Transport Corridors for Economic Development in the GMS

Hideki Kawahara, Jayant Kumar Routray

Abstract— *The general objective of this study is to assess how transport corridors contribute to economic development in the GMS (The Greater Mekong Subregion). Four transport corridors were selected to examine the impacts in Cambodia, Yunnan Province of PRC, Thailand, and Viet Nam. By using secondary data available from international agencies and statistical divisions of respective countries, correlations and impacts were analyzed in the study area.*

On the basis of analysis, the potential of transport cum economic corridors in the study area has been presumed and illustrated from "regional dynamics" point of view by means of three scenarios – Scenario 1: Dominances of PRC and Thailand continue to expand, Scenario 2: Viet Nam comes to the force in the short run, and Scenario 3: Cambodia and Lao PDR increase their expectations.

Keywords— **Infrastructure, Transport Corridor, Potential, Economic Development, Regional Cooperation, Regional Dynamics.**

1. INTRODUCTION

According to the World Bank estimate, the global population living less than $1 a day was 986 million as of 2004 [1]. Most of them are living in developing countries, and provision of infrastructure is extremely limited in those countries. It is reported that per capita stock of infrastructure in low income countries remains almost one tenth of high income countries [2].

Meanwhile, in the recent context of globalization, the demand of regional cooperation has been increasing. Most countries cannot manage several issues by themselves because of their complex connections with the world.

In Asian region, the important regional cooperation program "The Greater Mekong Subregion (GMS) Economic Cooperation Program" was initiated by Asian Development Bank in 1992. The main objective of this program is to develop transport corridors and transform them subsequently to economic corridors in the GMS [3].

The GMS, which consists of Cambodia, Yunnan Province of People's Republic of China (PRC), Lao People's Democratic Republic (Lao PDR), Myanmar, Thailand and Vietnam have approximately 320 million of population as of 2005 and have approximately 2.5 million km2 total land area. The population of the GMS is larger than the USA having approximately 300 million in 2006, and the total area is almost equal to Western Europe with approximately 2.3 million km2. However member of the GMS countries are categorized at different levels of economy, as from least developed country to newly industrialized country.

2. OBJECTIVE

2-1. General Objective

The general objective of this study is to assess how transport corridor development contributes to economic development in the GMS, and to presume potential of the GMS.

2-2. Specific Objectives

The four specific objectives are as follows. Firstly, it is to examine the planning of the infrastructure among the GMS member countries with focus on policy and state of progress of transport corridor development. Secondly, it is to find out similarity among the people in the study area by using similarity points matrix to grasp the motivation of people's movement in terms of culture, economy and climate. Thirdly, it is to examine the direct impacts on the provinces passing four selected corridors with specific indicators in terms of trade and commerce, tourism and population. And finally it is to examine the differences of development process with time lag among the GMS countries by using development process model and regression analysis so as to understand economic and social changes.

3. METHODOLOGY

This study assesses the contribution and potential of the transport corridors for economic development in the study area on the basis of existing time series data. These secondary data were obtained from each country and international organizations. This study provides a picture of socioeconomic changes and their process by transport corridor developments.

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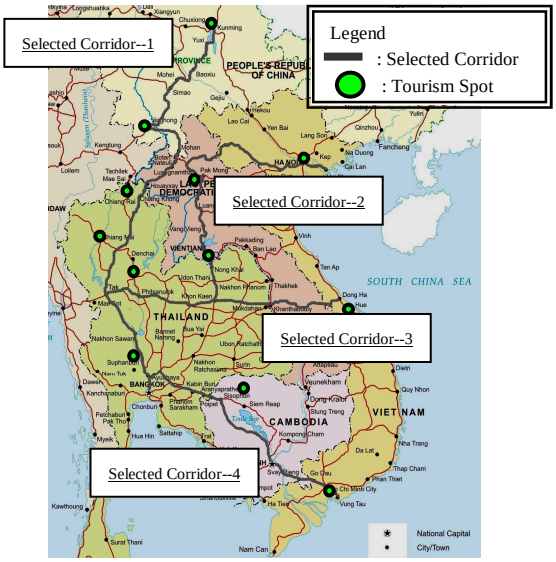
3-1. Selection of Transport Corridors

In this study, the transport corridors to be examined were selected by means of following criteria.

- Passing through three countries
- Connecting port city
- Passing through major cities
- Passing near the tourism spots

According to above criteria, the examined four corridors were selected as below.



Source: [4]

Map 1. Selected Transport Corridors

Myanmar was excluded in this study.

Table 1. Items, Contents and Indicators

No.	Items	Contents	Indicators
1. Correlation Analysis			
1-1	Planning for Infrastructure by Organization	-Policy -Progress State	-Length of Upgraded Road (km) -State of Upgraded Road (%)
1-2	Similarity among People	-Culture	-Language -Ethnics -Religion -Dietary
		-Economy	-DAC Category
		-Climate	-Rainy Season
2. Impact Analysis			
2-1	Direct Impact on Provinces	-Trade and Commerce	-Industrila Establishment -Gross Provincial Products -Industrial Ouput
		-Tourism	-Hotel and Restaurant Establishment -Retail Sales
		-Population	-Population Density
2-2	Development Process by Country	-Economic Impact -Social Impact	-R^2 Value -Time Lag

3-2. Items of Analysis

This study comprises two main sorts of analyses, namely "Correlation Analysis" and "Impact Analysis". Table 1 shows the items, contents and indicators of analyses in this study. Different data sets were used to satisfy followings as shown in Table 1.

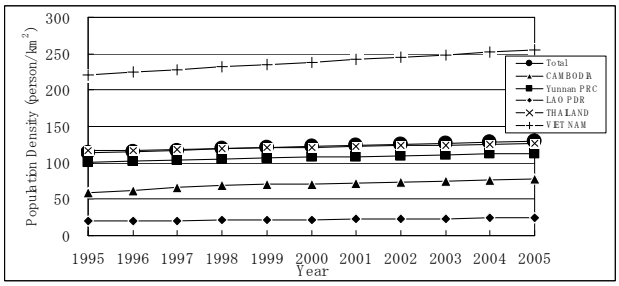
4. PROFILE OF STUDY AREA

The Mekong is one of the typical international rivers in Asian region which originate in Tibetan Plateau and it flows through six countries along the Indochinese Peninsula, that is, Yunnan province in PRC, Myanmar, Thailand, Lao PDR, Cambodia and Vietnam. It is 4,350 km long with 795,000 km2 watershed area.

4-1. Population

The population has been increasing in this study area. Figure 1 shows the population density changes in whole study area and each country. The whole growth rate of population reached 13.7 % from 1995 to 2005. It accounted for almost 3.3 % of the world population as of 2005. In the same way, it was 3.3 % also in 2000; it is almost proportional to the world population size.

