CHAPTER 3 REVISION OF MASTER PLAN

3.1 Conceptual Methodology

3.1.1 Review of the Previous Master Plan

Southern Lao is expected to become a focal point which integrates the regional economy and thus stimulates economic growth in the GMS countries. The deteriorated condition of the road network in the southern region hinders economic growth and the poverty reduction efforts. Accordingly, the previous study proposed the road improvement master plan in the southern region to provide (i) international/ regional corridor, developing a trunk road network and (ii) basic access, ensuring reliable all-weather access to social infrastructures to reduce poverty.

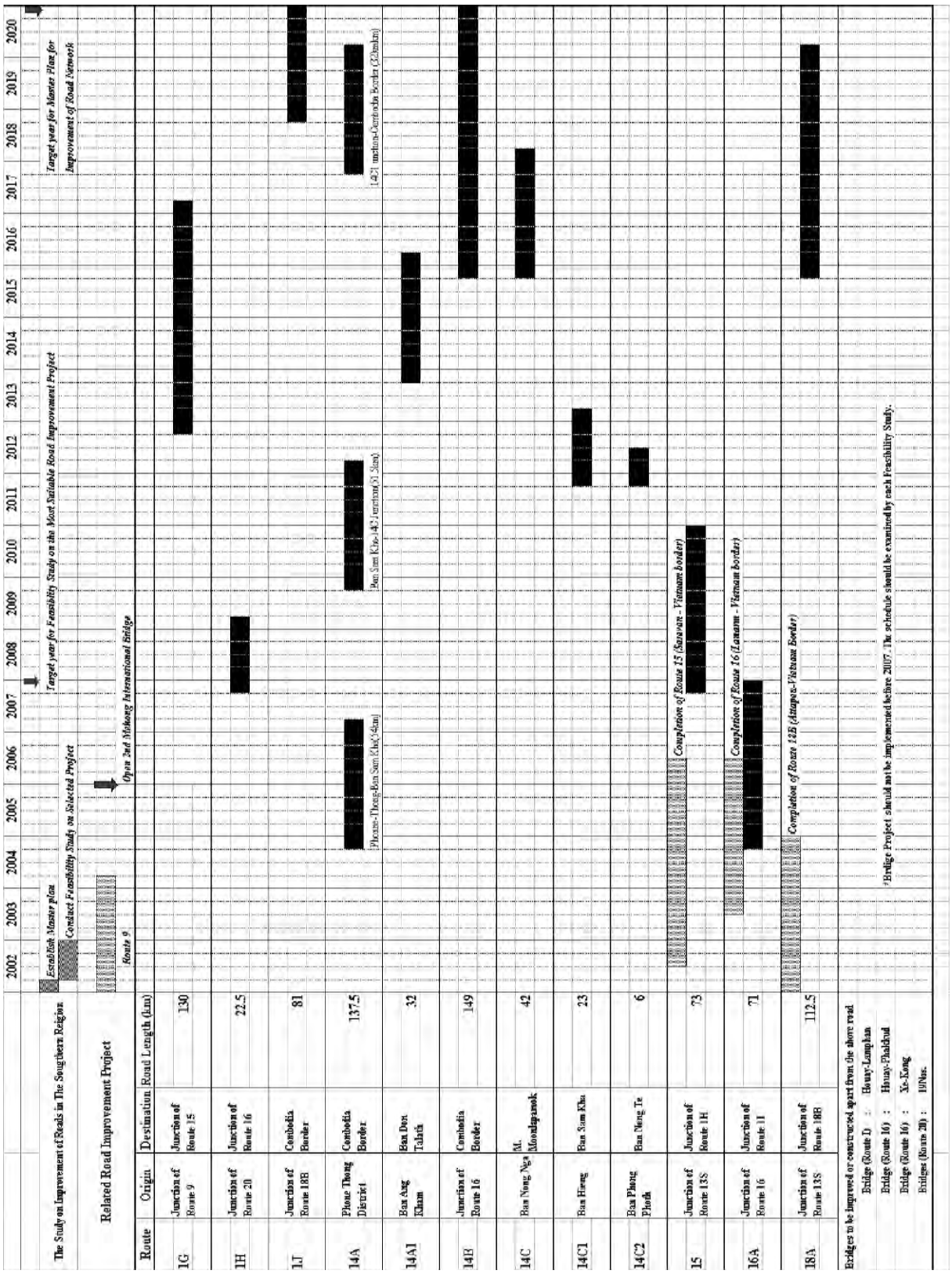
A multi-criteria analysis was applied to the previous study, which incorporated economic evaluation of road investments, together with socio-economic impacts and environmental impacts. Based on the result of project evaluation, the grade and corresponding score of the impact of each candidate road and bridge projects were determined (see Table 3.1.1).

Table 3.1.1 Overall Evaluation Result in Previous Study

Route	Cost-benefit Impacts	Socio-economic Impacts	Environment Impacts	Total Score
Weight	35%	45%	20%	
NR-1G	D 65	A- 92	D+ 68	77.8
NR-1H	B 85	C+ 78	A+ 98	84.5
NR-1J	E 55	B+ 88	C+ 78	74.5
NR-14A (i)	A 95	B 85	B+ 88	89.1
NR-14A (ii)	D 55	B 85	B+ 88	75.1
NR-14A (iii)	E 55	B 85	B+ 88	75.1
NR-14A1	C 75	C+ 78	A+ 98	81.0
NR-14B	E 55	C- 72	A+ 98	71.3
NR-14C	E 55	C- 72	A 95	70.7
NR-14C1	E 55	D+ 68	A 95	68.9
NR-14C2	E 55	D+ 68	A+ 98	69.5
NR-15	B 85	C 75	A+ 98	83.1
NR-16A	A 95	B 85	C 75	86.5
NR-18A (i)	D 65	A+ 98	C 75	81.9
NR-18A (ii)	E 55	A+ 98	C 75	78.4
NR-18A (iii)	C 75	A+ 98	C 75	85.4
Bridge (NR-1l)	D 65			65.0
Bridge (NR-16)	D 65			65.0
Bridge (NR-16)	E 55			55.0
Bridge (NR-20)	D 65			65.0

Source: Improvement of Roads in the Southern Region in Lao PDR (JICA, 2003)

Summing scores multiplied by weight of each impact (i.e., 35% for cost-benefit Impacts, 45% for socio-economic Impacts and 20% for environmental impacts), the previous study established NR-14A as the road with highest benefit with NR-16A, the second. The study thus suggested road improvement projects on both roads as the most urgent projects toward the target year of 2007. As illustrated in the Figure 3.1.1, the study also proposed the road improvement master plan towards the year 2020, suggesting 1,539 km of road improvement projects in total.



Source: Improvement of Roads in the Southern Region in Lao PDR (JICA, 2003)

Table 3.1.2 Road Improvement Master Plan toward 2020

3.1.2 Approach and Methodology Applied to this Study

Socio-economic conditions have drastically changed since the previous road improvement master plan was formulated. The current trend of the road transport in the southern region, which influences the road improvement master plan, is summarized below.

- Increasing traffic demand was observed along the main trunk roads, such as NR-13 and NR-9, due to an increase in the international and domestic trade in the region.
- Development potential of the mining industry and agricultural industry were realized and development plans of these industries in the southern region were formulated.
- Some road improvement projects were under implementation in the southern region, including those along NR-14A, NR-1H, and NR-15B and NR-16B.

In this regards, the Study revised the previous master plan and formulated the road improvement master plan in the southern region by the following steps.

- At the initial stage of the Study, a long list of both road and bridge improvement projects was prepared. This long list of road projects was limited to unpaved national roads, including on-going road improvement projects. The long list of bridge projects included new long-span bridge projects, such as Sekong Bridge and Sedone Bridge, and deteriorated and narrow bridges, observed along NR-9 and NR-20. (Step 1)
- Future socio-economic framework was prepared with the target year of 2025 by reviewing and updating information such as population and GDP. Industrial and agricultural development projects were listed for a further study to estimate the traffic generated from these projects. (Step 2)
- Future traffic demand in the study area was estimated based on existing and future road network and origin-destination matrices, built in the ongoing JICA Study on the Comprehensive Logistics System in Lao PDR. (Step 3)
- Initial environmental examination was carried out to identify major adverse environmental impacts caused by the project. (Step 4)
- Road and bridge improvement projects were evaluated by a multi criteria analysis, scoring evaluation indicators such as cost-benefit, future traffic volume, development potential, and environmental impacts. (Step 5)
- Economic feasibility of the project was tested, analyzing project benefits generated through reduction of vehicle operating costs and travel time versus the construction and maintenance cost of the project. (Step 6)
- Priority projects were selected based on the revised master plan and the scope of the projects by the Japanese grant aid was narrowed down through the evaluation of the appropriateness, necessity and urgency of the projects. (Step 7)

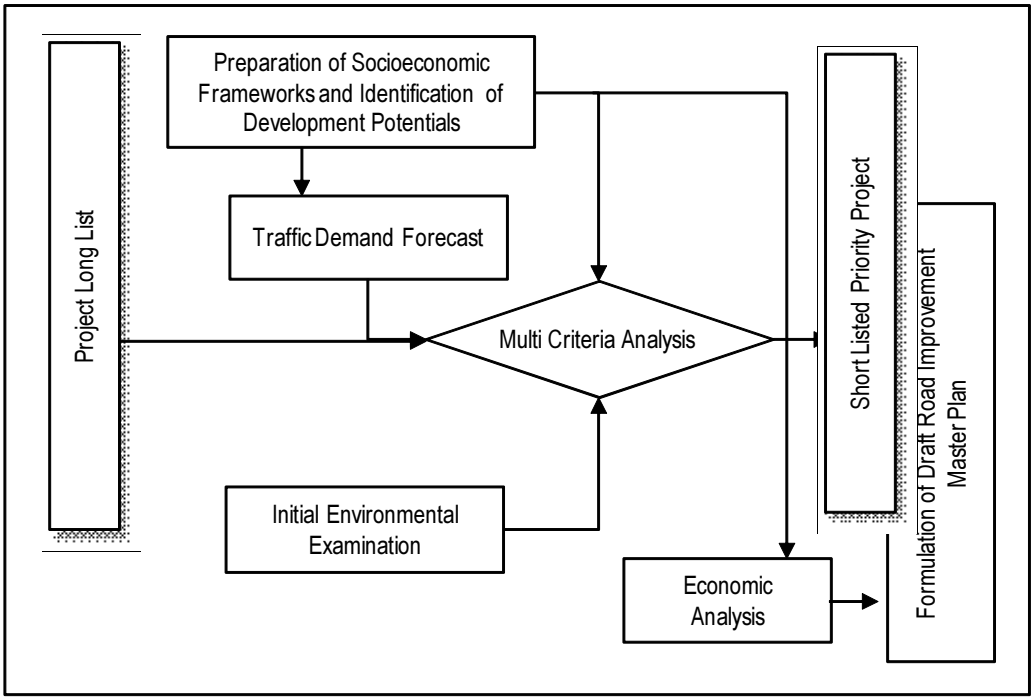


Figure 3.1.1 Overall Approach for Formulation of Draft Road Improvement Master Plan

3.2 Socio-economic Framework

3.2.1 Review of the Previous Master Plan

(1) Population

Table 3.2.1 indicates the alternative population forecasts to 2020 prepared by the study team during the previous master plan. The alternatives were based on the Socio-economic Strategy[1] prepared in February 2001.

