need to be organized on an annual basis.

Taken together, the attractions could attract a reasonable share of the destination and transit international markets moving along the corridor (ADB 2007b) as shown in Table 2. Table 3 shows the projected distribution of visitors to each site on the corridor segment.

Table 2: Forecast Visitors for Attractions on the Corridor Segment

Year	2011	2012	2013	2014	2015
International	64,449	72,116	80,804	90,661	101,857
Domestic	4,360	4,622	4,899	5,193	5,505
Total	**68,809**	**76,738**	**85,703**	**95,854**	**107,362**

Source: ADB (2007b).

Table 3: Forecast Visitors to Specific Attractions on the Corridor Segment

Year	2011	2012	2013	2014	2015
Nam Ha National Protected Area Interpretation Center	22,019	24,556	27,425	30,673	34,356
Nam Eng Cave	22,019	24,556	27,425	30,673	34,356
Vat Mahaphot Historic Site	8,257	9,209	10,284	11,502	12,883
Bor Kung Nature Park	8,257	9,209	10,284	11,502	12,883
Nam Phae Village Scenic Site	8,257	9,209	10,284	11,502	12,883
Total	**68,809**	**76,739**	**85,702**	**95,852**	**107,361**

Source: ADB (2007b).

Conclusions

This paper describes an approach to tourism development along economic corridors using the Lao PDR segment of the GMS North–South Economic Corridor as a model. Although the regional economic corridors open up market access opportunities along the transport route, the tourism opportunities will not be maximized unless the attractions are built up to draw and

receive tourists. Greater emphasis on infrastructure and product development is needed in the GMS setting where a regional tour model may not be appropriate. Given the relative lack of development among attractions in the corridor, the model seeks to create attractions that will also pull transit tourists traveling to and from the end poles of the corridor.

The tourism development framework developed for the GMS economic corridors seeks to develop tourist facilities for attractions on the corridor segment, and give travelers reasons to stop and stay. However, the GMS economic corridor strategy acknowledges that infrastructure and product development will not be sufficient to ensure the sustainability of the program. Thus, capacity-building and institutional support mechanisms are also built into the strategy.

Constraints and Challenges

Tourism attraction developments are local concerns in that they most directly involve the provinces or districts where the specific attractions are located. Unless the attraction covers a large area and is shared by two or more countries, the development of tourist facilities does not typically require a regional initiative. For GMS economic corridors, the development of tourist attractions and sites is undertaken by the respective country.

However, just as the attractions seek to take advantage of the regional transport infrastructure, so too will there be a need for cooperative regional programs to provide marketing and other support over the long term. Because the tourist markets (as well as the tour operators who service them) originate from the corridor nodes in the PRC and Thailand, it will be necessary to direct the marketing and promotion efforts in these countries. Information about the attractions in the Lao PDR segment of the North–South Economic Corridor must be available at distribution points all along the corridor—especially in those sections in the PRC and Thailand. Similarly, when the other country segments are developed for tourism, they will also benefit from the ability to use the Lao PDR sites as potential marketing and distribution points.

The tourism marketing plan for the Lao PDR segment of the North–South Economic Corridor will be self-contained. However, as the other country segments are developed, a transnational tourism corridor approach can help synthesize the individual programs into a broader marketing package for the subregion as a whole. Similar to the EuRoB and the Great Silk Road, this will be a program to market the North–South Economic Corridor as a single tourism destination. More significantly, it will require a regional cooperative effort to unify the individual GMS attractions under a single marketing theme. Whether this will be done on a GMS-wide level or simply across the economic corridor, will require the building of a transnational, partnership-based institution to coordinate the individual and collective marketing efforts.

Transregional cooperation between and among the linked GMS countries will also be required in order to facilitate tourist movement across borders from one country segment of the North–South Economic Corridor to another. As the tourism corridor becomes more established in the marketplace, subregional cooperation may again be employed to develop corridorwide standards that can ensure consistency of facility and service quality among the various attractions.

In summary, the tourism model intended for the Lao PDR segment demonstrates a nontraditional tourism development approach wherein economic growth through tourism is not the primary objective. Rather, growth is viewed as an opportunity for making progress toward sustainable development, equity, and other Millennium Development Goals. In order to realize

these, a holistic approach that addresses hard (product and infrastructure) and soft (institutional strengths and human resource capacity) components must be adopted.

From the perspective of regional cooperation and the GMS, the model highlights the opportunities that regional projects, such as transport corridors, can open up for individual members in terms of developing the attractions in their respective territories. At the same time, the model also highlights venues for new levels of regional cooperation from the development of country-based tourism attractions and sites.

Finally, the successes and problems of the GMS economic corridor tourism strategy in the Lao PDR segment, as well as its subsequent implementation in the other GMS countries, will need to be monitored so that the lessons learned can be used in future tourism projects.

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Biofuels and Rural Renewable Energy in the Greater Mekong Subregion: Issues, Challenges, and Opportunities

Roehlano M. Briones[1] and Mahfuzuddin Ahmed[2]

Abstract

The projected long-term scarcity of fossil fuels, concerns with energy security, and problems associated with carbon emissions have led to the rapid worldwide expansion of biofuels. The transition to farmed energy may well be the next frontier in the transformation of agriculture. This paper reviews issues, challenges, and opportunities of biofuels and rural renewable energy development in the Greater Mekong Subregion (GMS). The potentials and risks for GMS agriculture are undeniable, although proven models of sustainable development have yet to be identified . Under the GMS Strategic Framework for Subregional Cooperation in Agriculture, GMS countries are creating a coherent framework for biofuels development, centered on partnerships among governments, the private sector, and small farmers. Priority areas for development include agricultural diversification of resource-poor farmers, utilization of marginal lands and areas less suitable for food agriculture, small-scale biodigester technologies in energy-deficient villages, research and development, extension, infrastructure, capacity building of farmer organizations and regulatory agencies, promotion of cross-border supply chains, and other market enabling activities. GMS countries are at varying stages of developing an explicit strategy for biofuels and rural renewable energy .

Introduction

Over the past two centuries, fossil fuels have displaced biofuels as the dominant energy source worldwide. Recent trends have, however, exposed the disadvantages of fossil fuel dependence. Oil prices have surged in recent years, as increasing global demand for energy meets limited expansion of supply. Fossil fuel emissions are also being linked to local pollution and global climate change. Governments and investors are now actively promoting fossil fuel alternatives,

[1] Research fellow II, Philippine Institute for Development Studies, rbriones@mail.pids.gov.ph
[2] Senior project economist, Asian Development Bank, akmahmed@adb.org

such as biofuels. The early 21st century may well be the era of transition from fossil to alternative fuels, and the accompanying transformation from food to multiuse agriculture.