In 2005, the total amount of population in the study area was accounted for 39.2 % in Viet Nam, 30.6 % in Thailand, 21.0 % in Yunnan PRC, 6.5 % in Cambodia and 2.7 % in Lao PDR. Likewise in 1995, it was composed of 38.6 % in Viet Nam, 31.9 % in Thailand, 21.4 % in Yunnan PRC, 5.6 % in Cambodia and 2.5 % in Lao PDR respectively. Therefore, the population structure in the study area had not changed largely for the last decade.



Source: [5] to [17]

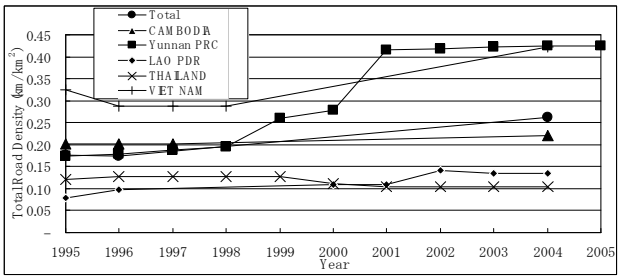
Fig. 1. Population Density Change.

4-2. Road Network

The road network facilitates various people's activities. Figure 2 shows the total road density change in the whole study area and in each country. The total road length includes both paved and unpaved roads.

In terms of road density, Yunnan PRC and Viet Nam have more than 0.4km/km^2 but Thailand and Lao PDR have less than 0.15km/km^2. There exists a gap among countries in the state of road network development.

The total road length has been greatly expanding in this area; as a result it amounted to approximately 427.6 thousand km. The growth rate of it reached 47.3 % from 1995 to 2004. However, when compared to road network status in developed countries, the total road length in this study area is almost equal to total road length of Italy which has 484.7 thousand km as of 2004 [5]. Although the road network in the study area has been expanding, it is not yet adequate.



Source: [6] to [18]

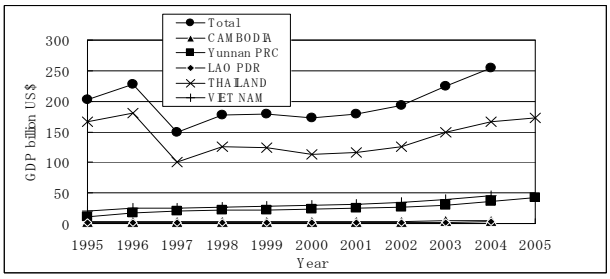
Fig. 2. Total Road Density Change.

4-3. Economy

The Gross Domestic Product (GDP) was estimated as a result of people's economic activities facilitated to a larger extent by transport network. Figure 3 shows the total GDP changes calculated at current prices in US$ in the whole study area and for each country.

It is obvious that the impact of the Asian Financial Crisis in 1997 was realized in the whole study area. The annual growth rate of GDP in total recorded -34.4% in 1997 and it could not recover until 2004. The total growth rate reached 25.4 % from 1995 to 2004. With regard to the data of each county, the total amount of GDP in the study area was accounted for 65.4 % in Thailand, 17.8 % in Viet Nam, 14.0 % in Yunnan PRC, 1.8 % in Lao PDR and 1.0 % in Cambodia as of 2004.

There lies large gap in GDP among countries. Also, it can be observed the close relationship between the GDP change in total study area and Thailand.



Source: [6] to [18]

Fig. 3. GDP Change.

5. FINDINGS

5-1. Correlation Analysis

5-1-1. Plannning for Infrastructure by Organization

(1) Cambodia

In the Government of Cambodia, regional and international integration is regarded as one of the key pillars of their development agenda. Since Cambodia has border with three countries, which Lao PDR, Thailand and Viet Nam, it is said that the regional integration will provide Cambodia the socioeconomic development by attracting investment, creating employment, increasing income, and reducing poverty.

Table 2 shows the state of transport corridor progress in Cambodia. Approximately 50 % of total network had been accomplished, and the achievement of selected corridor-4 was 89.9 % as of 2006.

Table 2. Transport Corridor Progress State in Cambodia

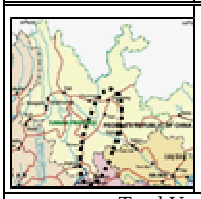
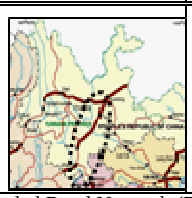
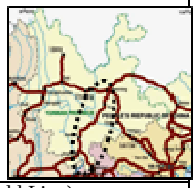
1996	2006	2015 (Plan)
		
Total Upgraded Road Network (Bold Line)		
Length: 0 km	Length: 1,590 km	Length: 3,010 km
State: 0 %	State: 52.8 %	State : 100 %
Selected Corridor – 4 (Inside Dotted Line ⋯⋯)		
Length: 0 km	Length: 620 km	Length: 690 km
State: 0 %	State: 89.9 %	State : 100 %

(2) People's Republic of China (Yunnan Province)

The PRC Government has been investing heavily on infrastructure developments to promote and support the high economic growth rate. Especially, the western region's development is an important component of overall development policy in the PRC.

Table 3 shows the transport corridor progress status Yunnan PRC. Approximately 50 % of total networks had been accomplished, and the achievement of selected corridor -1 was 59.7 % as of 2006.

Table 3. Transport Corridor Progress State in Yunnan PRC

1996	2006	2015 (Plan)
		
Total Upgraded Road Network (Bold Line)		
Length: 0 km	Length: 1,200 km	Length:2,360 km
State: 0 %	State: 50.8 %	State : 100 %
Selected Corridor – 1 (Inside Dotted Line ⋯⋯)		
Length: 0 km	Length: 370 km	Length: 620 km
State: 0 %	State: 59.7 %	State : 100 %

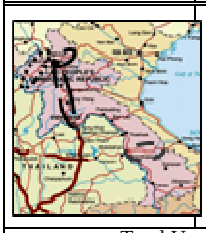
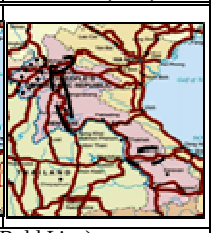
(3) Lao People's Democratic Republic

The government of Lao PDR has regarded economic cooperation as an important means for supporting sustainable economic growth. Lao PDR is located at the heart of the GMS and surrounded by all GMS countries - Cambodia, PRC, Myanmar, Thailand and Viet Nam. Therefore for this landlocked country, the regional cooperation is vital to their sustainable economic growth. They will be able to connect to sea port by way of these transport corridors.

Table 4 shows the transport corridor progress status in Lao PDR. Approximately 45 % of total network had been accomplished, and the achievement of selected corridor -1 was 0 %, selected corridor -2 was 76.5 %,

and selected corridor -3 was 100 % as of 2006 respectively.