Amongst the three alternatives, the study team selected "Consultants' Central" as the most appropriate scenario. According to this scenario, national population would increase from 5.2 million in 2000 to 8.3 million in 2020, with an annual average population growth rate of more than 2%.

Table 3.2.1 Population Forecast to 2020

	Forecasted Population					Annual Average Growth Rate (%)			
	2000	2005	2010	2015	2020	2000-05	2005-10	2010-15	2015-20
Socio-economic Strategy February 2001	5,218	5,900	6,700	NA	8,300	2.49	2.58	NA	2.16*
Consultants' High	5,218	5,930	6,730	7,600	8,500	2.59	2.56	2.46	2.26
Consultants' Central	5,218	5,900	6,660	7,450	8,300	2.49	2.45	2.27	2.18
Consultants' Low	5,218	5,860	6,520	7,200	7,900	2.35	2.16	2.00	1.87

Note: NA means not available. * Annual average growth rate from 2010 to 2020

Source: Improvement of Roads in the Southern Region in Lao PDR Final Report

[1] The strategy is not published now but the contents of the strategy were compiled into National Growth and Poverty Eradication Strategy (NGPES) in March 2003.

Table 3.2.2 indicates the population forecasts in 4 provinces (Saravan, Sekong, Champasak and Attapeu). Total population was projected to increase from 1.0 million in 2000 to 1.6 million in 2020 with annual population growth rate of 2.3%. Share of the population in each province was almost fixed. The percentage is 55% for Champasak Province, 28% for Saravan Province, 10% for Attapeu Province and 7% for Sekong Province.

Table 3.2.2 Population Forecast in 4 provinces

(Unit: 000 persons)

Province	2000	2005	2010	2015	2020
Saravan	292.3	330.5	373.1	417.4	464.9
Sekong	73.2	82.8	93.4	104.5	116.4
Champasak	571.9	648.8	730.0	816.7	909.7
Attapeu	99.4	112.4	126.9	141.9	158.1
Total	1,036.8	1,174.5	1,323.4	1,480.5	1,649.1

Source: Improvement of Roads in the southern region in Lao PDR Final Report

(2) Development Scenario

In order to forecast socio-economic development of the southern region, the following sectors were examined in the previous master plan: (a) development of growing cores, (b) poverty reduction, (c) market-oriented agriculture, fishery and livestock, (d) infrastructure network and (e) sustainable forestry. Development scenarios of the sectors were compiled as follows:

- Development of growing cores: Pakse will be a super core for the study area while Saravan, Sekong and Attapeu are positioned as satellite cores. These cores will lead to industrial and commercial development. Agricultural production will continue to be a foundation for prospective economic development. Pakse and its surrounding areas are expected to function as a center of agriculture production and tourism. Infrastructure development such as roads and power plants should be concentrated upon to enable effective development of the cores. Development of NR-15B, 16B and 18B will vitalize economic condition of Pakse and other cities.
- Poverty reduction: Poverty reduction is one of the most important national issues together with economic development. Food security, primary education, primary health care accessibility should be improved to the level of national minimum.
- Market-oriented agriculture, fishery and livestock: land for agriculture and agricultural production are increasing, and agriculture needs to change from self-sufficient agriculture to commercial agriculture. Agricultural development at Boloven Plateu is a progressive effort toward the change.
- Infrastructure network: Connecting every district capital with all weather roads should be a goal of a middle and long term development plan. MPWT and DPWT should carefully examine the anticipated economic performance of their investment.
- Sustainable forestry: Forestry occupied 78% of the total merchandise export. Cutting trees or selling forest concession to the private sector is one of the easiest ways to increase government revenue. However, forestry should be managed in the most conservative manner.

(3) Economy

Table 3.2.3 shows alternative national GDP forecasts to 2020. These alternatives were also prepared from the Socio-economic Strategy in February 2001. In the Socio-economic Strategy, target annual GDP growth rate to 2020 was set as 7%. From the standpoint of conservative economic development, the study team used the target in the Consultants' High alternatives. The study team selected the Consultants' Central alternatives as the most appropriate scenario, and used the scenario to forecast the number of vehicles in the future.

Table 3.2.3 GDP Forecasts to 2020

Alternatives	1999-2010	2010-2020
High	7.0	7.5
Central	6.0	6.0
Low	5.0	5.0

Source: Improvement of Roads in the southern region in Lao PDR Final Report

(4) Vehicle Ownership

Table 3.2.4 and Table 3.2.5 show forecasts of GDP and number of vehicles up to 2020. The study team set elasticity of vehicle ownership to GDP in the forecast. It was the same methodology used in "Third Highway Improvement Project," conducted in 1998. It was expected that economic development in Vientiane Capital would progress more rapidly than other places in Lao PDR, and that ownership of motorcycles and tuk-tuks would be saturated. It was also expected that elasticity of motor vehicles was low. In other provinces, the substantial improvement would be observed with improvement of road network system and the expected increase of vehicles. Changes of GDP and elasticity are indicated in Table 3.2.4

Table 3.2.4 Forecast of GDP and Number of Vehicles to 2020 (1)

Item		Growth	1999	2005	2010	2015	2020	Annual Growth Rate (%)			
								99-05	05-10	10-15	15-20
GDP Index 1999=100.0		High	100.0	150.1	210.5	302.2	433.8	7.0	7.0	7.5	7.5
		Central	100.0	141.9	189.8	254.0	340.0	6.0	6.0	6.0	6.0
		Low	100.0	134.0	171.0	218.3	278.6	5.0	5.0	5.0	5.0
Vientiane	Elasticity to GDP: Motor Vehicles	High	NA	1.1	1.1	1.2	1.2	7.6	7.6	8.8	8.8
		Central	NA	1.1	1.1	1.1	1.1	6.3	6.3	6.5	6.5
		Low	NA	1.0	1.0	1.1	1.1	5.0	5.0	5.2	5.2
	Elasticity to GDP: Motorcycles Tuk - tuks	High	NA	1.0	0.9	0.7	0.5	7.0	6.4	5.5	4.0
		Central	NA	1.0	0.9	0.8	0.7	6.0	5.5	4.6	4.1
		Low	NA	1.0	0.9	0.8	0.8	4.8	4.5	4.1	3.8
Outside of Vientiane	Elasticity to GDP: Motor Vehicles	High	NA	1.4	1.4	1.5	1.5	9.3	9.4	10.6	10.6
		Central	NA	1.3	1.3	1.4	1.4	7.5	7.6	8.1	8.1
		Low	NA	1.2	1.2	1.3	1.3	5.9	5.9	6.3	6.3
	Elasticity to GDP: Motorcycles Tuk-tuks	High	NA	2.1	2.1	2.0	1.9	12.7	13.0	13.4	12.8
		Central	NA	2.1	2.1	2.1	2.0	11.1	11.3	11.3	10.9
		Low	NA	2.1	2.1	2.1	2.1	9.4	9.6	9.6	9.6
Total	Elasticity to GDP: Motor Vehicles	High						8.2	8.3	9.5	9.6
		Central						6.7	6.8	7.2	7.2
		Low						5.3	5.3	5.7	5.7
	Elasticity to GDP: Motorcycles and Tuk-tuks	High						9.8	10.2	10.6	10.4
		Central						8.5	8.7	8.8	8.8
		Low						7.0	7.3	7.4	7.7

Source: Improvement of Roads in the southern region in Lao PDR Final Report

Table 3.2.5 indicates the forecasted changes in number of motor vehicles and motorcycles/tuk-tuk. In Vientiane, ownership of vehicles will increase from 42.1 vehicles per 1,000 persons in 1999 to 95.1 vehicles per 1,000 persons in 2020, while ownership of motorcycles and tuk-tuks will increase from 136.5 vehicles per 1,000 persons in 1999 to 237.4 vehicles per 1,000 persons in 2020 (with Central alternative). These figures are from 3.2 to 9.4 and from 15.1 to 85.6 outside of Vientiane, respectively.

Table 3.2.5 Forecast of GDP and Number of Vehicles (2)

Item		Growth	Number of Vehicles (000)					Vehides/000 (persons*)				
			1999	2005	2010	2015	2020	1999	2005	2010	2015	2020
Vientiane	Motor Vehicles	High	24.6	38.2	55.1	83.9	127.7	42.1	56.5	72.2	98.3	134.4
		Central	24.6	35.4	48.0	65.9	90.4	42.1	52.4	62.9	77.2	95.1
		Low	24.6	33.0	42.1	54.3	70.1	42.1	48.8	55.2	63.7	73.8
	Motorcycles and Tuk – tuks	High	79.7	119.6	163.0	212.7	259.0	136.5	177.0	213.6	249.3	272.6
		Central	79.7	113.1	147.5	184.9	225.6	136.5	167.3	193.3	216.8	237.4
		Low	79.7	105.5	131.7	160.8	194.1	136.5	156.0	172.6	188.5	204.3
Outside of Vientiane	Motor Vehicles	High	14.4	24.4	38.2	63.1	104.3	3.2	4.7	6.5	9.6	14.2
		Central	14.4	22.2	31.9	47.0	69.3	3.2	4.2	5.4	7.1	9.4
		Low	14.4	20.2	26.9	36.6	49.7	3.2	3.9	4.6	5.5	6.8
	Motorcycles and Tuk-tuks	High	68.3	140.2	258.6	484.0	884.6	15.1	26.8	43.9	73.4	120.4
		Central	68.3	128.4	219.5	375.5	629.5	15.1	24.6	37.2	56.9	85.6
		Low	68.3	117.1	185.1	292.4	462.1	15.1	22.4	31.4	44.3	62.9
Total	Motor Vehicles	High	39.0	39.0	93.2	147.0	232.0	7.6	10.6	14.0	19.7	28.0
		Central	39.0	39.0	79.9	112.9	159.6	7.6	9.8	12.0	15.2	19.2
		Low	39.0	39.0	69.0	90.9	119.8	7.6	9.0	10.4	12.2	14.4
	Motorcycles and Tuk-tuks	High	148.0	148.0	421.6	696.7	1,143.6	29.0	44.0	63.3	93.5	137.8
		Central	148.0	148.0	367.0	560.4	855.0	29.0	40.9	55.1	75.2	103.0
		Low	148.0	148.0	316.8	453.2	656.2	29.0	37.7	47.6	60.8	79.1

Note: * with central population forecast

Source: Improvement of Roads in the southern region in Lao PDR Final Report

Table 3.2.6 indicates the forecasted number of vehicles if the study area experienced the same growth with other areas outside of the Vientiane Capital. Vehicles per 1,000 persons will increase from 16.6 in 1999 to 93.8 in 2020.