Global patterns and trends are mirrored in the Greater Mekong Subregion (GMS). Energy demand is projected to increase by 7%–16% per annum—faster than the expected rate of economic growth—placing great stress on existing energy systems. These energy demands mask great disparities in the use of energy. An estimated 50 million of the 300 million people in the GMS are not reached by electricity and rely on traditional fuels (ADB 2003). Modern biofuels offer a promising alternative to both traditional and conventional energy systems.

There is nevertheless considerable uncertainty over impacts and prospects of biofuel expansion. Some biofuel technologies are not economically competitive even under current petroleum prices. Other biofuel projects may require large-scale investments with long gestation periods, thereby facing financial risks. Furthermore, expansion of biofuels entails drawing away resources from other sectors, especially food production. Biofuel development must take into account the full spectrum of market and societal values, such as foregone food and other agricultural output, impacts on environmental services, and overall improvements in well-being of the rural poor.

Support for biofuel development will need to be informed by assessment of economic viability, potential social and environmental impacts, and the level of policy engagement. Considerable information is available at the global, regional, and national levels in scattered form. This information has been compiled and analyzed in a sector assessment conducted by the Asian Development Bank (ADB) (2006) through desk review of the literature and secondary data, key person interviews, and focus group discussions in the GMS. In this paper, we present the findings of this assessment concerning the issues, challenges, and opportunities for biofuel and rural renewable energy development in the GMS.

Background and Framework

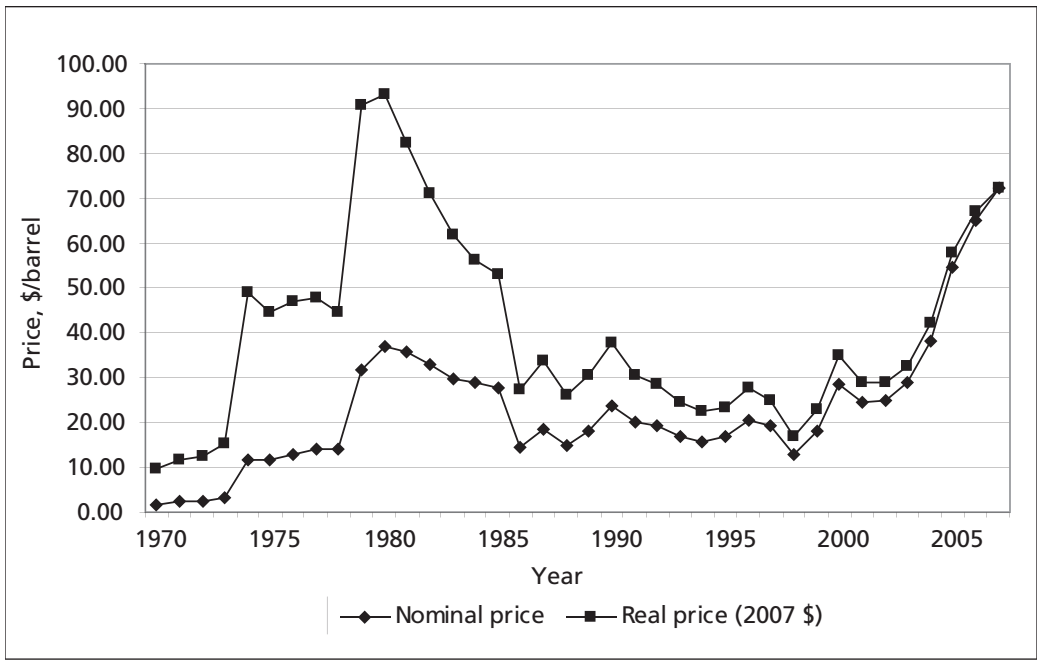
Global Context

The global energy situation analysis is based on data and assessments from the International Energy Agency (IEA 2006a, 2006b, 2007). Global total primary energy supply in 2005 reached 11.4 billion tons of oil equivalent. Fossil fuels account for the bulk of the total (81%), while combustible renewables and waste account for only 10%. (These are renewable sources or waste materials producing energy through combustion, and are mostly of biological origin, i.e., bioenergy sources.) Steady growth in global income and population will lead to sustained increases in global energy demand. Over 2005–2030, energy production is expected to increase by 55%; the addition is largely accounted for by developing countries (74%). These projections are consistent with those of the United States (US) Energy Information Administration (EIA) (2007). Meeting this demand is a great challenge, especially in the case of crude oil. EIA estimates that production is everywhere at capacity, except in Saudi Arabia. Oil reserve growth tapered off in the 1980s and 1990s as the marginal costs of oil production increased (IEA 2004). As supplies tightened, oil prices soared (Figure 1).

EIA projects the crude oil price to soften in the near term, before resuming its long-term climb upward. In constant 2006 US dollars, the price of crude oil could temporarily retreat

to about $60[3] per barrel in 2015, then hold steady to $62 by 2030 or $108 in nominal terms. Similarly, EIA (2008) projected a price per barrel of $70 by 2015, ascending to $113 by 2030. Note that these are general trend projections and do not take into account short-term macroeconomic volatility, such as the current global downturn.

Figure 1: Nominal and Real World Prices of Crude Oil, 1970–2006
($/barrel)



Source: British Petroleum (2008).

An added disadvantage of fossil fuel use is the consequent emission of greenhouse gases, primarily carbon dioxide. These emissions have now by scientific consensus been implicated in global warming (International Panel on Climate Change 2007).

Several countries have resumed renewable energy development. One option being aggressively pursued is biofuels. The European Union (EU) instituted the Biofuels Directive in 2003, with indicative targets on biofuel content and incentives for biofuel production. In some European countries, this led to exemptions from the high taxes imposed on fossil fuels, subsidies for infrastructure investment and planting of feedstocks, and mandates on minimum biofuel content for major transport fuels. The US, through the Energy Policy Act of 2005, provided tax incentives for biofuels blending, broadened production incentives, and authorized loan guarantees and grants for ethanol facilities. Tariffs were also maintained on ethanol imports to protect the domestic ethanol industry. The result has been to expand further the already highly subsidized corn industry and induce farmers to shift to corn planting (Childs and Bradley 2007).