Table 4. Transport Corridor Progress State in Lao PDR

1996	2006	2015 (Plan)
		
Total Upgraded Road Network (Bold Line)		
Length: 0 km	Length: 1,660 km	Length: 3,790 km
State: 0 %	State: 43.8 %	State : 100%
Selected Corridor – 1 (Inside Dotted Line •••••••)		
Length: 0 km	Length: 0 km	Length: 220 km
State: 0 %	State: 0 %	State : 100 %
Selected Corridor – 2 (Inside Dotted Line — —)		
Length: 0 km	Length: 520km	Length: 680 km
State: 0 %	State: 76.5 %	State : 100 %
Selected Corridor – 3 (Inside Dotted Line – – ·)		
Length: 0 km	Length: 260km	Length: 260 km
State: 0 %	State: 100 %	State : 100 %

(4) Thailand

Thailand has been supporting neighboring countires by regional economic framework policy, "from the battle fields to the market".

Table 5 shows the transport corridor progress situation in Thailand. Approximately 90 % of total network had been accomplished, and the achievement of selected corridor -1, 2, 3, and 4 were 86.9 %, 100 %, 100 % and 37.5 % as of 2006 respectively.

Table 5. Transport Corridor Progress State in Thailand

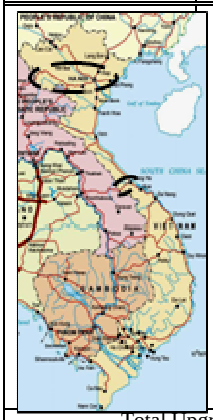
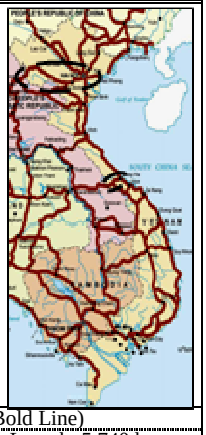
1996	2006	2015 (Plan)
		
Total Upgraded Road Network (Bold Line)		
Length: 2,360 km	Length: 8,120 km	Length: 8,770 km
State: 26.9 %	State: 92.6 %	State : 100 %
Selected Corridor – 1 (Inside Dotted Line •••••••)		
Length: 930 km	Length:930 km	Length:1,070km
State: 86.9 %	State: 86.9 %	State : 100 %
Selected Corridor – 2 (Inside Dotted Line — —)		
Length: 180 km	Length: 180 km	Length:180 km
State: 100 %	State: 100 %	State : 100 %
Selected Corridor – 3 (Inside Dotted Line – – –)		
Length: 450 km	Length: 860 km	Length: 860 km
State: 52.3 %	State: 100 %	State : 100 %
Selected Corridor – 4 (Inside Dotted Line •••••••••)		
Length: 120 km	Length: 120 km	Length: 320 km
State: 37.5 %	State: 37.5 %	State : 100 %

(5) Viet Nam

The Government of Viet Nam regards regional cooperation and integration as important to achieve their development goals in the "Vietnam's Five-year Socioeconomic Development Plan (SEDP) 2006 -2010". Especially, the poorest border districts/provinces in Viet Nam will be highly influenced by regional cooperation with Cambodia, the PRC, and Lao PDR.

Table 6 shows the transport corridor progress status in Viet Nam. Approximately 40 % of total networks had been accomplished, and the achievement of selected corridor -2, 3, and 4 were 26.3 %, 100 %, and 38.1 % as of 2006 respectively.

Table 6. Transport Corridor Progress State in Viet Nam

1996	2006	2015 (Plan)
		
Total Upgraded Road Network (Bold Line)		
Length: 0 km	Length: 2,610 km	Length: 5,740 km
State: 0 %	State: 39.5 %	State : 100 %
Selected Corridor – 2 (Inside Dotted Line — —)		
Length: 0 km	Length: 150 km	Length: 570 km
State: 0 %	State: 26.3 %	State : 100 %
Selected Corridor – 3 (Inside Dotted Line – – ·)		
Length: 0 km	Length: 90 km	Length: 90 km
State: 0 %	State: 100 %	State : 100 %
Selected Corridor – 4 (Inside Dotted Line •••••••••)		
Length: 0 km	Length: 80 km	Length: 210 km
State: 0 %	State: 38.1 %	State : 100 %

5-1-2. Similarity among People

It is possible that social differences and similarities among countries affect to people's activities. For example, if people use same language, they can interact with less restriction. Moreover, if they are same level of economy, they will be able to move without worrying about price differences.

Therefore, the analysis to examine similarity between and among countries from people's point of view is important to understand the background of socioeconomic change by transport corridor developments. In this analysis, culture, economy and climate were selected as contents of this analysis to reveal factors of spontaneous movements of goods and services by people's intention, not by government's strategy.

(1) Definition of Similarity

The similarities in all contents are defined below in the table 7. If two countries have same item in some subject, point 1 is given. If they have some similar item, then point 0.5 is given; and if they have different item, then point 0 is given for this purpose.

Table 7. Definition of Similarity

Contents	Indicators	Country A		Country B	Point
Culture	Language	Official	-	Official	1
		Official	-	Other	0.5
		Other Combination			0
	Ethnic	Majority	-	Majority	1
		Majority	-	Minority	0.5
		Other Combination			0
	Religion	Primary	-	Primary	1
		Other Combination			0
	Dietary	Rice	-	Rice	1
		Other Combination			0
Economy	Category	Least Developed Country	-	Least Developed Country	1
		Low Middle Income Country	-	Low Middle Income Country	1
		Other Combination			0
Climate	Rainy Season	May to September	-	May to September	1
		Other Combination			0

(2) Similarity among People

The total points indicate the relative evaluation of similarities among counties. The higher total points indicate more similarities between countries. The highest points (4.5) are obtained in the relationship between Lao PDR and Thailand, followed by 4.0 points between Cambodia and Lao PDR. On the other hand, the lowest points (2.0) are observed to reflect the relationship between PRC and Viet Nam.