Table 3.2.6 Forecast of Vehicle Numbers in the Study Area

(Unit: 000 vehicles)

		1999	2005	2010	2015	2020
Motor vehicles	High	2.78	4.71	7.37	12.2	20.1
	Central	2.78	4.29	6.16	9.1	13.4
	Low	2.78	3.90	5.19	7.1	9.6
Vehicles per 1,000 population with central population forecast		2.7	3.7	4.7	6.1	8.1
Motor-cycles/ tuk-tuks	High	16.8	34.4	63.5	118.9	217.6
	Central	16.8	31.5	53.9	92.3	154.7
	Low	16.8	28.8	45.5	71.9	113.5
Vehicles per 1,000 population with central population forecast		16.6	26.9	40.7	62.3	93.8

Source: Improvement of Roads in the southern region in Lao PDR Final Report

3.2.2 Review of Upper Plans

(1) National Development Strategies and Plans since 1990s

The most important development target for Lao PDR is "to graduate from Least Developed Country (LDC)" by 2020. It was adopted at the 6th Party Congress in 1996, and, the following guidelines were adopted in the 7th Party Congress in 2001.

- Keep balance among economic growth, social and cultural development, and environmental management;
- Coordinate economic growth among sectors, and between urban and rural areas;
- Promote national solidarity and democracy under sound economic development strategy and economic development framework;
- Promote national development along with development opportunity of the region and the world, and participate in regional economic integration;
- Achieve socio-economic development connected with national stability and national security.

Based on the long-term national development vision, NGPES with a target year of 2010 was prepared in 2004. It is the basis of the first Poverty Reduction Strategic Paper (PRSP), and it has the following development targets:

- Most areas in the country will get out from poverty and quit slash-and-burn farming by 2010;
- GDP growth rate will increase to 7% by 2010;
- The share of the primary sector will drop from 51% in 2001 to 37% in 2010, whereas that of the secondary sector will increase from 25% to 32%. The tertiary sector's share will also increase from 24% to 32%. The ratio of investment to GDP will increase to 25% by 2010.

National Socio-Economic Development Plan (2006-2010), the 6th 5-year plan, was adopted in the 8th Party Congress in 2006. It has been the basis of 2nd PRSP under the NGPES.

The long-term vision which is to ensure the graduation of the country into a post-LDC by 2020 has been kept as one of the major goals of development. In addition, the other major goals, which are to achieve the targets in the Millennium Development Goals (MDGs) and the Brussels Program of Action for the Least Developed Countries (2001-2010), have been also included in this plan.

In such major goals, the following targets have been set in the 6th 5-year Plan:

- Accelerate economic growth and improve the people's quality of life, by restructuring the economy and employment to build a market economy based on the country's rich resources and international integration;
- Build the market economy further with a socialist orientation;
- Continue to enlarge and develop effective external economic relations;
- Continue strengthening the socio-economic infrastructure as fundamentals for development in the 6th 5-year Plan and for the next (7th) 5-year Plan.
- Maintain GDP growth rate at an average of 7.5 to 8 % per annum in order to achieve goals mentioned above.

- Attain target growth rates of 3 to 3.4% for the primary sector, 13 to 14% for the secondary sector, and 7.5 to 8% for the tertiary sector. Industrial compositions are 36% for the primary, 36% for the secondary sector, and 28% for the tertiary sector. GDP per capita will reach 827 USD in 2010.

(2) Direction of Next Socio-economic Development Plan from 2011 to 2015

Lao PDR Government has started preparing the next 5-year plan from 2011 to 2015. Although contents of the plan have not been approved yet, tentative direction of the plan can be summarized as follows:

- Provide necessary pre-requisites for improving the well-being of people, reducing poverty, achieving MDGs by 2015 and graduating from LDC group by 2020.
- Achieve macro-economic stability and rapid growth. Also mobilize workforces in line with modern industrial growth.
- Ensure socio-economic development of the country, by balancing economic growth, socio-cultural development and environment preservation.
- Improve governance, capacities, efficiency and transparency in managing the development process
- Strengthen international cooperation and integrate the economy into the regional and global organizations (WTO, ASEAN, AFTA, GMS)

Based on these development directions, the government will attempt to attain 8% of annual GDP growth and aim at 1,700 USD of GDP per capita in 2015.

(3) Provincial Development Plans

Table 3.2.7 and Table 3.2.8 indicate the major targets of provincial socio-economic development plans from 2006 to 2010 and from 2011 to 2015, respectively. Regarding economic development, Savannakhet and Champasak expect industrial development at SEZ and industrial zone. On the other hand, other provinces expect service sector development by use of rich natural resources.

Development/improvement of infrastructure is also major target in each province. In particular development/improvement of road network and bridge in rural areas is a high priority in these provinces.

Table 3.2.7 Targets in the Provincial Socio-economic Plan 2006 to 2010

Province	Priority in the Plan
Savannakhet	- Industrial and tourism development at Savan-Seno SEZ - Improvement of roads & bridges in the rural area
Saravane	- Export of local products; tourism development - Construction of roads and bridges; electricity network
Sekong	- Export of local products; reduction of slash & burns - Electricity network; roads and bridges; education
Champasak	- Industrial development at industrial zone; agriculture development at Boloven Plateau; tourism development; commercial development
Attapeu	- Agriculture; forestry; handicraft - Transportation and communication

Source: Socio-economic Plans 2006-2010 of each province

Table 3.2.8 Targets in the Provincial Socio-economic Plan 2011-2015

Province	Priority in the Plan
Savannakhet	- Elimination of poverty households (3.8% of the total households in 2009); economic development (agriculture-forestry, industry and service) - Enhancement of Savannakhet town
Saravane	- Development of tourism and service industries by use of rich national resources - Strengthening cooperation with neighboring provinces and Vietnam
Sekong	- Reduction of 50% of existing poverty; Stopping logging - Improvement of infrastructure (road network, telecommunication, electricity and water supply in rural area)
Champasak	NA
Attapeu	Agriculture-forestry; development of electricity and mining - Addressing damage by flooding; development of CLV

Source: Socio-economic Plans 2006-2010 of each province

3.2.3 Development Scenario

(1) Urban Development

In the study area, high level of urban development is expected at Savannakhet and Pakse. These towns will work as the regional centers. These cities are positioned as "Secondary Towns" after Vientiane Capital, and expected to work as regional centers in Lao PDR.

Pakse will be the center of the southern regions, base for international and domestic trade, and base for international level tourism sites such as Wat Phou. Manufacturing companies will be located at industrial zone near Pakse[2], and administration function of plantations and mines will also be located at Pakse.

Development of Savannakhet heavily relies on development of Savan-seno Special Economic Zone. As of May 2010, 13 companies invested in SEZ site C which is 10km from Savannakhet, and construction work of factories have started. If the developments advance, Savannakhet will serve the functions of providing supporting industries to Savan-Seno SEZ and providing housing to workers at Savan-Seno SEZ. Savannakhet will also provide administration service to Savannakhet Province which is the most populous province in Lao PDR.

The other three provincial towns will work as the centers of administration and commercial services in each province. Substantial development is expected in these towns. Urban development in the study area was observed in these towns.

(2) Agricultural Development

Lao PDR had achieved self-sufficiency in rice production in 1999. In accordance with economic development, expected role of agriculture is changing from securing basic food to cultivating commercial cash crops. In this regard, agricultural development around Boloven Plateau is a progressive effort. Currently, plantations are being established along NR-20, NR-16 and NR-18B. Most of the plantations cultivate coffee beans while others cultivate natural rubber and vegetables. It is expected that production in the plantations will be diversified so as to supply variety of

[2] Private companies are preparing plans to develop industrial estates at Pakse.

vegetables and fruits to the cities in the GMS.

(3) Industrial Development

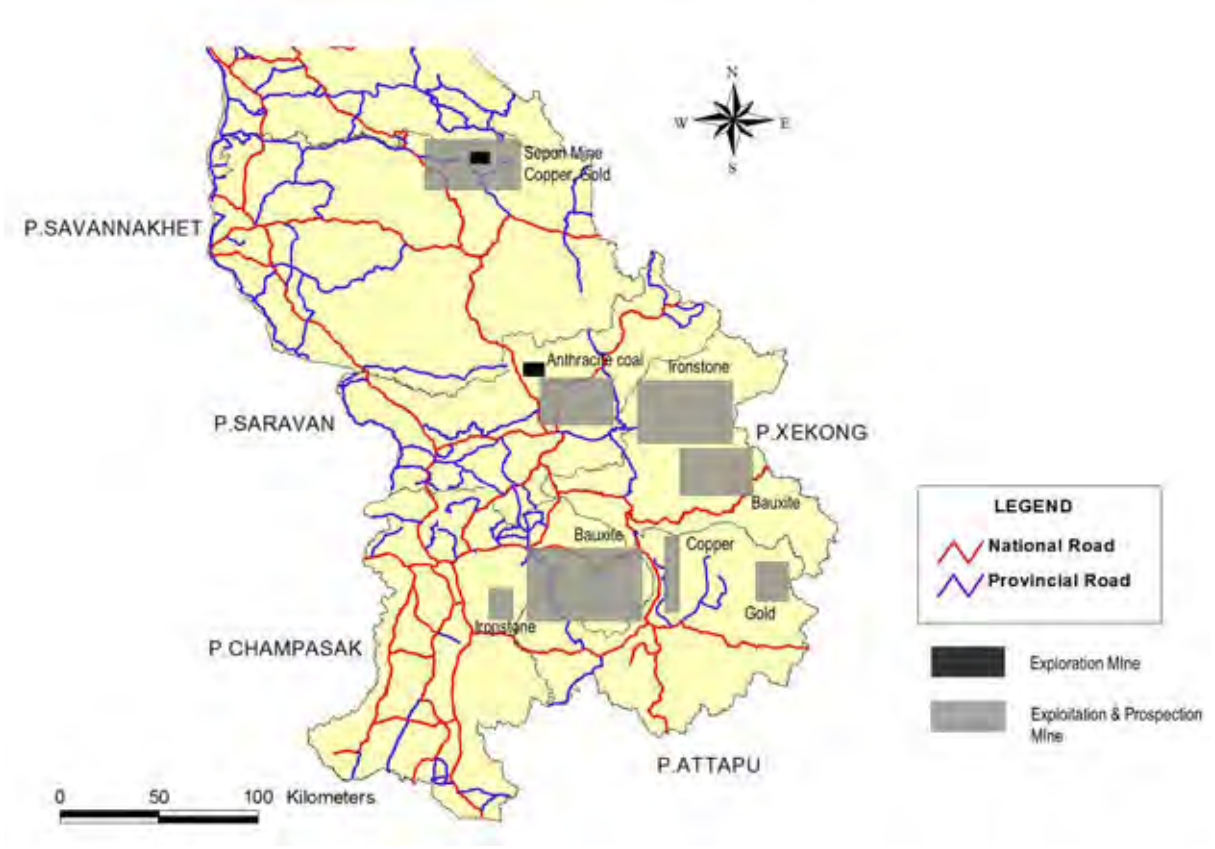
The industrial development zone in Pakse and Savan-Seno SEZ will continue to be centers for the manufacturing industry in the future. There exists the prospect of these industrial zones inviting investors in electrical parts and machine parts production from Bangkok and the eastern seaboard of Thailand. The other potential industry is the processing of nonferrous metals by use of rich mineral resources and cheap electricity. The supporting industry will also be located around Pakse and Savannakhet. The residential area for the workers will also be developed around these towns.