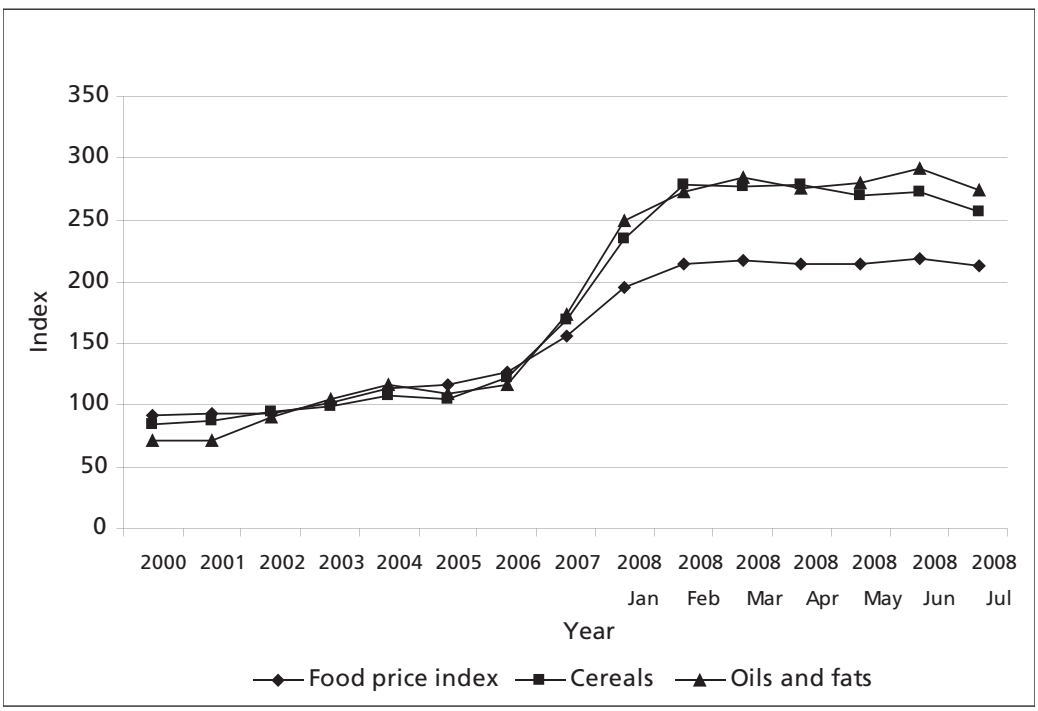
[3] In this paper, "$" refers to US dollars.

The drive toward renewable energy has also been bolstered by the Kyoto Protocol, in which signatory countries committed to emission reduction targets. The protocol created a system of certified emission reduction credits that could be traded in an international carbon market. Under the Clean Development Mechanism (CDM), protocol member countries could finance projects (usually in developing countries) that would earn certified emission reduction credits toward their emission reduction targets.

The Biofuels Controversy

The emergence of biofuels was initially hailed for its benefits in terms of energy security, clean environment, and creation of income-generating opportunities for farmers, especially in developing countries. However, the tide of opinion turned as food prices began to soar in 2007 (Figure 2). The movement of the Food and Agriculture Organization (FAO) of the United Nations food price index, already on an upward path since the turn of the millennium, accelerated sharply in 2007, a trend that carried over into 2008. Price increases for cereals, along with oils and fats, were even more pronounced. (The recent lull in price increases is associated with the sharp but temporary retreat in global demand.)

Figure 2: World Food Price Indices, 2000–2008



Source: Food and Agriculture Organization of the United Nations.

These spikes now bolster earlier criticisms of biofuel policies voiced by some environmental groups and development nongovernment organizations. Biofuels, it was said, would accelerate the expansion of unsustainable patterns of agriculture for nonfood uses. Such expansion might pose a threat to food security and cause marginalization of small farmers, destruction of the environment and natural resources, pollution, and even loss of cultural heritage (Global Forest Coalition 2006).

Some of these objections are perhaps overstated, or misidentify the issue. As pointed out in Evenson and Gollin (2003), achieving levels of food security without intensified, modern agriculture would have required much more farmland, with worse impacts on the environment. Furthermore, marginalization of small-scale agriculture is more apparent than real; Lipton (2006) has shown that smallholder agriculture has increased, even in countries where globalization and liberalization have advanced the most.

However, the threat to food security owing to competition for land and other agricultural resources is a real problem. The International Food Policy Research Institute has made projections related to biofuel expansion using its IMPACT model (Rosegrant et al. 2006). Results are obtained as a straightforward, exogenous increase in "other demand" for agricultural commodities. Under a scenario of aggressive biofuel growth, biofuel shares in gasoline and diesel consumption rise for the major transport fuel markets over 2005–2020. However, feedstock crop prices increase dramatically (Table 1). The highest increases are for cassava, whose price rises by a third relative to the baseline; this is followed by oilseeds, sugarcane, and maize. Increases are even sharper by 2020. Under a technological breakthrough scenario, price increases are mitigated, but remain sizable. Further attenuation of price increases are seen for the combined breakthrough and aggressive growth scenario; however, prices in 2020 for cassava, oilseeds, and sugarcane are still, respectively, 54%, 43%, and 43% higher than the baseline.