Table 8. Similarity Points Matrix

Country[a]	Item		PRC	LAO	THA	VIE
CAM	Culture	Language	0	0	0	0
		Ethnic	0.5	0	0	0.5
		Religion	0	1	1	1
		Dietary	1	1	1	1
	Economy	Category	0	1	0	0
	Climate	Rainy Season	1	1	1	1
	Total Points		2.5	4	3	3.5
PRC	Culture	Language		0	0	0
		Ethnic		0.5	0	0
		Religion		0	0	0
		Dietary	—	1	1	1
	Economy	Category		0	1	0
	Climate	Rainy Season		1	1	1
	Total Points			2.5	3	2
LAO	Culture	Language			0.5	0
		Ethnic			1	0
		Religion			1	1
		Dietary	—	—	1	1
	Economy	Category			0	0
	Climate	Rainy Season			1	1
	Total Points				4.5	3
THA	Culture	Language				0
		Ethnic				0
		Religion				1
		Dietary	—	—	—	1
	Economy	Category				0
	Climate	Rainy Season				1
	Total Points					3

Note: a CAM = Cambodia, LAO = Lao People's Democratic Republic, PRC = People's Republic of China, THA = Thailand, VIE = Viet Nam.
Source: [19] to [21]

5-2. Impact Analysis

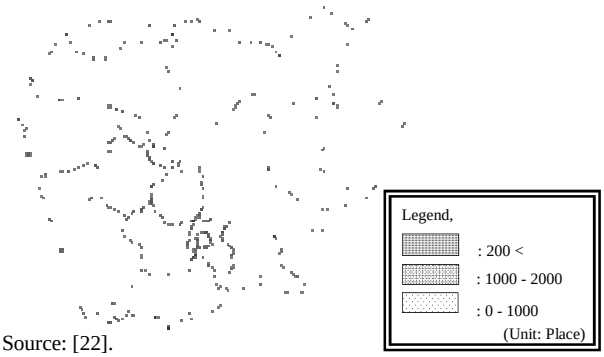
In this analysis, the impacts on provinces where passing corridor have been examined by using figures and maps that show socioeconomic changes by country. These provincial data collected for each country are varied in nature from country to country in terms of type, category, year and so forth. Therefore, data used in this analysis are not uniform among countries.

5-2-1. Direct Impact on Provinces

(1) Cambodia

a. Trade and Commerce

The Map 2 below shows that industry establishments by province as of 2000 along the selected transport corridor-4. The achievement state of selected transport corridor-4 development in Cambodia can be seen in Table 2. Many industries had been established around Phnom Penh but few industries also were established in the bordering provinces to Thailand and Viet Nam as of 2000.

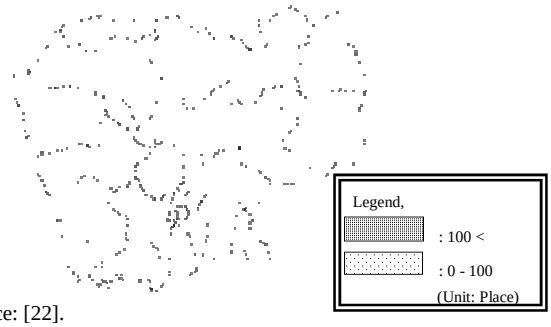


Source: [22].

Map 2. Industry Establishments in Cambodia as of 2000.

b. Tourism

Map 3 shows that hotel and restaurant establishments on provinces along the selected corridor-4 as of 2000. According to this map, it cannot be observed any distinct contribution on provinces by transport corridor-4 development to tourism sector as the number of hotel and restaurant establishments concentrated only in Phnom Penh.



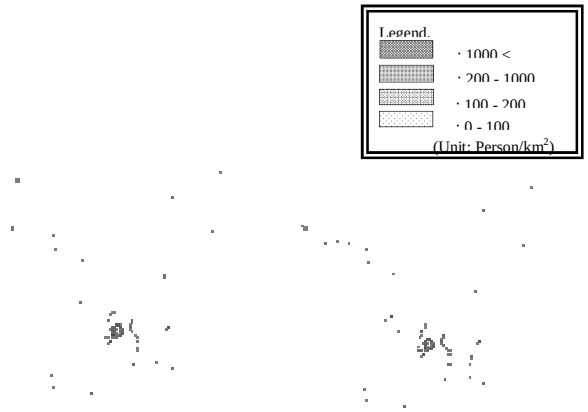
Source: [22].

Map 3. Hotel and Restaurant Establishments in Cambodia as of 2000.

c. Population

Map 4 shows the population density by provinces as of 1994 and 2006. The achievement state of selected transport corridor-4 development can be seen as 0 % and 90 % respectively in table 2. It can be observed that population density increases in proportion to the progress of transport corridor development on bordering provinces to Thailand and Viet Nam. The socioeconomic

conditions in both areas might be improved due to transport corridor development.



Source: [22].

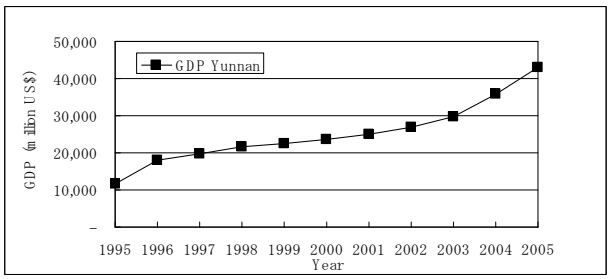
(a) As of 1994 **(b) As of 2006**

Map 4. Population Density in Cambodia.

(2) People's Republic of China (Yunnan Province)

a. Trade and Commerce

Next figure 4 shows the GDP change in Yunnan province from 1995 to 2005. It shows the trend of GDP change which had been increasing without any stagnation. The growth rate of GDP recorded about 270 % during this period.



Source: [6] to [18]

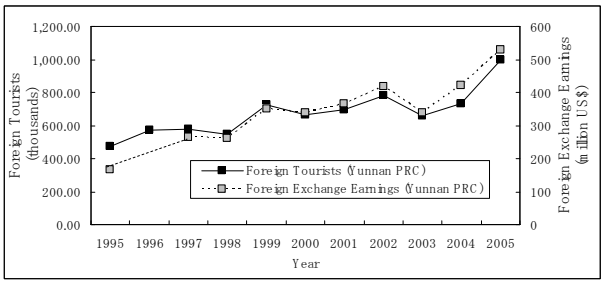
Fig. 4. GDP in Yunnan Province PRC.

b. Tourism

Yunnan province has famous tourism sites, such as "Shangri La", registered as a world heritage by UNESCO. Figure 5 shows the number of international tourist arrivals and exchange earnings on Yunnan province from 1995 to 2005. Although there were some fluctuations, the general trend of foreign tourists had been increasing. Its growth rate reached approximately 110 % from 1995 to 2005.

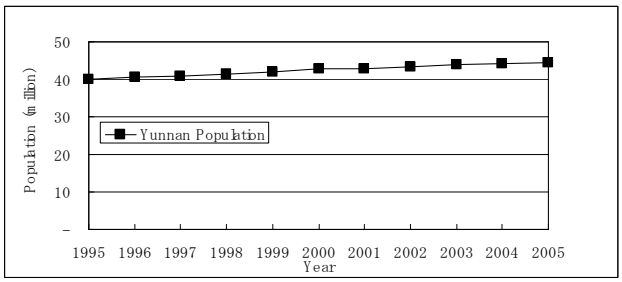
c. Population

In Yunnan province, population had not changed so much from 1995 to 2005. The population growth rate was 12 % during this period. In comparison with the high growth rate of GDP shown in figure 4, and foreign tourist arrivals in figure 5, population had been stable.