Regarding the mining industry, Xepone Mine will continue to play an important role in the production and export of copper and gold for the coming 30 years, considering its deposits and production capacity. Saravane, Champasak and Sekong have many existing and prospective mines. Figure 3.2.1 shows the mining sites in the study area. Bauxite which is exploited at Champasak and Sekong is a potential mining resource in the future. China is the biggest producer of Aluminium: it produced 13 million tons in 2008[3]. However, Vietnam and Cambodia also have potential sites for Bauxite mines, and some of the mining sites have already been opened up for exploitation. For these reasons, mining of bauxite will face severe price competition in the future. The situation is the similar for other mineral resources.

The other issue pertaining to mining development is coordination with other sectors. In particular, Boloven Plateau, which is a potential site for bauxite exploitation, is also a potential site for agricultural development. Therefore it is necessary to coordinate future land use for these projects.

Having considered these points, it is expected that exploitation of these mineral resources will be conducted and will contribute to the regional development in the future.

[3] World aluminum production volume was 39 million ton in 2008. The one third of the world production was in China.



Source: 1/1,000,000 Concession Map from Department of Geology, Ministry of energy and Mines

Figure 3.2.1 Mining Sites in the Study Area

Currently, 11 hydropower plants are operated in Lao PDR. 4 of these are located in the study area. Table 3.2.9 indicates operated, constructed and planned hydropower plants in the study area. There are 2 constructed and 9 planned (Project Development Agreement signed) hydropower plant projects in the study area. These hydropower plant projects will not contribute significantly to employment generation and regional development in the operational stage. However, they will require labour force and connection roads during their construction. Construction of these hydropower plants will have significant impact on the regional development.

Table 3.2.9 Hydropower Plants in the Study Area

Name	Location (Province)	Installed Capacity	Status	Year of Starting Operation	Investors	Market
Houay Ho	Champasak/Attapeu	150MW	In Operation	1999	Belgium/EDL/Thailand	Thailand
Selabam Hydropower	Champasak	5MW	In Operation	1970	EDL	Laos
Se Xet 1	Saravane	45MW	In Operation	1990	EDL	Laos/Thailand
Se Xet 2	Saravane	76MW	In Operation	2009	EDL	Laos/Thailand
Tad Salen Hydropower	Savannakhet	3.2MW	Under Construction	TBD	Thailand	Laos
Xekhaman 3 Hydropower	Sekong	250MW	Under Construction	2010	EDL/Vietnam	Laos/Vietnam
Don Sahong (Mekong)	Champasak	360MW	PDA signed	2015	Malaysia/Laos Gov	Laos/Thailand
Nam Kong 1	Attapeu	75MW	PDA signed	2012	Russia/LHSE	Thailand or Vietnam or Laos
Nam Phak	Champasak	75MW	PDA signed	TBD	Japan/EDL	Laos
Sekong 4	Sekong	300MW	PDA signed	2013	Russia/LHSE	NA
Sekong 5	Sekong	400MW	PDA signed	TBD	Russia/LHSE	Thailand or Vietnam or Laos
Xepian-Xenamnoy	Attapeu and Champasak	390MW	PDA signed	2015	Korea/Thailand/LHSE	Thailand
Xe Katam	Champasak	61MW	PDA signed	2012	Japan/Thailand/Lao Gov	Laos
Xekaman 1	Attapeu	322MW	PDA signed	2013	Vietnam/Laos Gov	Vietnam/Laos
Xelanong 2	Saravane	60MW	PDA signed	TBD	Japan/Laos Gov	Laos

Note: TBD To be decided; PDA Project Development Agreement

Source: Poweringprogress web page (http://www.poweringprogress.org/)

(4) Tourism Development

Wat Phou and Si Phan Don are international-level tourist sites. Expansion of the Pakse Airport will enable the connection of Pakse and the surrounding tourism resources with other World Heritage sites such as Luang Prabang and Siem Riap. Pakse will be a gateway for the tourism sites in the southern region. In accordance with the tourism development around Pakse, a new tourism circuit connecting Wat Phou, Si Phan Don with Boloven Plateau will be developed.

The other potential of tourism development will be one-stop sites for international tourists from Thailand to Vietnam and from Vietnam to Thailand. Savannakhet is the largest one-stop site, and small towns along National Road No 9 will also work as one-stop sites.

3.2.4 Socio-economic Framework

(1) Population

The national socio-economic framework has already been proposed in the preceding JICA Studies, namely: Industry Development Study, Logistics Study, and Study on Regional Core Cities. Table 3.2.10 and Figure 3.2.2 show population projection until 2030 at national level.

Table 3.2.10 Population Projection until 2030

	2005	2010	2015	2020	2025	2030
Population (000 persons)	5,622	6,133	6,696	7,286	7,874	8,417
Annual average population growth rate (%)		1.8	1.8	1.7	1.6	1.3

Source: JICA Study Team (Industrial Development Study, Logistics Network Study and Study on Regional Core Cities)

The population projection is calculated from the cohort method with a total fertility rate (TFR) and death rate prepared by UN population Division. Population of Lao PDR will increase by 2.8 million in 25 years, from 5.6 million in 2005 to 8.4 million in 2030.

Table 3.2.1 and Figure 3.2.2 indicate changes in urban population and rural population until 2030. The figures are calculated based on an assumption that the urban proportion will increase by 40% of the total by 2025, and by 43.5% by 2030. This estimation is similar to the projection of "World Urbanization Prospects", which describes that the percentage of urban population will increase from 27.4% in 2005 to 49.0% in 2025, and 53.1% in 2030. In addition to that, arable land per rural inhabitant is 0.19 ha in Lao PDR, which is lower than Thailand, Cambodia and Myanmar, according to "The Status of Food and Agriculture" published by Food and Agriculture Organization of the UN (FAO). Due to the demographic pressure, shift of population from rural areas to urban areas would continue.

Table 3.2.11 Urban Population and Rural Population

(Unit: 000 persons)

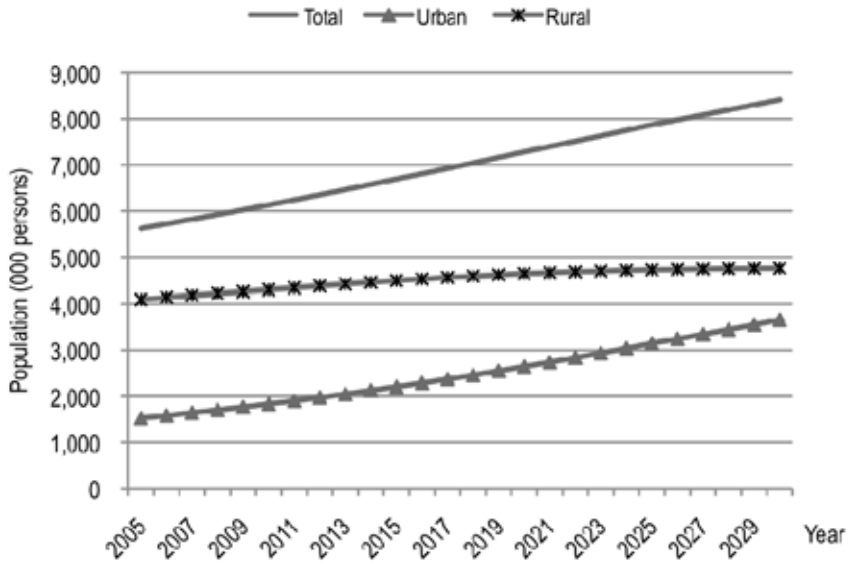
Year	Total Population	Urban Population	Rural Population
1995	4,575	782	3,793
2005	5,622	1,523	4,092
2015	6,696	2,204	4,491
2025	7,874	3,149	4,724

Source: Census 1995 and 2005; JICA Study Team (Industrial Development Study, Logistics Network Study and Study on Regional Core Cities)

Table 3.2.12 Arable Land per Rural Inhabitant in 2004

	Arable land per rural inhabitant (ha)
Lao PDR	0.19
Thailand	0.37
Vietnam	0.10
Cambodia	0.32
Myanmar	0.28

Source: State of Food and Agriculture, Food and Agriculture Organization of the United Nations



Source: JICA Study Team (Industrial Development Study, Logistics Network Study and Study on Regional Core Cities)

Figure 3.2.2 Change of Total Population, Urban Population and Rural Population

Table 3.2.13 indicates population by provinces up to 2025. The projection is calculated by breaking down urban population and rural population into the associated figures at provincial level.

In Vientiane Capital, population will amount to 1.2 million in 2025, an increase by 1.8 times in 20 years. Savannakhet with 1.1 million inhabitants, Champasak with 0.9 million and Vientiane with 0.6 million will follow Vientiane Capital. Future population will concentrate in the plain region in Vientiane Capital and along the Mekong River and NR 13. On the other hand, population increase will be limited in mountainous provinces. Table 3.2.14 is the breakdown of the population into figures at district level.