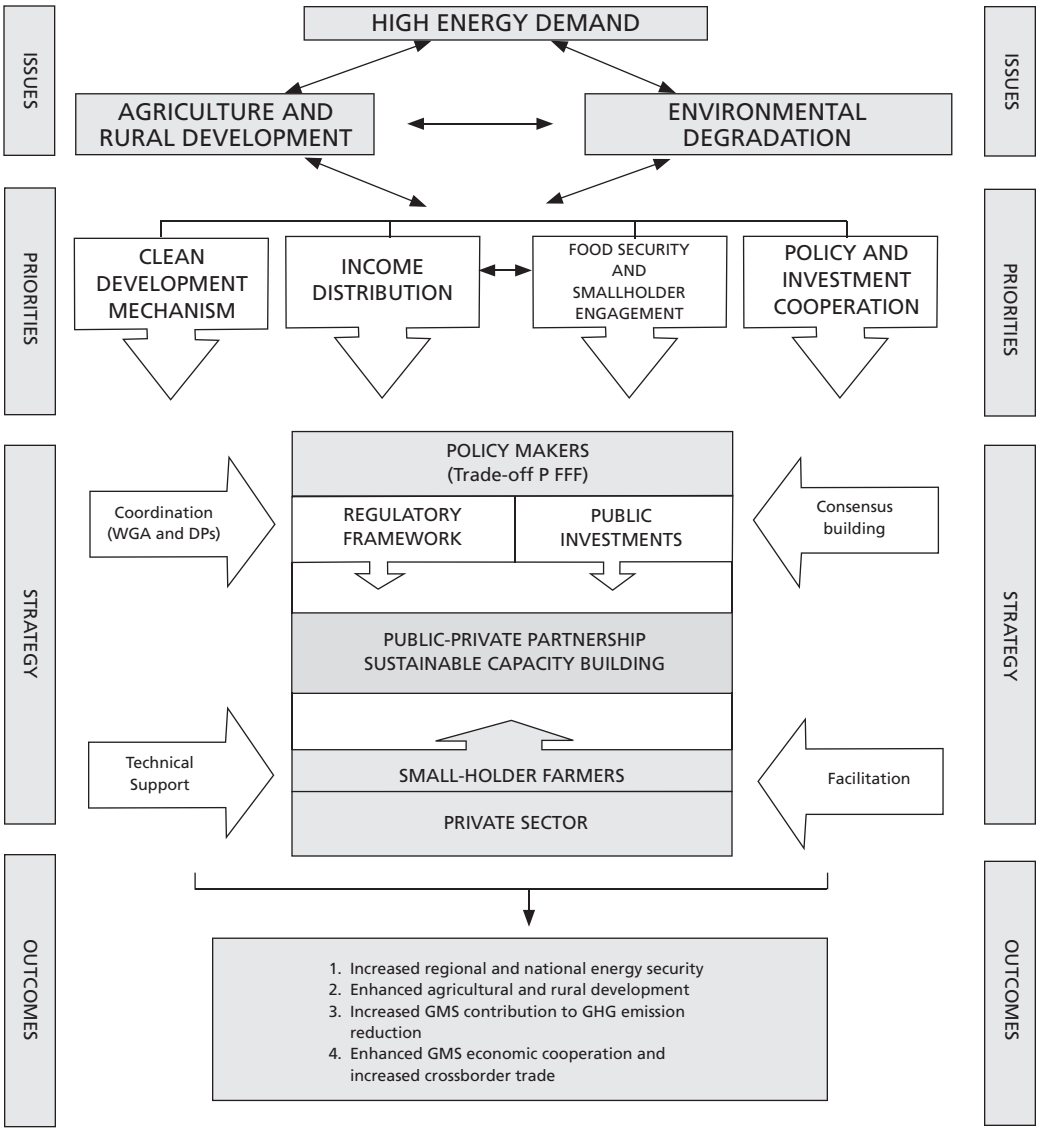
Table 1: Change in World Price of Feedstock Crops in Percent over Baseline

Feedstock Crop	Aggressive 2010	Aggressive 2020	Break-through 2020	Combined 2020
Cassava	33	135	89	54
Maize	20	41	29	23
Oilseeds	26	76	45	43
Sugar Beet	7	25	14	10
Sugarcane	26	66	49	43
Wheat	11	30	21	16

Source: Rosegrant et al. (2006).

Certainly these magnitudes warrant a serious reexamination of biofuel policies, both in Organisation for Economic Co-operation and Development (OECD) and developing countries. The relationships involved in the food–energy–environment nexus are complex and demand a comprehensive framework that addresses risks while realizing opportunities from biofuel development.

Figure 3: Greater Mekong Subregion Biofuels and Renewable Energy Initiative Development Framework



DP = development partner; GHG = greenhouse gas; GMS = Greater Mekong Subregion; PFFF = policies on food, fuel, and feed; WGA = Working Group on Agriculture.

Source: Authors.

Development Framework

Figure 3 outlines a subregional development framework for the biofuels and rural renewable energy initiative, developed in consultation with GMS partners and stakeholders. Cross-sector issues on high energy demand, agriculture and rural development, and environmental

degradation are the basis for priority initiatives. The priority goals are (i) CDM[4], (ii) better income distribution, (iii) food security and smallholder engagement, and (iv) policy investment and cooperation. These goals serve as a blueprint in formulating the main strategies of public–private partnership and capacity building, which are central to the development framework. To the extent feasible, business activity should be left to the private sector, with the public sector playing an important supporting role in research and development, dissemination of new technologies, promotion of entrepreneurship, brokering investment finance, building capacities, setting and enforcing standards, and protecting contracts. Partnership and capacity building should result in effective regulatory frameworks, sound patterns of public investment, and active participation of both smallholders and private sector business. The expected outcomes are increased regional and national energy security, enhanced agricultural and rural development, increased GMS contribution to reducing greenhouse gas emissions, and enhanced GMS cooperation and increased cross-border trade. A key challenge for GMS cooperation in the energy sector is keeping up with expected demand growth due to rapid industrialization and maintaining competitiveness through reasonable and reliable energy supplies. Collective action will be required to go beyond the power sector to natural gas and refining, and to reduce oil imports from outside the region by exploring technological options, such as coal liquefaction and biofuels.

Greater Mekong Subregion Policies and Strategies on Biofuels

Situation in the Greater Mekong Subregion

Energy supplies are unevenly distributed in the GMS (Table 2). The highest per capita production and index of energy development are in Thailand, followed by the People's Republic of China (PRC). Far below these are Viet Nam, Lao People's Democratic Republic (Lao PDR), and Myanmar. Electricity access is adequate for Thailand and the PRC, and has shown improvement in Lao PDR. However, access is extremely limited for Cambodia, whose electrification rate (17%) is the lowest in Asia.

GMS countries remain mostly agriculture based; even Thailand, where agriculture is a minority share in gross domestic product, still generates 40% of total employment from agriculture. Area harvested in the subregion ranges from just over 1 million hectares (ha) in the Lao PDR, to nearly 18 million ha in Thailand (Table 3). Agriculture in the GMS is dominated by rice, although Thailand has diversified, with large areas planted with maize, cassava, sugarcane, and oil crops (coconut and oil palm). Next is Viet Nam, where other major crops are maize, coffee, and cassava. Cambodia has the largest proportion of crop area planted to rice, with the remaining one fifth shared among assorted crops. Thailand and the PRC are in the best position to realize gains from biofuel development, but there is a large scope for diversification into biofuels in the other GMS countries.

[4] The CDM is an arrangement allowing industrialized countries with a greenhouse gas reduction commitment (called Annex B countries) to invest in projects that reduce emissions in developing countries as an alternative to more expensive emission reductions in their own countries. A crucial feature of an approved CDM carbon project is that it has established that the planned reductions would not occur without the additional incentive provided by emission reductions credits, a concept known as "additionality." The CDM is supervised by the CDM Executive Board and is under the guidance of the Conference of the Parties of the United Nations Framework Convention on Climate Change.