Source: [6] to [18]

Fig. 5. Foreign Tourists and Exchange Earnings in Yunnan Province PRC.



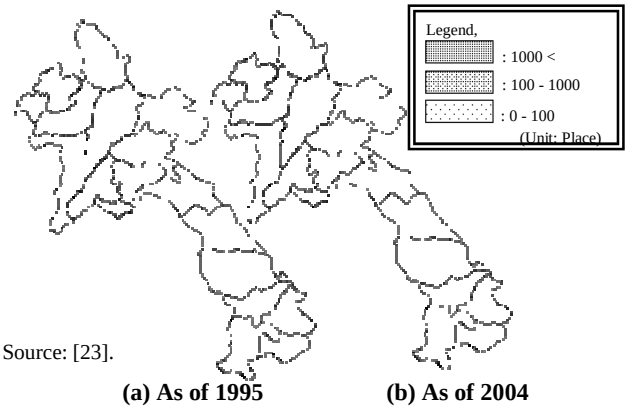
Source: [6] to [18]

Fig. 6. Population in Yunnan Province PRC.

(3) Lao PDR

a. Trade and Commerce

The following map 5 shows the number of industry establishments in provinces where selected corridor-1, 2, and 3 are passing as of 1995 and 2004. The achievement status of selected transport corridor-1, 2, and 3 in Lao PDR are given in table 4. We can clearly observe that the number of industrial establishments in north part of Lao PDR had been increasing in proportion to transport corridor development.



Source: [23].

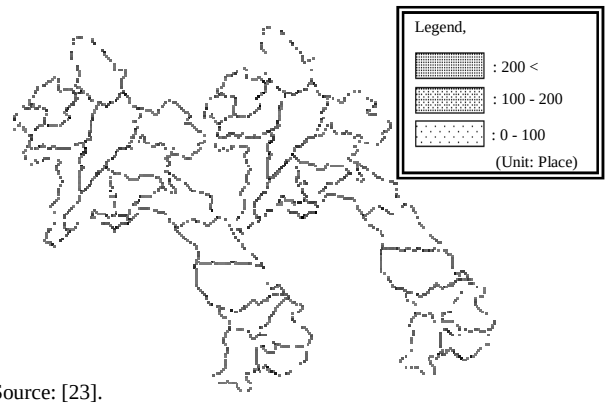
(a) As of 1995 **(b) As of 2004**

Map 5. Industry Establishments in Lao PDR.

b. Tourism

Map 6 shows the hotel and restaurant establishments in provinces along the selected corridor-1, 2, and 3 as of 2002 and 2005. The achievement status of selected transport corridor developments can be seen in table 4. It can be observed that contribution of transport corridor developments to tourism sector in provinces along the selected corridors in terms of the hotel and restaurant

establishments had spread in proportion to transport corridor developments.



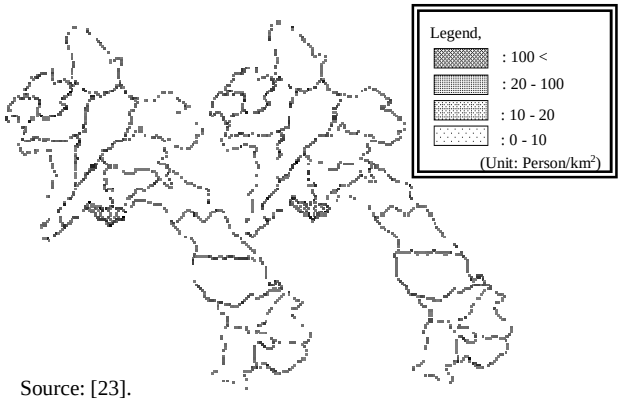
Source: [23].

(a) As of 2002 (b) As of 2005

Map 6. Hotel and Restaurant Establishments in Lao PDR.

c. Population

Map 7 shows the population density of 1995 and 2005. The achievement status of selected transport corridor-1, 2, and 3 are given in table 4. The population density change had been increasing along the selected transport corridors. However, in comparison with the direct impact to tourism, the contribution of transport corridor developments to population change is not largely influenced in Lao PDR.



Source: [23].

(a) As of 1995 (b) As of 2005

Map 7. Population Density in Lao PDR.

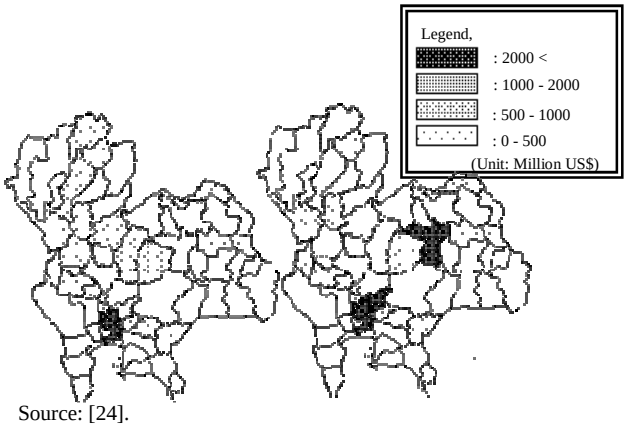
(4) Thailand

a. Trade and Commerce

Map 8 shows the Gross Provincial Products (GPP) as of 1998 and 2005 along the selected transport corridor-1, 2, 3, and 4. The achievement status of selected transport corridor developments in Thailand are given in table 5. GPP had increased on provinces where meet two corridors and bordering provinces to Cambodia and PRC.

b. Tourism

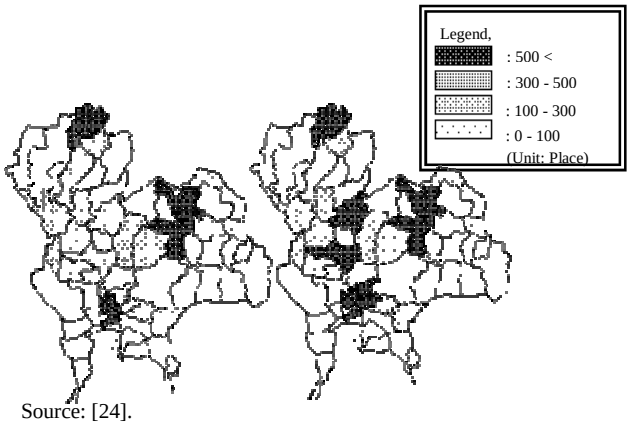
Map 9 shows that hotel and restaurant establishments in provinces along the selected corridors as of 1998 and 2005. According to these maps, the contribution of transport corridor development to tourism sector in provinces along the selected corridor are observed as the hotel and restaurant establishments are spread in proportion to transport corridor developments. Especially, the provinces, where two selected transport corridors meet, were remarkably increasing



Source: [24].

(a) As of 1998 (b) As of 2005

Map 8 Gross Provincial Products in Thailand.