Table 3.2.13 Population by Provinces up to 2025 (Unit: 000 persons)

Province	1995	2005	2015	2025
Vientiane Capital	524	692	927	1,244
Phongsaly	153	166	202	220
Luangnamtha	115	145	201	268
Oudomxay	210	265	291	331
Bokeo	114	145	157	205
Luangprabang	365	407	470	504
Huaphanh	245	281	314	315
Xayaboury	292	339	380	441
Xiengkhuang	210	241	291	331
Vientiane	331	417	492	567
Borikhamxay	164	225	268	315
Khammuane	272	337	380	441
Savannakhet	672	826	983	1,134
Saravane	256	324	358	394
Sekong	64	85	112	126
Champasak	501	607	760	913
Attapeu	87	112	112	126
Total	4,575	5,615	6,696	7,874

Source: JICA Study Team

Table 3.2.14 Population of Districts in the Study Area to 2020

Province	District	Population (persons)			Share (%)			
		2005	2015	2025	2005	2015	2025	Annual Average Population growth Rate 2005-20 (%)
Savannakhet	Khanthabouly	112,915	139,000	190,000	14	14	17	2.6
Savannakhet	Outhoomphone	80,516	99,600	116,100	10	10	10	1.8
Savannakhet	Atsaphangthong	39,102	46,300	54,600	5	5	5	1.7
Savannakhet	Phine	50,784	60,100	67,200	6	6	6	1.4
Savannakhet	Sepone	43,046	51,000	57,000	5	5	5	1.4
Savannakhet	Nong	21,106	21,600	22,300	3	2	2	0.3
Savannakhet	Thapangthong	31,497	37,300	41,700	4	4	4	1.4
Savannakhet	Songkhone	82,461	97,600	107,300	10	10	9	1.3
Savannakhet	Champhone	101,559	120,200	132,600	12	12	12	1.3
Savannakhet	Xonbuly	51,472	61,000	65,300	6	6	6	1.2
Savannakhet	Xaybuly	54,441	64,500	72,100	7	7	6	1.4
Savannakhet	Vilabuly	30,264	32,500	32,500	4	3	3	0.4
Savannakhet	Atsaphone	50,448	59,700	66,800	6	6	6	1.4
Savannakhet	Xayphoothong	44,557	55,300	66,500	5	6	6	2.0
Savannakhet	Thaphalanxay	31,734	37,600	42,000	4	4	4	1.4
Total of Savannakhet		825,902	983,300	1,134,000	100	100	100	1.6
Saravane	Saravane	85,875	96,600	108,300	26	27	27	1.2
Saravane	Ta oi	22,198	23,400	24,600	7	7	6	0.5
Saravane	Toomlarn	21,812	23,000	24,100	7	6	6	0.5
Saravane	Lakhonepheng	37,966	43,700	50,100	12	12	13	1.4
Saravane	Vapy	31,979	34,200	36,500	10	10	9	0.7
Saravane	Khongxedone	54,062	61,500	69,600	17	17	18	1.3
Saravane	Lao ngarm	58,685	63,700	68,900	18	18	17	0.8
Saravane	Samuoi	11,750	11,900	11,900	4	3	3	0.1
Total of Saravane		324,327	358,000	394,000	100	100	100	1.0
Sekong	Lamarm	26,584	35,800	41,600	31	32	33	2.3
Sekong	Kaleum	12,869	16,300	17,400	15	15	14	1.5
Sekong	Dakcheung	18,461	23,700	25,600	22	21	20	1.6
Sekong	Thateng	27,081	36,200	41,400	32	32	33	2.1
Total of Sekong		84,995	112,000	126,000	100	100	100	2.0
Champasak	Pakse	78,669	108,000	158,000	13	14	17	3.5
Champasak	Sanasomboon	62,238	78,300	90,600	10	10	10	1.9
Champasak	Bachiangchaleunsook	48,743	62,000	75,500	8	8	8	2.2
Champasak	Paksxong	64,145	84,800	105,700	11	11	12	2.5
Champasak	Pathoomphone	51,370	58,700	64,200	8	8	7	1.1
Champasak	Phonthong	85,188	104,400	120,700	14	14	13	1.8
Champasak	Champasack	55,403	68,500	79,300	9	9	9	1.8
Champasak	Sukhuma	49,670	58,700	64,200	8	8	7	1.3
Champasak	Moonlapamok	38,525	45,700	49,100	6	6	5	1.2
Champasak	Khong	73,419	91,200	105,700	12	12	12	1.8
Total of Champasak		607,370	760,300	913,000	100	100	100	2.1
Attapeu	Xaysetha	28,359	28,430	33,000	25	25	26	0.8
Attapeu	Samakkhixay	30,182	30,250	35,000	27	27	28	0.7
Attapeu	Sanamxay	26,344	26,410	29,000	23	23	23	0.5
Attapeu	Sanxay	16,515	16,560	18,000	15	15	14	0.4
Attapeu	Phouvong	10,720	10,750	11,000	10	10	9	0.1
Total of Attapeu		112,120	112,400	126,000	100	100	100	0.6

Source: JICA Study Team

(2) Economy

In regard to the national economic development, an average growth scenario, as indicated inTable 3.2.15, and Figure 3.2.3, was prepared through analysis of different development alternatives. After the recession in 2010, GDP growth rate will recover to the level before the Global Financial Crisis, and a 7.5% average growth rate is assumed until 2020. After that the average growth rate will decrease gradually in accordance with maturity of economy and decrease of population growth rate.

Table 3.2.15 GDP Growth Scenarios until 2030

(Unit: percent)

	2010	2011-20	2021-25	2025-30
Average GDP Growth Rate	6.0	7.5	7.0	6.5

Source: JICA Study Team (Industrial Development Study, Logistics Network Study and Study on Regional Core Cities)

Real GDP will increase by 4.4 times in 22 years from LAK 44 trillion in 2008 to LAK 205 trillion in 2030. Real GDP per Capita will also increase by 3 times from USD 891 in 2008 to USD 2,779 in 2030 as indicated in Figure 3.2.3.

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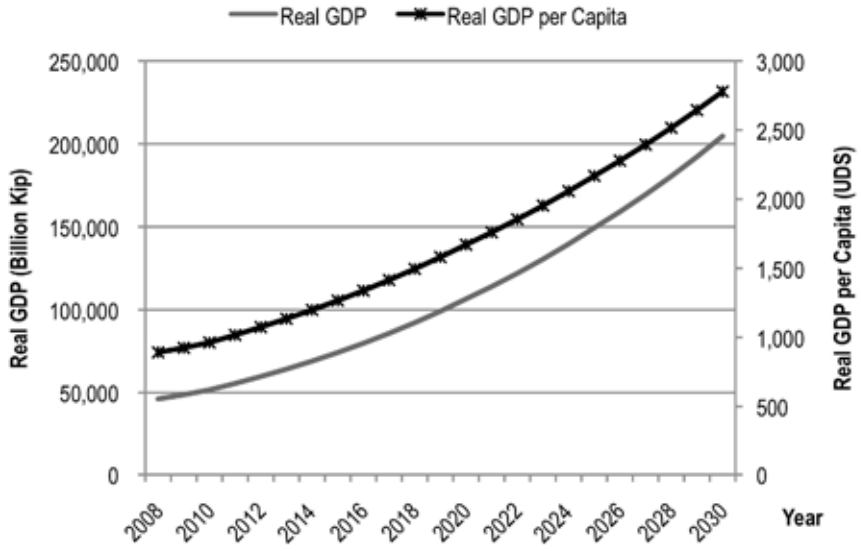


Source: JICA Study Team (Industrial Development Study, Logistics Network Study and Study on Regional Core Cities)

Figure 3.2.3 GDP Growth Scenarios until 2030

Official data of regional or provincial Gross Regional Domestic Products (GRDP) has not been prepared in Lao PDR. Therefore, JICA Study Team estimated the provincial GRDP, using "The Household Lao PDR Social and Economic Indicators Lao Expenditure and Consumption Survey 20002/03" (hereinafter referred as "LECS 3") and "Report of Economic Census, 2006".

indicates GRDP by provinces in 2008, 2015 and 2025. Figures in 2008 were calculated from the methodology mentioned above. Vientiane Capital contributes about 23% of the GDP followed by Savannakhet with a 12% contribution and Champasak with 10%. The figures in 2015 and 2025 were set from future development potential and population growth.

The fifth to seventh column of Table 3.2.16 indicates GRDP per capita measured in USD in 2008. The GDP per capita in Vientiane Capital will exceed USD 2,000 by 2015 and USD 3,500 by 2025. GDP per capita in Vientiane Province, Xayabury, Luangnamtha Champasak will exceed GDP per capita at the national level (USD 2,168) by 2025. On the other hand, GDP per capita in Saravane, Xiengkhung and Huaphanh will remain at a lower level than the national average.

Table 3.2.16 Change of GRDP and GRDP per Capita

Province	GRDP (bill kip in 2008)			GRDP per capita (USD in 2008)		
	2008	2015	2025	2008	2015	2025
Lao PDR	46,215	74,196	149,397	891	1,266	2,168
Phongsaly	896	1,484	2,988	579	841	1,549
Luangnamtha	1,118	2,226	5,976	789	1,266	1,913
Oudomxay	1,533	2,226	4,482	642	875	1,549
Bokeo	972	1,484	2,988	747	1,081	1,668
Luangprabang	3,448	5,194	8,964	925	1,264	2,032
Huaphanh	1,703	2,226	2,988	669	811	1,084
Xayabury	3,054	5,194	10,458	994	1,563	2,710
Vientiane Capital	10,574	17,807	37,349	1,585	2,194	3,568
Xiengkhuang	1,653	2,226	2,988	739	875	1,032
Vientiane	3,961	6,678	14,940	1,030	1,552	3,011
Borikhamxay	1,851	2,968	5,976	888	1,266	2,168
Khammuane	2,407	3,710	7,470	786	1,116	1,936
Savanakhet	5,499	8,904	16,434	720	1,035	1,656
Saravane	1,607	1,484	2,988	549	709	1,301
Sekong	450	742	1,494	552	758	1,355
Champasak	4,736	8,904	19,422	828	1,227	2,243
Attapeu	736	742	1,494	751	758	1,355