Table 2: Energy Statistics for Greater Mekong Subregion Countries, 2005

	TPES per Capita in toe, 2005	Share of Combustible Renewables and Waste, %	Electrification Index	Energy Development Index, 2002
Thailand	1.58	16.5	0.911	0.677
PRC	1.31	13.0	0.970	0.603
Viet Nam	0.60	46.7	0.797	0.409
Myanmar	0.31	69.6	0.050	0.091
Cambodia	0.35	73.2	-	-
Lao PDR	0.32	68.6	-	-

Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China, toe = tons of oil equivalent, TPES = total primary energy supply.

Notes:

1. TPES figures for Cambodia and Lao PDR are for 1995 and 2002, respectively. Population data from www.un.org/popin/data.html
2. The electrification index is the ratio (actual value – minimum value)/(maximum value – minimum value).
3. The energy development index is composed of three dimensions: (i) per capita commercial energy consumption, (ii) percent of commercial energy in total final energy use, and (iii) percent of population with access to electricity. Along each dimension, an index is calculated as in Note 2 for the electrification index. The energy development index is the simple arithmetic mean of the three resulting indices.

Sources: International Energy Agency (IEA) for electrification and energy development index; IEA for TPES of Thailand, PRC, Viet Nam, and Myanmar; Ministry of Mines and Energy for Cambodia; Vongxay (2004) for Lao PDR.

Table 3: Agricultural Crop Percentage Shares in Greater Mekong Subregion Countries, 2005

	Cambodia	Myanmar	Thailand	Viet Nam
Rice	83.1	46.7	62.5	58.2
Maize	2.4	2.2	6.4	8.4
Cassava	1.0	0.1	6.1	3.4
Beans	1.9	15.7	1.5	1.6
Sugar Cane and Sugar Crops	0.2	1.0	6.6	2.1
Coconuts	0.4	0.3	2.1	1.0
Coffee	0.0	0.0	0.4	4.0
Palm Nuts and Kernels	0.0	0.0	2.0	0.0
Others	10.9	34.1	12.2	21.2
Total Area ('000 hectare)	2,904	15,014	16,070	12,588

Source: FAOSTAT.

Countries whose biofuel strategy must be more clearly articulated are Cambodia, Lao PDR, Myanmar, and Viet Nam. For these countries, the prominent element in their biofuel strategy is the promotion of biogas, both for household consumption, support of agriculture, and forest protection. Cambodia and Viet Nam both have a national biodigester program (with Government of the Netherlands support). For crop biofuels, a high-level official strategy is still being defined in the four countries; it is noteworthy, however, that in the Lao PDR there is an active private sector initiative for rural electrification based on biofuels, spearheaded jointly by the Lao Institute for Renewable Energy and Sunlabob. Their program targets research and development and technology demonstration for jatropha (*Jatropha curcas*), identified as suitable for planting in the country's vast wastelands (ADB 2008).

The more advanced GMS countries in terms of biofuels strategy development are the PRC and Thailand. Context, policies, and programs in the PRC are as follows (Latner et al. 2006). Ethanol production is concentrated in the northeast, providing a market for 10% of the corn production in northeastern provinces, particularly for low-quality and older stocks. Expansion is aimed at the northwestern provinces (sorghum and jatropha) and the south (sugarcane and cassava). Gasoline stations are mostly operated by state-owned national companies. Many of these stations offer the E10 blend (10% ethanol content). Demand for fuel ethanol is determined by state company decisions, which reflect national government directives. The national Government is providing incentives and subsidies for ethanol production. Research and development activities are underway for ethanol and biodiesel. However, there remains some ambivalence given the possible trade-off between biofuel expansion and food security, the latter being strongly championed by the Ministry of Agriculture.

Thailand has the most completely formulated strategy for biofuel development. It focuses on harnessing local agricultural resources to meet domestic energy needs. For ethanol production, the main feedstock is sugarcane (molasses) and cassava, because Thailand is the world's second biggest exporter of refined sugar and the largest exporter of dried cassava. A 10% ethanol content requirement is being phased in to cover the entire gasoline market by 2012. For biodiesel, the target is to introduce a mandatory 10% biodiesel content by 2012 (ASEAN Energy Cooperation 2006) The National Biofuel Committee is the national agency preparing and implementing the strategic plan on biofuels in coordination with the ministries of finance, agriculture, industry, and energy. Research and development are jointly coordinated with the Ministry of Science and Technology in cooperation with national universities. Financing and project development mechanisms have been set up through special purpose entities .

Biofuel Technologies

The main sources of biofuels are wild harvest, waste material, and energy crops. Traditional fuels (e.g., from wild harvest) can be differentiated from modern biofuels by the degree or sophistication in processing. Traditional fuels, often used for cooking, produce indoor air pollution, which has been implicated in the deaths of 1.5 million people yearly in developing countries (WHO 2006). The biggest scope for modernization lies in agrobiofuels obtained from by-products or products of agriculture. Modern crop biofuels mainly take the form of ethanol and biodiesel, which are clean-burning fuel blends. For farm by-products, a modern biofuel is

biogas, produced from anaerobic digestion, which is suitable for indoor lighting and cooking, but without the noxious fumes and odors of traditional fuel.

Commercialization of modern biofuel production is continuing. At the lower end of the agrobiofuel market is energy production from farm wastes. Small-scale biodigesters are becoming popular in rural areas of South and East Asia: the PRC and India each have several million digesters installed. In Viet Nam, 45,000 biogas plants were constructed in 2003–2007 under the National Biogas Program in 30 provinces and, due to increasing demand for biogas technology among small farm households, a second phase is currently being implemented until 2011 (ADB 2009). A model country is Nepal, for which the expansion of the digester industry has been spearheaded by public–private sector provision, covering an estimated 150,000 units (SNV 2006).

Crop biofuels are at the high end of the market and already a booming global business. Crop fuels currently account for 1% of the road fuel market. Total production of fuel ethanol more than doubled in 2000–2005 (Worldwatch Institute 2006). In 2004, about 14 million ha were being used to produce biofuels, accounting for 1% of the world's arable land (IEA 2006a).

Demand is centered in the OECD. Global production of ethanol is concentrated in Brazil (mainly from sugarcane) and the US (mainly from corn). Brazil is also the leading exporter of ethanol. However, there remain important barriers to trade in the form of product standards, preferential treatment of domestic producers, and tariffs (Coelho 2005). For biodiesel, the leading global producers are EU countries; this output is mostly for domestic use. The favored feedstocks are rapeseed and soybean.