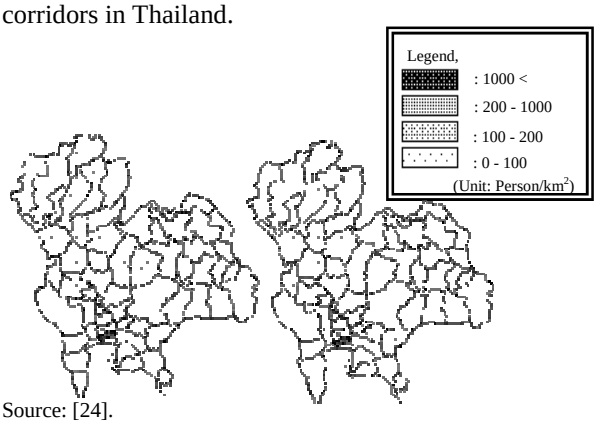
Source: [24].

(a) As of 1998 (b) As of 2005

Map 9. Hotel and Restaurant Establishments in Thailand.

c. Population

Map 10 shows the population density changes as of 1998 and 2005. Distinct changes are observed regarding population in provinces along the selected transport corridors in Thailand.



Source: [24].

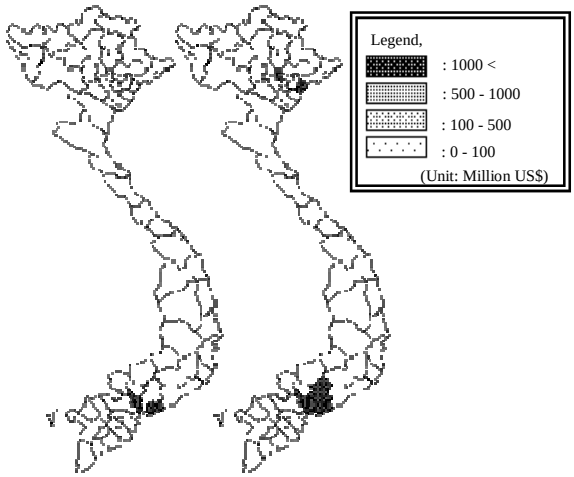
(a) As of 1998 (b) As of 2005

Map 10. Population Density in Thailand.

(5) Viet Nam

a. Trade and Commerce

Map 11 shows the industrial output value as of 1996 and 2006 along the selected transport corridor-2, 3, and 4. The achievement status of selected transport corridor-2, 3, and 4 developments in Viet Nam are given in table 6. The industrial output value had been increasing in provinces along the selected corridors-2 and 4.



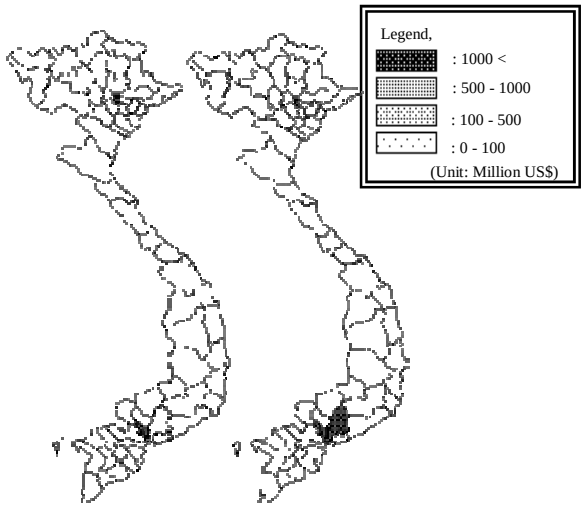
Source: [25].

(a) As of 1996 **(b) As of 2006**

Map 11. Industrial Output Value in Viet Nam.

b. Tourism

Map 12 presents the retail sales in provinces along the selected corridors as of 1996 and 2006. According to this map, it reflects the contribution of all selected transport corridor-1, 2, and 3 developments as the retail sales had been increasing.



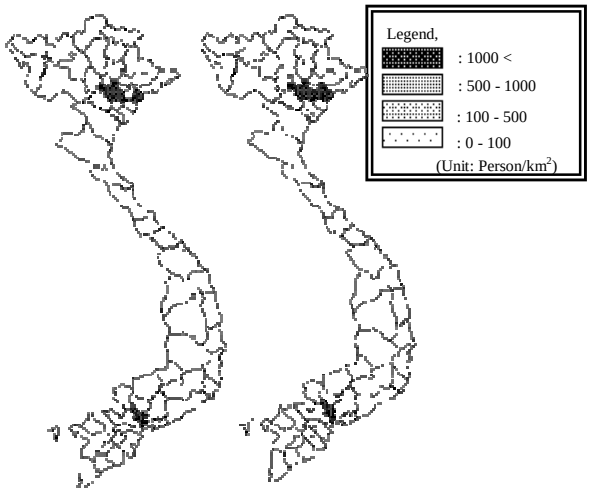
Source: [25].

(a) As of 1996 **(b) As of 2006**

Map 12. Retail Sales in Viet Nam.

c. Population

Map 13 shows the distribution of population density of 1996 and 2006. No distinct changes are observed regarding population density in provinces along the selected transport corridors.



Source: [25].

(a) As of 1996 **(b) As of 2006**

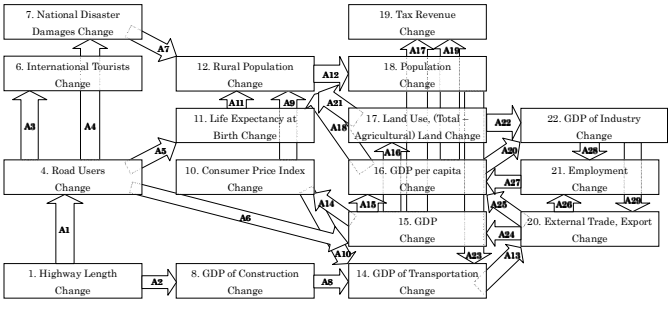
Map 13. Population Density in Viet Nam.

5-2-2. Development Process by Country

(1) Development Process Model

In this analysis, the impacts to socioeconomic changes by country from transport corridor developments have been examined. Figure 7 shows development process model modified to suit this study on the basis of the model proposed by Nakamura [26]. And regression analysis which confirms the extent of probabilistic correlataion between two events in the development process model was used.

All the data used in this analysis were obtained from international organizations [6 and 7]. Therefore, by usigng same formatted date, the differences of development process due to transport corridor developments among countries in this study area could be compared. And the results were shown in arrows which hatched by three types ($0.8 \leq R^2 \leq 1.0$ $0.5 \leq R^2 < 0.8$ and $0.0 \leq R^2 < 0.5$) so as to understand the extent of correlation between two events.



Source: [26].

Fig. 7. Development Process Model.