Source: JICA Study Team

3.3 Traffic Demand Forecast

3.3.1 Review of the Previous Master Plan

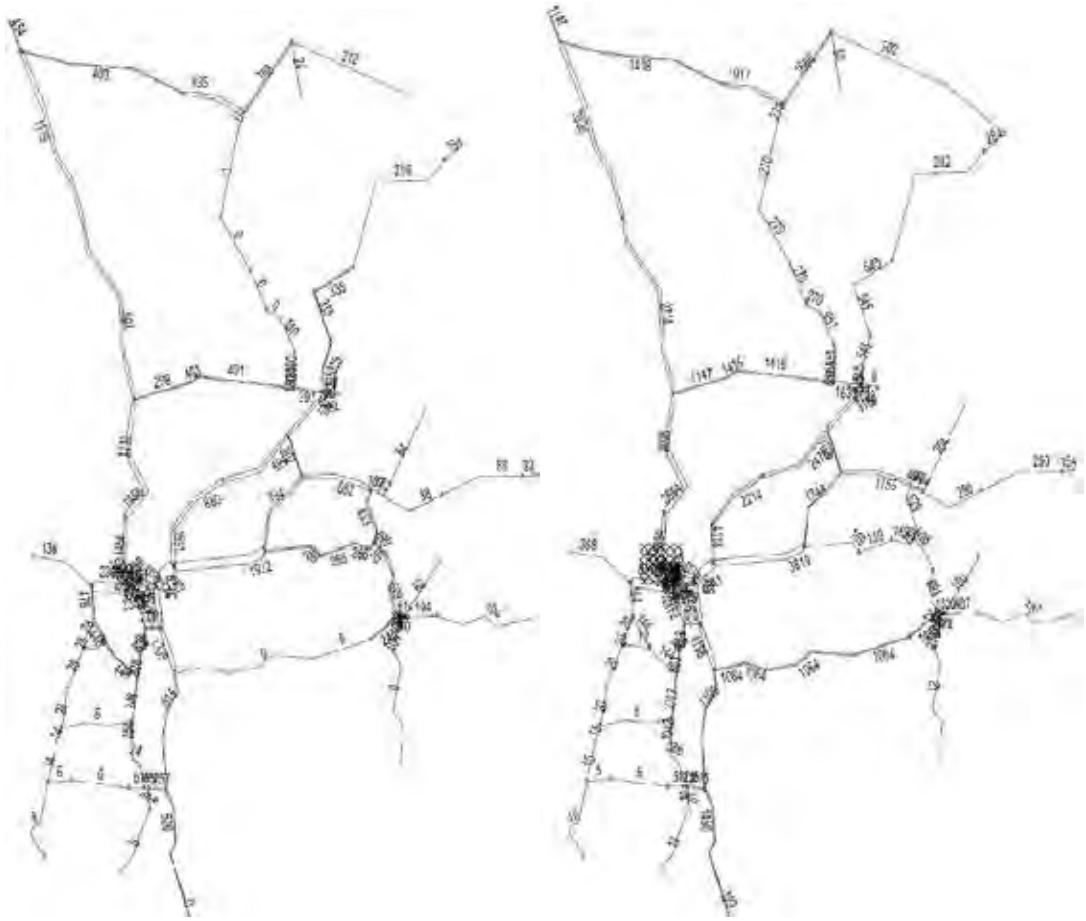
(1) Review of the Previous Master Plan

In the previous master plan prepared in 2003, existing (2001) and future (2007 and 2020) traffic demands were forecasted. The outline of traffic demand in the previous study is summarized as follows.

- Traffic analysis zone is defined by district boundary, and the study area is divided into 30 traffic analysis zones, excluding 12 of the 15 districts in Savannakhet.
- Road network for the traffic assignment consists of national roads only. Road network conditions such as capacity and free flow speed were defined by the road geometry, terrain, and land use based on the road design standard of Lao and the results of travel time survey at 36 road sections.
- Existing vehicular OD matrices in 2001 were built based on the results of 12 hours traffic count survey and roadside OD interview survey at 15 locations. The OD matrices consist of 5 modes, including light vehicle, bus, motorcycle, heavy and medium truck.
- A control total of future vehicular trip in the study area was estimated by the current total of vehicular trip and GDP growth rate. GDP growth rate was estimated at approximately 7.3% p.a. between 2001and 2020.
- Based on the estimated 2001 OD matrices, vehicular trip generation model including vehicle registration or GRDP as explanatory variables was estimated.

- Vehicular trip distribution model was estimated by gravity model including trip generation and distance between origin and destination zones.
- Modal split model was not constructed because of low public transport services and low capability to shift to private vehicle.
- Incremental traffic assignment model was used for traffic assignment model for the estimation of traffic volume by each road link.

As a result of traffic demand forecast, traffic volumes in 2007 (Base Case) and 2020 (Scenario 1: All roads in the Study Area are improved) were forecasted in the previous master plan (see Figure 3.3.1) The most congested road sections are observed along NR-13, NR-18 and NR-16 in Pakse.



Source: Improvement of Roads in the Southern Region in Lao PDR (JICA, 2003).

Note: The traffic volumes are PCU/day.

Figure 3.3.1 Forecasted Traffic Volume in 2007 (Left) and 2020 (Right) by Previous Master Plan

(2) Approach and Methodology Applied to this Study

In the Comprehensive Study on Logistics System in Lao PDR (JICA, ongoing), transport network and OD Matrices were built by updating those prepared by the GMS Transport Sector Study (ADB, 2006). The total length of network prepared in logistics study is 93,800 km. The GSM countries were divided into 254 traffic analysis zones. The OD matrices consist of 9 vehicular modes (motorcycle, passenger car, bus, loading and empty light truck, medium truck and trailer) in the

year of 2009 and 2015, 2025.

For the traffic demand forecast in this Study, road networks and OD matrices prepared in the logistics system study were utilized in the manner described below.

- Modification of road network: On-going and planned road improvement projects in the study area were included in the current and future road network. The road network was modified in order to maintain zonal connectivity.
- Confirmation of road network condition: Road network condition such as free flow speed and road capacity was defined as shown in Table 3.3.1. This was applied to the logistics study. In Lao PDR, basically, national roads corresponding to ASIAN Highway were defined as road class III, and other national roads as road class IV.
- Division of traffic analysis zone: The zone system in the existing network and OD matrices in the logistics study was prepared based on the provincial boundary. For the detailed demand forecast in the study area, provincial zone in the study area was divided into district zones. As a result, the total number of traffic analysis zones was 291 zones in the GMS while the study area consisted of 42 zones.
- Update of OD matrices: Based on the results of traffic count survey, existing OD matrices as of 2009 were updated and calibrated. Based on the calibrated existing OD matrices, future OD matrices were also forecasted by the Frater growth factor method.

Table 3.3.1 Defined Free Flow Speed (km/hour)

Type of Link	Good Quality			Fair Quality			Poor Quality		
	Level	Rolling	Mountainous	Level	Rolling	Mountainous	Level	Rolling	Mountainous
Priority Road	112	96	80	96	80	64	80	64	48
Priority Plus Road	112	96	80	96	80	64	80	64	48
Class I	90	72	66	72	60	54	54	48	42
Class I/II	87	72	63	72	60	51	57	48	39
Class II	84	72	60	72	60	48	60	48	36
Class II/III	74	66	58	63	55	47	52	44	36
Class III	65	60	55	55	50	45	45	40	35
Class III/IV	59	54	50	50	45	41	41	36	32
Class IV	52	48	44	44	40	36	36	32	28

Source: JICA Study Team

Table 3.3.2 Defined Road Capacity (PCU / day)

Type of Link	Good Quality			Fair Quality			Poor Quality		
	Level	Rolling	Mountainous	Level	Rolling	Mountainous	Level	Rolling	Mountainous
Priority Road	102,900	82,320	61,740	72,030	57,624	43,218	41,160	32,928	24,696
Priority Plus Road	171,400	137,120	102,840	119,980	95,984	71,988	68,560	54,848	41,136
Class I	80,000	64,000	48,000	56,000	44,800	33,600	32,000	25,600	19,200
Class I/II	60,000	48,000	36,000	42,000	33,600	25,200	24,000	19,200	14,400
Class II	23,500	18,800	14,100	16,450	13,160	9,870	9,400	7,520	5,640
Class II/III	20,000	16,000	12,000	14,000	11,200	8,400	8,000	6,400	4,800
Class III	16,000	12,800	9,600	11,200	8,960	6,720	6,400	5,120	3,840
Class III/IV	9,300	7,440	5,580	6,510	5,208	3,906	3,720	2,976	2,232
Class IV	7,000	5,600	4,200	4,900	3,920	2,940	2,800	2,240	1,680

Source: JICA Study Team

Source: JICA Study Team

Figure 3.3.2 Road Network and Zoning System for the Traffic Demand Forecast

3.3.2 Traffic Demand Forecast

Future traffic demand in the study area was forecasted by the procedure shown in Figure 3.3.3.

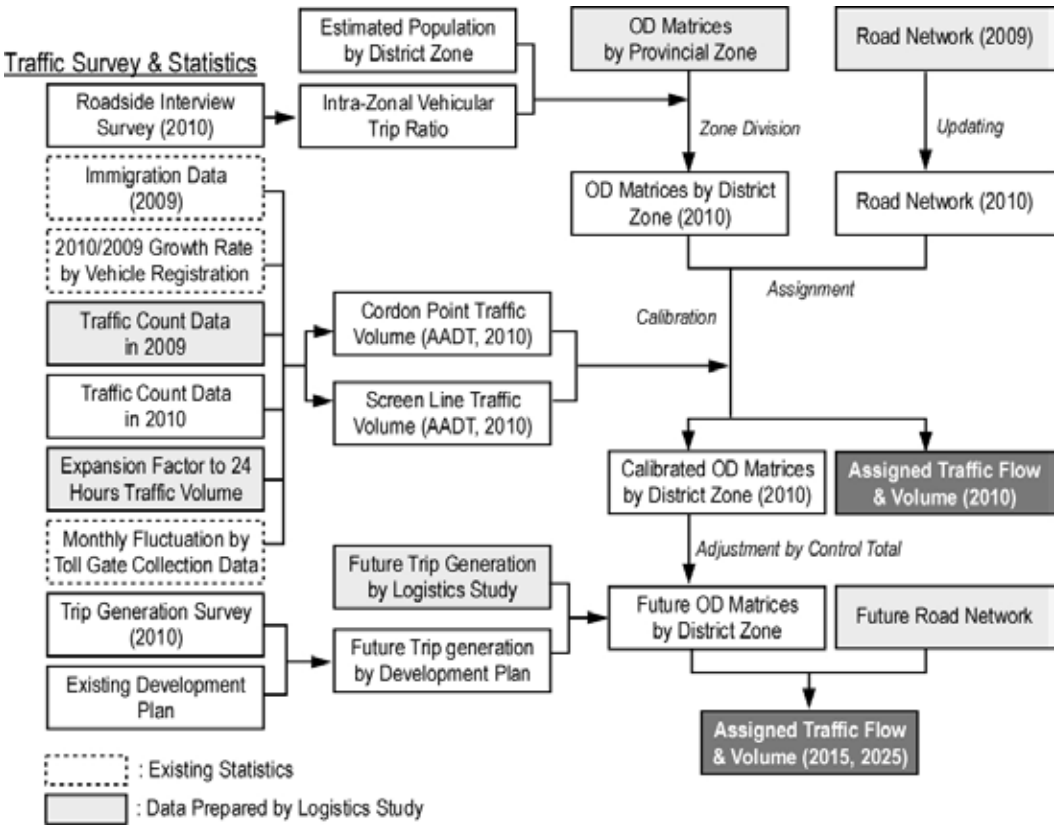
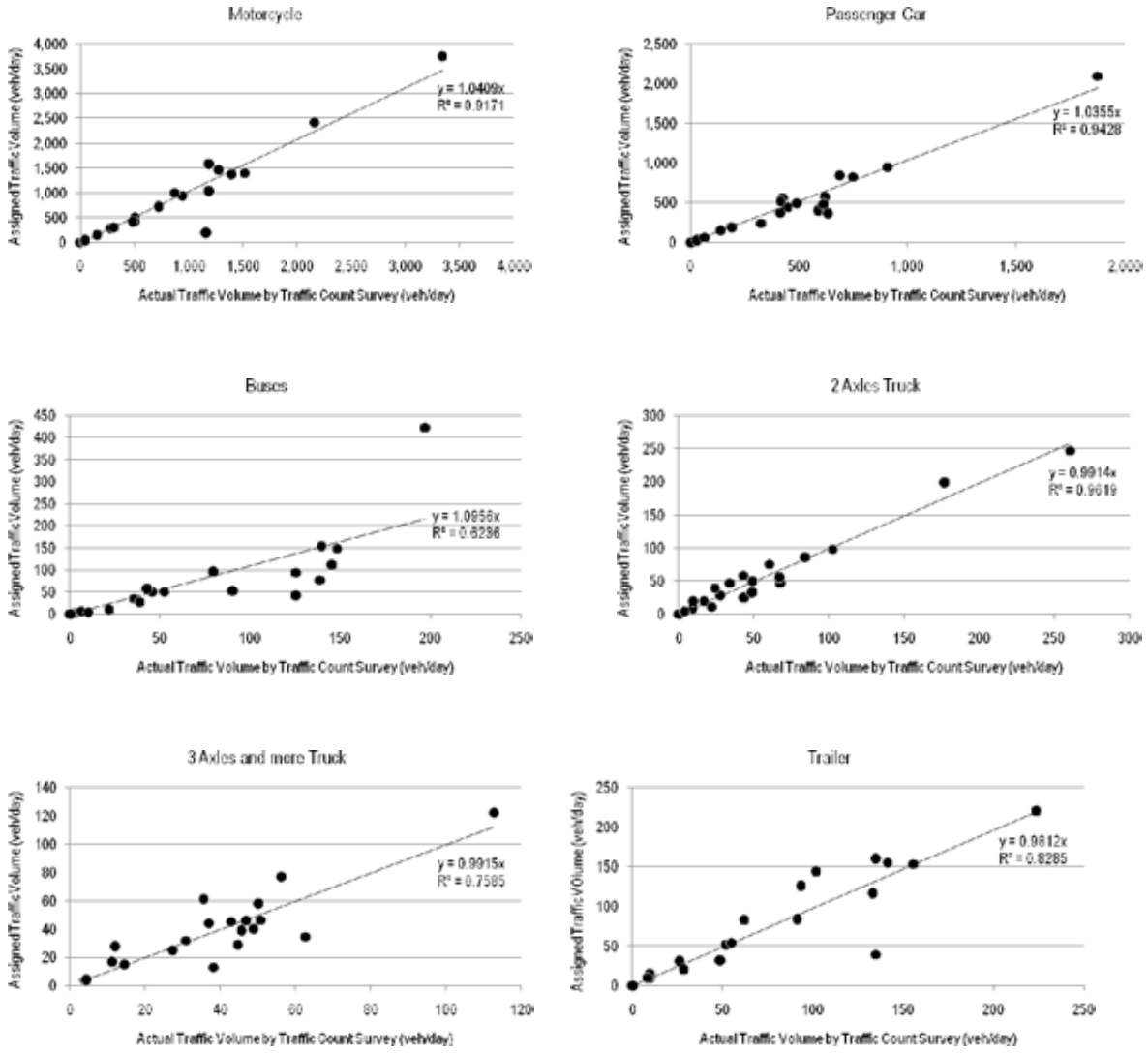