Prospects for crop biofuels are highly favorable. An OECD–FAO (2007) outlook identified the increasing use of cereals, sugar, oilseeds, and vegetables for biofuel as one of the main drivers of agricultural markets, with major farm commodity prices expected to remain above their historic equilibrium over the next 10 years. By 2030, biofuels may eventually quadruple their share in transport fuel consumption, and double their share in total arable land (IEA 2006b).

Assessment

Economic feasibility

Biofuels from Farm Waste

There is a growing body of assessments to show that large-scale biomass energy systems (for electricity generation) based on residues can be economically and technically viable. However, small-scale applications face high collection cost (Karekezi et al. 2004). One estimate of average energy cost for this method is about $12.70/gigajoule, compared with a total cost of $8.17/gigajoule for crude oil (assuming a price of $50/barrel).

For biogas energy, the options can be narrowed down to animal dung from pig and cattle. These animals are generally raised in confined spaces, reducing collection cost. Poultry manure, while also subject to low collection cost, faces low biogas productivity due to its high nitrogen content. Community-based biogas systems face high collection and transaction costs, making household systems more attractive (Kartha et al. 2005). For household biogas technology from pig and cattle dung, the rate of return may be 23% per year based on fuelwood savings. The

investment cost ranges from $212 to more than $300. This suggests some scope for private sector supply combined with financing for cash-strapped farmers, and possibly a subsidy for tank construction.

Crop Fuels: Ethanol

A recent study compiled cost estimates of ethanol from several feedstocks and locations (USDA 2006) (Table 4). Production costs are lowest in Brazil, using sugarcane. This is followed by corn ethanol in the US, though this does not adjust for shadow values owing to subsidies. Production costs of ethanol from sugar beets in the EU are fairly high and are not competitive with gasoline. Feedstock costs account for 37%–50% of the total, the remainder being the processing component.

Table 4: Production Costs Per Liter of Ethanol
($)

	Sugarcane (Brazil)	Corn (United States)	Sugar Beets (European Union)
Feedstock	0.08 (37)	0.14 (50)	0.26 (34)
Processing	0.14 (63)	0.14 (50)	0.51 (66)
Total	**0.21**	**0.28**	**0.77**

Note: Figures in parentheses denote percentage shares of cost.
Source: USDA (2006).

Ethanol from sugarcane in Brazil is widely regarded as the model for crop biofuels. Kojima and Johnson (2006) estimated the cost of ethanol from sugarcane in Brazil to be $0.23–$0.29 per liter (somewhat higher than the US Department of Agriculture estimate in Table 4). Feedstock costs are estimated at 58%–65% of production cost (again much higher than the figures in Table 4). Brazilian ethanol is competitive with oil prices as low as $35/barrel. In late 2005, pure ethanol cost 40% less than the gasoline–ethanol blend (Worldwatch Institute 2006). Low ethanol production costs in Brazil are attributed to reliance on rainfed farming, abundance of land, and decades of research and development.

It is unlikely that sugarcane production costs in the rest of the world would be able to those in Brazil, which are the lowest at $145/ton. Production in Thailand, the second largest exporter, costs $195/ton, and in Australia, $185/ton. In a quarter of the world, production cost is $200–$250/ton, and for half of global output, the cost averages about $400/ton (Kojima and Johnson 2006).

Cost information is sparser for other feedstocks, which are less common sources of fuel ethanol. Next to molasses, Thailand is focusing on cassava for ethanol. While ethanol yield per ton of feedstock is lower for cassava than sugarcane, cassava can be grown in marginal lands with arid and acidic soils. Moreover, it is a low-value crop, compared to sugarcane. Another emerging feedstock is sweet sorghum. The cost of sweet sorghum ethanol in India is estimated at $0.29/liter, lower than that of molasses ($0.33/liter). In addition, a grain yield of about 2–6 tons/ha can be harvested; stillage after juice extraction can be used as feed or for

power generation (in a similar manner to bagasse). There is also a high potential for genetic improvement to produce even higher sweet-stalk yield and sucrose content. Dissemination of improved breeds and utilization for ethanol production are being done through an innovative partnership among national institutes, the International Crops Research Institute for the Semi-Arid Tropics, private seed companies, and a private distillery (Reddy et al. 2005).

Crop Fuels: Biodiesel

Unit cost of the more widely used biodiesel fuels is about $0.40–$0.79 per liter for rapeseed in the EU and $0.40–$0.75 for soybean in the US. These are competitive at the low end with diesel, where cost is $0.40–$0.67 per liter, but this covers a limited proportion of the existing industry. Costs can be potentially lower for tropical crop feedstocks (Worldwatch Institute 2006). The main tropical oil crop is palm oil, followed far behind by coconut. Proven technologies have been demonstrated for both.

Jatropha, mentioned earlier for its potential in the PRC and the Lao PDR, has become a major focus of interest, despite having been virtually nonexistent in the conventional plant oil market. Jatropha produces an inedible oil, which therefore cannot compete with edible oils. The jatropha plant is abundant in the tropics and subtropics worldwide, as it is tolerant of diverse climatic conditions, including arid zones, nutrient-poor, sandy, and saline soils, and eroded or degraded lands (Winrock 2006). It may be planted on marginal lands and less favored areas, thus reducing competition for prime agricultural land for food crops.

Table 5 presents some estimates of productivity and cost indicators for these alternative feedstocks. Yields are greatest by far for oil palm. Oil content is potentially higher for jatropha than coconut, although with much greater variability. In comparison with fossil fuel, the low end of the cost range for most of these biofuels would keep them competitive (depending on prevailing prices of crude oil); however, it is not clear whether abundant supply can be obtained at this low end. The least minimum cost is estimated for jatropha; unlike oil palm and to some extent coconut, long-term prospects for reducing these costs further appear favorable, primarily because jatropha is a new crop with considerable scope for technological change.

Table 5: Productivity and Cost Indicators for Biodiesel Feedstocks

Feedstock	Average Biofuel Yield (liter per hectare per year)	Biofuel Production Cost ($ per liter)	Time to Profitability (year)	Productive Lifespan (year)
Oil Palm	5,000–6,000	0.40–0.70	5–6	25–30
Coconut	1,000–3,000	0.43–0.60	7–12	75–80
Jatropha	400–4,400	0.35–0.60	3–4	30–40

Source: Winrock (2006).