(2) Regression Analysis

The regression analysis concerns the correlation between two variables with the object of identifying, estimating,

and validating. The strength of a linear relation "R^2" is measured by following formula (1).

$$R^2 = \frac{\left[\sum\left(x-\bar{x}\right)\left(y-\bar{y}\right)\right]^2}{\left[\sum\left(x-\bar{x}\right)^2\right]\left[\sum\left(y-\bar{y}\right)^2\right]} \quad (1)$$

where, x = data of independent variable
$\bar{x}$ = average of independent variable
y = data of response
$\bar{y}$ = average of response

If the result of R^2 value is more than 0.8, the correlation between two events is concluded as "significant" in this analysis.

(3) Time Lag on Development Process by Country

The road network development has two main important roles, that is to say, job provision to related industries (from arrow A2 to A3, in Fig.7) and sustainable road network use for people's activities (from arrow A1 to A3, A4, A5, A6 in Fig.7). In terms of sustainable use of road network, it is thought that time lag between the events are generated.

(4) Cambodia

Figure 8 shows the results of regression analysis considering time lag. In Cambodia, the time lag between "1.Highway Length Change" and "4.Road Users Change" is 0 year with significant correlation. And, the time lag between "4.Road Users Change" and "15.GDP Change" is 3 years, further, between "4.Road Users Change" and "6.International Tourist Change" is 4 years in significant correlation. A number of significant correlation between two events is 16 out of 29.

Transport corridor development had been contributed for road user benefits with time lag in Cambodia.

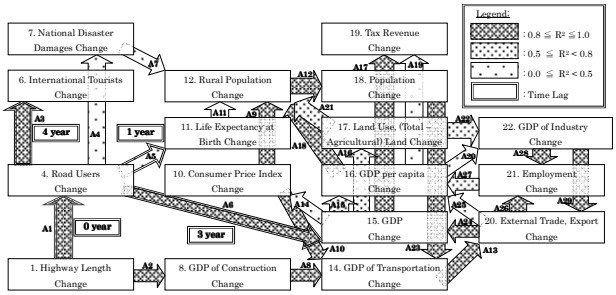


Fig. 8. Development Process with Time Lag in Cambodia.

(5) Lao PDR

Figure 9 shows the results of regression analysis with time lag in Lao PDR. The time lag between "1. Highway Length Change" and "4. Road Users Change" is 3 years supported by significant correlation. However, the time lag between "4. Road Users Change" and "15. GDP Change", "4. Road Users Change" and "6. International Tourist Change", "4. Road Users Change" and "11. Life Expectancy at Birth Change" has close to significant correlations. A number of significant correlations between two events is 10 out of 29.

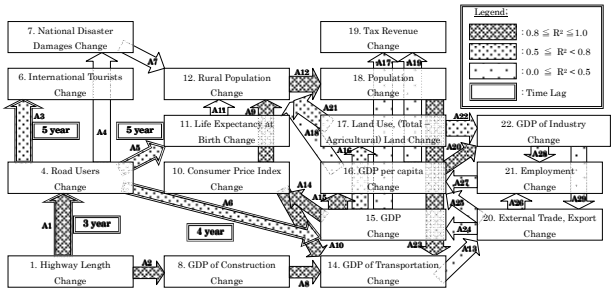


Fig. 9. Development Process with Time Lag in Lao PDR.

In Lao PDR, it is found that transport corridor developments had not contributed for user benefit even when the time lag is taken into account.

(6) Thailand

Figure 10 shows the results of regression analysis considering time lag in Thailand. The time lag between "1.Highway Length Change" and "4.Road Users Change" is 2 years with significant correlation. Time lag between "4.Road Users Change" and "15.GDP Change" is 5 years. A number of significant correlation between two events is 8 out of 29.

Transport corridor developments had contributed only for road user increment. However, it is clear that transport corridor development had contributed for GDP increase with five years time lag.

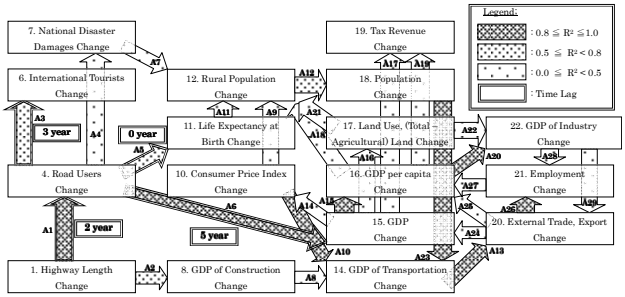


Fig. 10. Development Process with Time Lag in Thailand.

(7) Viet Nam

Figure 11 shows the results of regression analysis with time lag in Viet Nam. The time lag between "1.Highway Length Change" and "4.Road Users Change" is 4 years, the time lag between "4.Road Users Change" and "6.International Tourists Change" is 1 year, the time lag between "4.Road Users Change" and "11.Life Expectancy at Birth Change" is 4 years, the time lag between "4.Road Users Change" and "15.GDP Change" is 0 year with significant correlation values. A number of significant correlation between two events is 25 out of 29.

In Viet Nam, almost all links had significant correlation considering time lag. It can be said that this is the good example of socioeconomic development by using transport corridor development.

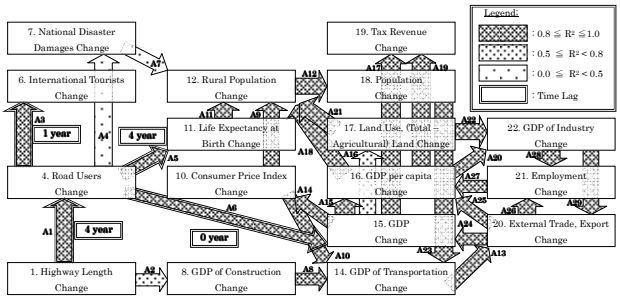


Fig. 11. Development Process with Time Lag in Viet Nam.

6. CONCLUSION

6-1. Overall and Key Conclusion

In the Greater Mekong Subregion, although there are some differences among countries, the socioeconomic situation and transport corridors have been improving since 1995.

The key conclusions in each analysis are as follows.

6-1-1. Planning for Infrastructure by Organization

All countries in this study area have positive policy for transport corridors development. However, differences exist in transport corridor development progress status among countries.

6-1-2. Smilarity among Pople

Bordering countries have more similarities among people than other countries. Especially, Cambodia and Lao PDR have similarities with their surrounding countries.

6-1-3. Direc Impact on Provinces

Thailand classified as “Low Middle Income Country” by DAC (Development Assistance Committee) has been increasing GPP in provinces where two corridors meet.

Similarly Viet Nam is classified as “Low Income Country”. This has been increasing in trade and commerce, tourism and population changes in provinces along the corridors.

And Cambodia and Lao PDR are classified as “Least Developed Country”. They have reflected changes in increasing in population or tourism in provinces along the corridors.