Figure 3.3.3 Traffic Demand Forecast Flow

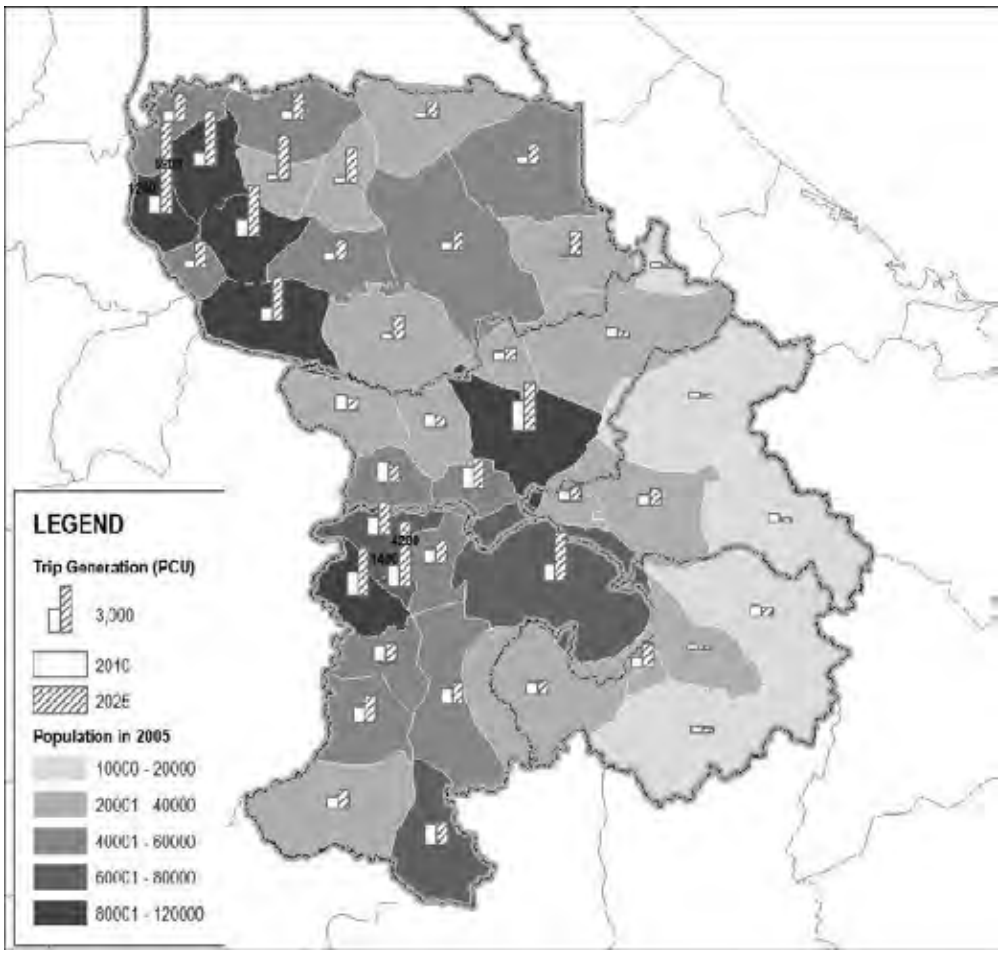
Figure 3.3.4 shows the traffic assignment volume of 2010 calibrated OD matrices and actual traffic count survey results. An extraordinary figure for the bus traffic volume was observed at the location near Seno.



Source: JICA Study Team

Figure 3.3.4 Results of 2010 OD Matrices Calibration

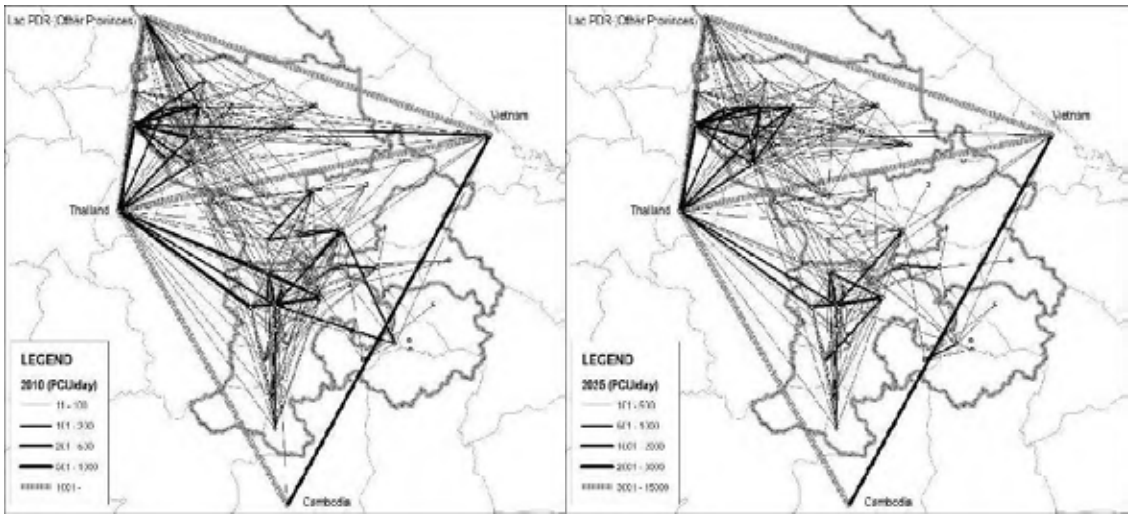
Figure 3.3.5 shows the estimated trip generation in 2010 and 2025. In 2025, trip generation will increase remarkably at Savannakhet, Champasak and Saravane.



Source: JICA Study Team

Figure 3.3.5 Trip Generation

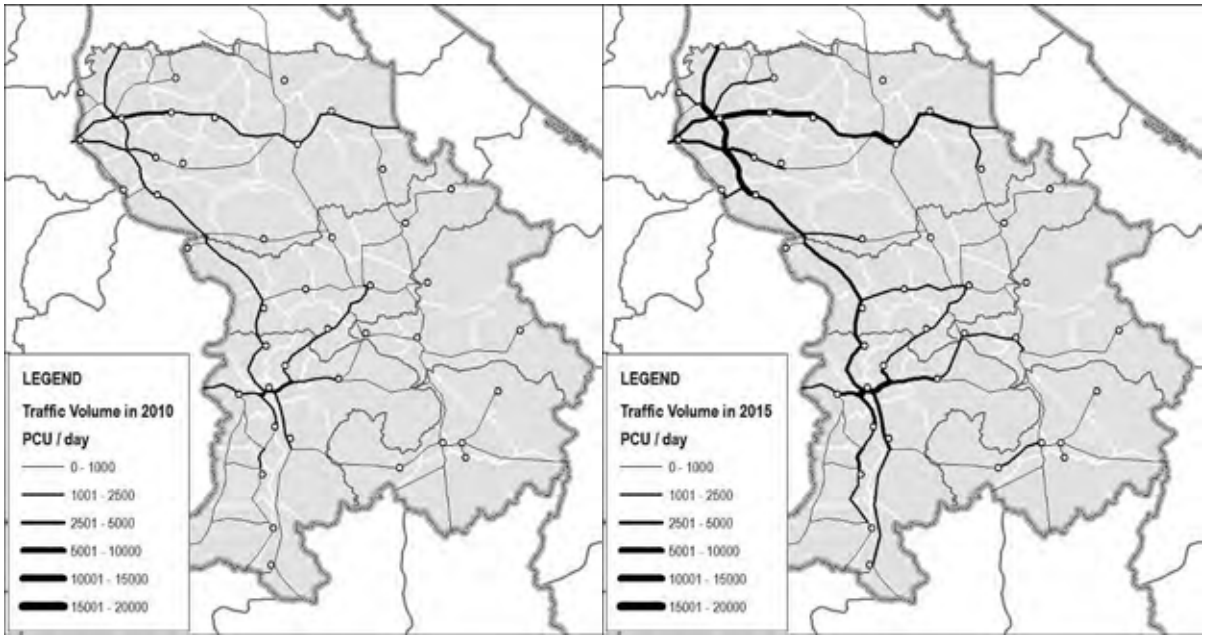
Figure 3.3.6 shows desire lines of forecasted OD matrices in 2010 and 2025. The structure of the study area exhibits two core centers, namely: Savannakhet and Champasak. In the future, this structure will persist.