These sources are far more productive than comparable feedstocks in temperate regions. Soybean in the US yields only 500 liters/ha, while rapeseed in the EU produces about 1,200 liters/ha (Worldwatch Institute 2006). This suggests a large scope for trade from tropical oils to

northern countries. However, while tariff barriers are low, nontariff barriers, logistic constraints, and underdeveloped technology all constrain sourcing of biodiesel from developing countries. Furthermore, subsidies for biofuel production and consumption in developed countries are (as with food agriculture markets) artificially reducing international prices, to the detriment of developing countries (Coelho 2005).

Costs would also depend on the scale of the processing (transesterification) plant. On a microscale (backyard production), transesterification is technically feasible, involving only a simple process of mixing ethanol, lye, and plant oil. The cost of biodiesel can, however, reach $0.90/liter (about $0.60 for transesterification). Transesterification cost, even for a small-scale plant, can be reduced to $0.20/liter; for large-scale plants it may even reach $0.05/liter (Fulton and Howes 2004). Cost reduction in oil pressing is minimal, as its cost levels are already very low—about $0.019/liter (Francis et al 2005). One way to increase cost competitiveness of jatropha oil is the sale of by-products, namely oil cake (for fertilizer) and glycerin (from transesterification). Nevertheless, the most promising area of reducing production cost is in the growing stage. There is considerable potential for raising yields through variety selection and genetic improvement (Winrock 2006); due to its novelty, identification of a site-specific set of best farming practices would also be a major boost to productivity.

Resource Potential

We restrict the assessment of resource potential to modern forms of bioenergy from agrobiofuels. Specific assumptions are

- Existing stock of animals is based on the annual average for 2003–2005. Energy production is based on estimates of daily dung output and energy content (Kootatep et al. undated). Available to supply feedstock are 50% of pigs, 40% of cows, and 10% of chickens.

- Existing crop or arable land area is based on the annual average for 2003–2005. Ethanol crops are limited to cassava and sugarcane. Diesel crops are limited to coconut, palm oil, and jatropha. A maximum of 10% of existing oil and sugar crop area is available for energy crop production. A similar assumption was used by Erricson and Nilsson (2006) in a resource assessment for Europe. Where diesel crops are not available, it is assumed that palm oil and jatropha will be used, each up to 10% of total arable land. Biofuel yield is based on Table 4. For cassava, ethanol yield from feedstock is set at 139 liters/ton; cassava yield is the 2003–2005 annual average for the country. The maximum proportions are much lower than those for animal waste, primarily because energy crop production competes with food crop production. Energy content assumes 30 millijoules/liter of biofuel (compared with crude petroleum, about 38 millijoules/liter).

Results of the resource assessment are shown in Table 6. Energy potential of animal waste is quite high in Cambodia and Myanmar, exceeding by far the energy potential of crop fuels. In the Lao PDR, energy potential from biofuels is still lower than for animal waste, but the gap

is not as large. Because of regular, daily production by a large number of livestock in these GMS countries relative to existing or even potential crop area, animal waste offers the greatest potential energy. The reverse holds for Thailand and Viet Nam. Hence, the biogas option should always be kept open for expanding rural renewable energy. However, biogas, especially in small systems, is typically unable to produce a marketable product. For widespread commercialization and expanded livelihoods, the emphasis should still be on crop biofuels.

Because of currently low per capita energy supply, the proportion of total energy that can be contributed by crop fuels in Cambodia and the Lao PDR is over two fifths of the total. Proportions are less for Myanmar (one fifth), Viet Nam, and especially Thailand (less than one twentieth), owing to high existing per capita energy supply. Nevertheless, the annual yields are quite impressive—equivalent to 213,000 tons of oil in Cambodia and 5.1 million tons in Viet Nam. In our method, Viet Nam can potentially produce more energy from crops than can Thailand because the large palm oil areas in Thailand are currently dedicated to edible oil production. It is conceivable though that in other GMS countries, oil crops can be dedicated to producing biofuel.

Table 6: Annual Resource Potential of Biofuels in Greater Mekong Subregion Countries

	Animal Waste		Energy Crops		Total	
	Energy Output (toe)	Percent of TPES, 2004	Energy Output (toe)	Percent of TPES, 2004	Energy Output (toe)	Percent of TPES, 2004
Cambodia	747,710	33.1	212,653	9.4	960,363	42.5
Lao PDR	387,821	21.4	357,943	19.8	745,764	41.2
Myanmar	2,587,589	18.8	383,081	2.8	2,970,670	21.6
Thailand	1,723,832	1.8	2,776,127	2.9	4,499,959	4.6
Viet Nam	3,252,615	6.5	5,149,471	10.3	8,402,086	16.7

Lao PDR = Lao People's Democratic Republic, toe = ton of oil equivalent, TPES = total primary energy supply.

Source: Authors' calculations.

Social and Environmental Benefits

Crop biofuel farming and processing may have an important impact on livelihoods of the poor. Local sale of energy-related products could help address energy needs in rural areas. Some studies have associated cash crop diversification, such as crops for biofuels, with poverty reduction, because cash crop agriculture is labor-intensive, raising employment and offering better returns than from traditional agriculture (Barghouti et al. 2004). In at least one respect, however, participation options for the poor may be wider. Farming for biofuels may have less stringent quality requirements regarding appearance, freshness, and chemical or pathogenic contamination, compared to cash crop farming for food.

The replacement of fossil fuels with crop biofuels would likely have environmental benefits through reduced emissions. Crop biofuels are largely sulfur-free and produce much less hydrocarbons, carbon monoxide, and particulate matter, although slightly more nitrous oxides

(Kojima and Johnston 2006). Also, because biofuels are a renewable energy source, a shift from fossil fuels to biofuels is expected to reduce carbon dioxide emissions. Careful accounting is needed to incorporate carbon emissions from inputs to crop growing, processing, and distribution relative to fossil fuel. However, in general, carbon emission reduction is foreseen with a shift to biofuel; for instance, replacement of diesel with biodiesel reduces net carbon emissions by 78% over the full product cycle, according to a US Department of Energy estimate (Kartha et al. 2005). Nevertheless, carbon reduction depends on the feedstock. A favorable fossil energy balance has been found for sugarcane ethanol and palm oil biodiesel, but not for temperate crop feedstocks such as corn and rapeseed (Worldwatch 2006).