6-1-4. Develpment Process by Country

It is reported that the effect of infrastructure development investment is not so large in low developed economy. It becomes effective in middle developed economy and less effective in high developed economy [2]. In this study, similar trend of results have been observed.

Cambodia and Lao PDR have medium correlation between transport corridor development and socioeconomic changes (10 and 16 significant arrows out of 29 in Figure 8 and 9 respectively).

Viet Nam has highest correlations between transport corridor development and socioeconomic changes (25 significant arrows out of 29 in Figure 11).

Thailand has lowest correlation between transport corridor development and socioeconomic changes (8 significant arrows out of 29 in Figure 10).

6-2. Scenario

On the basis of these results obtained in this study, three scenarios are presumed for countries by DAC category.

Scenario 1: PRC and Thailand dominances continue to expand

Scenario 2: Viet Nam comes to the force in the short run

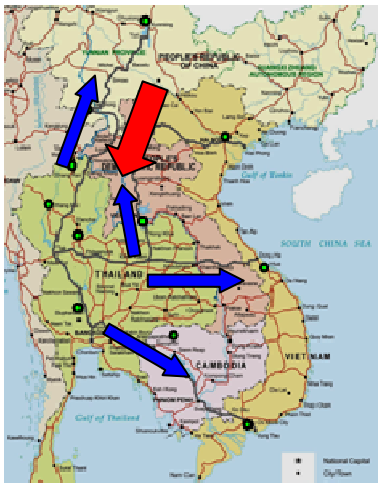
Scenario 3: Cambodia and Lao PDR increase their expectations

It is necessary to notes that political changes, natural disasters, economic crises or other uncertain factors are not taken into account in following scenarios.

6-2-1. PRC and Thailand Dominances Continue to Expand

For low middle income countries, PRC and Thailand have played important roles in the GMS as pioneers of economic development and providers of financial and technical assistance to other GMS member countries. They have high transport corridor accomplishments rate, and made transport corridors as functional in line with their economic activities. That is to say, PRC and Thailand had linked with selected corridor-1, with 61.9 % accomplishment rate as of 2006, and both countries were highly dependent on each other as trading partner. This is the model of an economic corridor.

In Thailand, these transport corridors can be used for risk reduction. In 1997, Thailand was highly affected by Asian Finance Crisis. It is commonly said that economy has cycle with “boom”, “bust”, “recession”, “depression” and “recovery”. To reduce the risk of impact by this cycle, Thailand can utilize transport corridors. For example, if Thailand shifts some of their industrial production functions (factories) to neighboring countries, it may become possible to reduce or avoid the economic risk. This will be good for neighboring countries in terms of capital investmen.



Map 18. Scenario -1: PRC and Thailand Dominance Continue to Expand.

The transport corridors connect to seaport in Viet

Nam. This is the greatest potential for Yunnan province of PRC. Most countries relate with PRC as trading parners. In addition to current economic dominant position of PRC in this region, the transport corridor can connect to large markets beyond the GMS.

6-2-2. Scenario -2: Viet Nam Comes to the Force in the Short Run

Viet Nam, low income country is located east side of the study area with a long coastal line. Therefore, Viet Nam can work as threshold of the GMS. When the transport corridor is complete, Viet Nam will be able to play an important role for trade within and outside the GMS trough port towns, and thus will gradually increase their impact on Cambodia and Lao PDR. This will place Viet Nam in more competitive position with Thailand.

Viet Nam had been improving its economy without negative impact so far after Asian Financial Crisis in 1997. Moreover, the prominent characteristic of GDP growth of Viet Nam is well balanced. Although, the agricultural sector had low or negative growth rates in other countries, Viet Nam had high growth rate and it was close to service sector. The agriculture sector was not so much affected by Economic Crisis. Therefore, it would be possible for Viet Nam to continue a stable economic growth country.

Furthermore, transport corridor network development had been significant correlation between and among socioeconomic events. In other words, tranport corridor network development had been working well for socioeconomic developments in Viet Nam. The completion status of transport corridor had remained low level as of 2006; but Viet Nam will be able to expect more socioeconomic improvement by its own transport corridor developments inside the country.

Map 19. Scenario -2: Viet Nam Comes to the Force in the Short Run.

6-2-3. Scenario -3: Cambodia and Lao PDR Increase their Expectations

Least developed countries such as Cambodia and Lao PDR are located between PRC, Thailand and Viet Nam, which are relatively better off in terms of economic growth and development. A number of transport corridors have been planned to pass through each capital cities and currently under development. This will be able to expand the economic potential because of their location by offering transit and production centers of various other activities. In fact their employment in secondary sector and corresponding GDP have been increasing more than other sectors. From this point of view, four selected corridors in this study will keep playing continuously important role.

In terms of Cambodia, they had the highest growth rate in international tourist arrivals in this study area. Although, the completion status of selected transport corridor-4 was 67.2 % as of 2006, more tourist arrivals are expected in proportion to transport corridor development due to its tourism potential.

Moreover, Cambodia has already fulfilled its transport corridor network development functions in relation to socioeconomic changes. Cambodia had the least per capita GDP in this study area as of 2004. However, they will be able to improve their socioeconomic status by utilizing transport corridor developments and by young workers who were born after baby boom in 1980's.

With regard to Lao PDR, the country has very close relationship with Thailand. Some area in Lao PDR, people can communicate with Thai people by using same language. In comparison with Thai GDP per capita, Lao PDR remains still low. Therefore, Lao PDR can expect investment from Thai companies which are looking for low expenses and this will boost secondary sector economy by establishing industries. On this point of view, transport corridor will play very important role.

Map 20. Scenario -3: Cambodia and Lao PDR Increase their Expectations.

Furthermore, many transport corridors have planned to pass though Lao PDR. Therefore Lao PDR can utilize their location as transit center of the GMS. At present total upgraded road network accomplishment remains

low (43.8 %), but the situation will improve dramatically when transport corridors are fully accomplished in this land-linked country.

7. RECOMMENDATION AND IMPLICATION

In this study, the contributions of transport corridor development in the GMS to economic development in constituent countries and the potential of the GMS are examined by using secondary data. It has been confirmed the existence of correlation between transport corridor development and economic development components. It is observed that the impacts from the transport corridor development to socioeconomic changes are diversified from one country to another. However, since these results include many external factors, it is complex to conclude more precisely the impact of transport corridor development on economic development.

Therefore, it is necessary to apply multivariate statistics technique or detailed regional analysis and so on to identify exact impacts in the future subject to availability of right type of data. However, the analysis from people point of view as demonstrated through "Similarity among People" should be more rigorously done.

ACKNOWLEDGMENT

The authors would like to express their thanks and appreciations to Dr. Mokbul Morshed Ahmad and Dr. Kiyoshi Honda in AIT for their critical and constructive comments, and valuable advices for improving the quality of this research.

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