For biogas technologies, environmental benefits have been widely cited. The replacement of fuelwood eliminates indoor pollution, cuts cooking time, and saves on wood collection time or cash for fuelwood purchases. In one case we have observed, an enterprising farmer has considerably expanded his digester system to run a generator set, thus providing electrical power to his home at night.

Animal and even human wastes can be safely treated, eliminating noxious odors and disease sources. A farm can obtain an abundant supply of organic fertilizer and soil conditioner from a biodigester. Farmers report 75%–100% savings in chemical fertilizer purchases, with no change in yield; in fact, there is some evidence for an increase in yield owing to improved soil quality. In communities, biodigesters provide great benefits through improved sanitation and reduced wastewater pollution. In Yunnan Province, biodigesters are an integral element in forest protection to maintain watersheds, local biodiversity, and promote tourism.

These external benefits tend to be localized. However, like crop biofuels, biogas projects may have global impacts through reduction of greenhouse gas emissions. This occurs directly, through mitigation of methane emissions from manure, as well indirectly, through prevention of forest loss. In Cambodia, the biogas program is conducting a study on the effects of the program on net carbon sequestration through improved manure management and reduced fuelwood usage, for possible funding of the project under the CDM. The emergence of the carbon market has opened up exciting funding opportunities for bioenergy projects in developing countries, including GMS countries.

The Way Forward

Major Issues

This assessment argues that the global emergence of farmed energy holds great promise for poor communities in the GMS. The following major issues need to be addressed.

Food security. The United Nations Special Rapporteur on the Right to Food (2007) has recently called for a 5-year ban on crop biofuels, calling the expansion of biofuels "unacceptable if it brings greater hunger and water scarcity to the poor in developing countries." This may, however, be an extreme position; note that it is biofuels policy distortion in the US and Europe that contributed to high food prices while failing to contribute to environmental and energy efficiency goals (Childs and Bradley 2007). The reasonable middle ground is to rationalize land-use policies for food and fuel, with preference for use patterns that avoid competition between food and fuel.

Environmental impact. Serious concerns have been raised that crop biofuels may accelerate deforestation, biodiversity loss, water depletion, and soil degradation. Again the response need not be a ban, but the serious enforcement of environmental and resource management standards, ensuring that biofuel development moves along a sustainable path. In particular, resource and environmental externalities should be fully priced in assessing benefits and costs of shifting to biofuel.

Cross-border cooperation. Biofuel policies are usually oriented toward meeting domestic energy requirements. Given opportunities for regional and global trade, there is a need to adopt a cross-border focus for supply chain formation and finance. Within the GMS, cross-border trade in biofuels or feedstocks shares most of the characteristics of conventional trade and contract farming in food products, and requires a similar set of interventions in the form of logistics infrastructure, a predictable and clear regulatory framework, and investment in domestic regulatory capacity. The GMS initiative can build on suggestions made by Thailand to the Association of Southeast Asian Nations (ASEAN) (Thianpitoon 2005). This would pave the way for forming a biofuel supply chain spanning the whole GMS. Investments and trade outside the GMS should also be welcome, as any impetus from foreign demand and capital would course rapidly through the supply chain.

An area of international finance in which domestic regulatory capacity is critical is the market for carbon credit. If the CDM develops greater flexibility in project eligibility, there may be a wide range of bioenergy and biofuel projects that could earn carbon credits through a wider range of transmission channels than currently observed. Domestic procedures and especially homegrown expertise should be developed in anticipation of the wider role of the carbon market in financing bioenergy projects

Technology and area selection. Some tropical agricultural regions in developing countries (most notably in Brazil) have demonstrated economic competitiveness of certain types of biofuel technologies. However, in countries at an introductory stage of biofuel production, commercial viability still needs to be proven. Selection of appropriate feedstock in suitable areas is crucial to the sustainability and expansion of biofuels in the GMS. Area and feedstock selection may need to be supported by a logistics system that spans possibly remote marginal lands, processing centers, and distribution networks. Competitiveness needs to be ascertained in the long term, both with respect to fossil fuels and second-generation biofuels, such as a possible technological breakthrough in cellulosic ethanol.

Poverty impact. While crop biofuel is a new income-generating opportunity for farmers, the current investment atmosphere appears to be biased toward large-scale plantations. To mitigate the risk of bypassing or even displacing the rural poor, public policy must strongly favor empowerment and capacity building of small farmers to be integrated in the biofuels value chain. When marginal areas, including uplands, are being targeted for biofuel production, a potent instrument for empowering the poor is the conferment of enforceable land rights for households and communities. Local benefits can be enhanced by organizing small producers (farmers and processors) to meet throughput volume and stability requirements of biofuel conversion plants, as in the Brazil and the US, where farmer cooperatives function as effective intermediaries between large processors and independent growers (de la Torre Ugarte 2006).

Addressing these issues would require rigorous analytical work and investments in research and development. The financial viability, as well as social and environmental impact of new technologies or recommendations, would have to be tested through pilot projects. Commercial-scale expansion would have to rely on private sector capital and leadership, benefiting from the lessons and best practices learned from the demonstration phase.

Concluding Remarks

Crude oil prices have persisted at a high level, and give every indication of a long-run upward trend. Several major oil-consuming countries, concerned with energy security and excessive carbon emissions, have adopted renewable energy initiatives. This has created an opportunity for development of biofuels and rural renewable energy for the GMS. At this nascent stage, there are no cases of widespread and sustained commercialization in the subregion. Nevertheless, the business potential is undeniable. It opens up income and employment opportunities for small farmers in the GMS, accelerating rural development and exposing new paths out of poverty. Other possible benefits include enhanced energy security, foreign exchange savings, and clean development from reducing fossil fuel emissions and reliance on traditional fuels.

However, the risks to society, the environment, and food security are no less real. The simple characterization of biofuels as "clean" or "renewable" may be misleading; the reality can only be discerned through complex and as yet uncertain calculations of net energy balance, net emissions over the production–consumption cycle, and net environmental impacts from the expansion of farmland, possibly into fragile ecosystems already under considerable stress. The diversion of agricultural resources from food to energy production remains a difficult trade-off, particularly under the current regime of high and volatile world food prices.

Much depends on a judicious choice of crop to be used for feedstock, technology employed, adequacy of supporting infrastructure, and enforcement of land-use policies. Ensuring a sustainable and pro-poor pathway for the biofuel sector requires an enabling environment based on partnerships among governments, private sector, and small-scale farmer organizations. The challenges to public policy in such a complex web of relationships are daunting, but must be met as soon as possible in view of the rapid pace of change in the world of farmed energy.

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