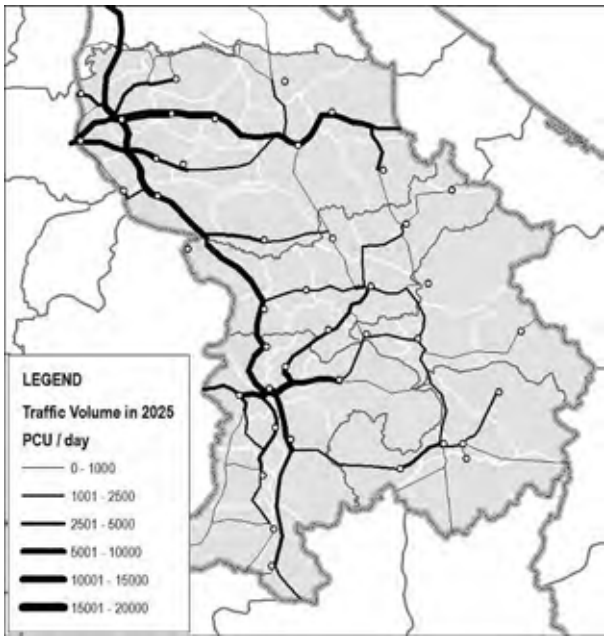


Source: JICA Study Team

Figure 3.3.6 Desire Line

Figure 3.3.7 shows the results of traffic assignment in 2010 and 2025. Large traffic volumes are observed along NR-9, NR-13S and NR-16. In 2025, the largest traffic volume, exceeding 18000 pcu/day in both directions, will be observed at NR-13S (Pakse - Houaysae).





Source: JICA Study Team

Figure 3.3.7 Forecasted Traffic Volume

Table 3.3.3 shows forecasted traffic volumes and volume capacity ratios at major roads and bridges in the study area.

Table 3.3.3 Assigned Traffic Volume at Major National Roads

Road		2010		2015		2025	
		Ave. PCU/day	Ave. VCR	Ave. PCU/day	Ave. VCR	Ave. PCU/day	Ave. VCR
NR-9		1,768	(0.13)	4,725	(0.31)	7,511	(0.56)
NR-1G		99	(0.05)	463	(0.10)	892	(0.19)
	Bridge	0	(0.00)	375	(0.09)	673	(0.16)
NR-15A		619	(0.25)	1,772	(0.29)	4,187	(0.68)
	Sedone Bridge	519	(0.19)	1,705	(0.24)	4,010	(0.57)
NR-15B		251	(0.13)	621	(0.13)	1,382	(0.25)
NR-16A		39	(0.02)	23	(0.00)	141	(0.03)
NR-16B		112	(0.07)	184	(0.04)	383	(0.09)
	Sekong Bridge	147	(0.09)	240	(0.06)	500	(0.12)
NR-18A		43	(0.02)	959	(0.17)	2,007	(0.36)
NR-1J		9	(0.00)	60	(0.02)	132	(0.04)
	Sekaman Bridge	42	(0.01)	291	(0.04)	646	(0.09)
NR-14A		604	(0.22)	1,527	(0.22)	2,853	(0.41)
NR-14B		45	(0.02)	0	(0.00)	397	(0.06)
NR-14C		47	(0.02)	0	(0.00)	256	(0.03)
NR-20		1,374	(0.25)	2,383	(0.43)	4,773	(0.80)
NR-1F		59	(0.03)	633	(0.11)	1,066	(0.19)

Source: JICA Study Team

3.4 Road Development and Improvement Master Plan

3.4.1 Review of the Road and Bridge Development Plan

The MPWT is now in the process of preparing the Strategic Plan for Transport Sector Development for the period 2008-2010 and Direction for 2011-2015. It elaborates and translates the main objectives defined by the 6th 5-year Plan into detailed action plans to be implemented as well as giving direction for the period running from 2011 to 2015. The strategy includes prioritization and estimation of costs for sector development based on needs proposed by provinces, forecasted resources available during the planned period, government's multiple criteria and economic efficiency of each project investment.

1) Development Goal

The development goals in the transport strategic plan are set out as follows:

- Maximized use of the potential of the country, which is located in the hub of the sub-region, to facilitate transport and economic corridors.
- Development of multimodal transport serving international and domestic transport.
- Giving high priority to preservation of existing roads while paying attention to the expansion and improvement of roads including north-south linked roads along Mekong and the border to the east.

- Development and modernization of transport services and improved efficiency of cross-border transport services, thus improving the country's competitiveness.

2) Targets for Infrastructure Development

- Properly preserve the existing road network.
- Improve the core road network to the standard of the neighboring countries and upgrade the sections of national roads which serve high volumes of traffic.
- Improve the condition of provincial, district, and rural roads connecting poor districts and rural villages to the level where they are accessible throughout the year.

3.4.2 Study Road and Bridge

(1) Summary of Road Network in Southern Region

National roads in the study area stretch into a network over the southern region that reaches a total length of 2,289 km. As of May 2010, six road and bridge projects in the study area, namely, NR-14A, Sekaman Bridge, NR-15B, NR-16A, NR-16B and NR-18A were all under implementation. However, in spite of the above on-going investment in improving the road network, most parts of the national roads remain unpaved. All national roads in the study area, excluding NR-9, were studied in the previous master plan. As was the case with the previous master plan study, the current study was also limited to national roads as listed in Table 3.4.1.

Table 3.4.1 Road Network in the Southern Region

Route	Origin	Province	Destination	Province	Road Length (km)	Road Condition
NR-9	Savannakhet	Savannakhet	Border of Vietnam	Savannakhet	244.0	Paved
NR-1F	Junction of Route 9	Savannakhet	Junction of Route 12	Khammuane	157.0	Unpaved
NR-1G	Junction of Route 9	Savannakhet	Junction of Route 15	Saravane	130.0	Unpaved
NR-1H	Junction of Route 15	Saravane	Junction of Route 16	Saravane	44.5	Paved
NR-1I	Junction of Route 18	Sekong	Junction of Route 18A	Attapeu	76.6	Paved
NR-1J	Junction of Route 16B	Attapeu	Border of Cambodia	Attapeu	81.0	Unpaved
NR-13S	Junction of Route 9	Savannakhet	Border of Cambodia	Champasak	395.0	Paved
NR-14A	Phone Thong Dist.	Champasak	Border of Cambodia	Champasak	137.5	Partially paved
NR-14A1	Ban Ang Kham	Champasak	Ban Don Talath	Champasak	32.0	Unpaved
NR-14B	Junction of Route 16	Champasak	Border of Cambodia	Champasak	149.0	Unpaved
NR-14C	Ban Nong Nga	Champasak	M. Moonlapa -mok	Champasak	42.0	Unpaved
NR-14C1	Ban Hieng	Champasak	Ban Sam Kha	Champasak	23.0	Unpaved
NR-14C2	Ban Phong Photh	Champasak	Ban Nong Te	Champasak	6.0	Unpaved
NR-15A	Junction of Route 13S	Saravane	Junction of Route 1H	Saravane	73.0	Unpaved
NR-15B	Junction at Ban Phone Dou	Saravane	Border of Vietnam	Saravane	165.0	Partially paved
NR-16	Border of Thailand	Champasak	Lamarm	Sekong	172.0	Paved
NR-16B	Lamarm	Sekong	Border of Vietnam	Sekong	123.0	Unpaved
NR-16A	Junction of Route 16	Champasak	Junction of Route 1I	Champasak	71.0	Unpaved
NR-18A	Junction of Route 13S	Champasak	Junction of Route 18B	Attapeu	112.5	Unpaved
NR-18B	Junction of Route 18A	Attapeu	Border of Vietnam	Attapeu	123.0	Paved

Route	Origin	Province	Destination	Province	Road Length (km)	Road Condition
NR-20	Junction of Route 16	Champasak	Junction of Route 1H	Saravane	69.0	Paved
				TOTAL	2,289.1	

(2) On-going and Upcoming Road Improvement

Seven national roads are currently being improved, mainly by private financing (Build & Transfer operation scheme; B/T). NR-14A and 15B are currently under construction on B/T basis. Improvement of NR-1H was recently completed by the Japanese ASEAN Integration Funds. Improvement of other roads such as NR-16A and 18A was already contracted out to the private sector on B/T basis. The on-going and forthcoming projects (as of May 2010) are summarized in Table 3.4.2.

Table 3.4.2 Ongoing Road Improvement Projects in Southern Area

Road	Description	Project Cost (USD mill)	Fund Source	Status/Progress of Implementation
NR-1H	**DBST** L=20km Tat Teng distrct to Sekong district	4.0	JAPAN-ASEAN Integration Funds	The Works had been completed by 10th May 2010
NR-14A	**AC** L=19km B. Houay Phek R16JCT. to Phaphin	19.0	Private (B/T)	Works in progress at the site. The earth works to form roadbed were nearly finished. The target completion date is within 2011
NR-15B	**DBST** L=147km Saravan to Vietnam border via Ta-oy, Toumlane and Samuoy,	58.6	Private (B/T)	The contract signed in 2005. However the works were often interrupted due to shortage of funds. The road works in progress at time of study: extending approx. 30km from Saravan out of 147km via local funds.
NR-16A	**AC** or **DBST** L=53km R1I JCT in Pakson to R16B JCT in Sekong	56.7	Private (B/T)	Contract signed in Jan 2010. At time of study, the survey and design was in progress. Currently in discussion at MPWT: downgrading from AC to DBST
NR-16B	**DBST** L=95km Sekong to Dukchung	44.5	Private (B/T)	Contract signed in Mar 2009. Works progress was 8.14% as of Feb 2010 which was 9.5% behind schedule: target progress by Feb 2010 was 17.63%.
	Gravel L=21km Dukchung to Vietnam Border	5.3	Local funds	Contract signed in Mar 2006. Works progress was 48.93% as of Feb 2010. Lack of revolving capital of Vietnam contractor affected work progress.
NR-18A	**DBST** L=116km R13S JCT to R1I JCT	100.0	Concession	MOU signed in Apr 2009. The survey and design; and mobilization of works on site were in progress at time of study. Commencement of works was scheduled for Aug 2010.
NR-1J	**DBST** L=19km, Sekaman Bridge	n/a	JAPAN-ASEAN Integration Funds	Design review was on-going at time of study.

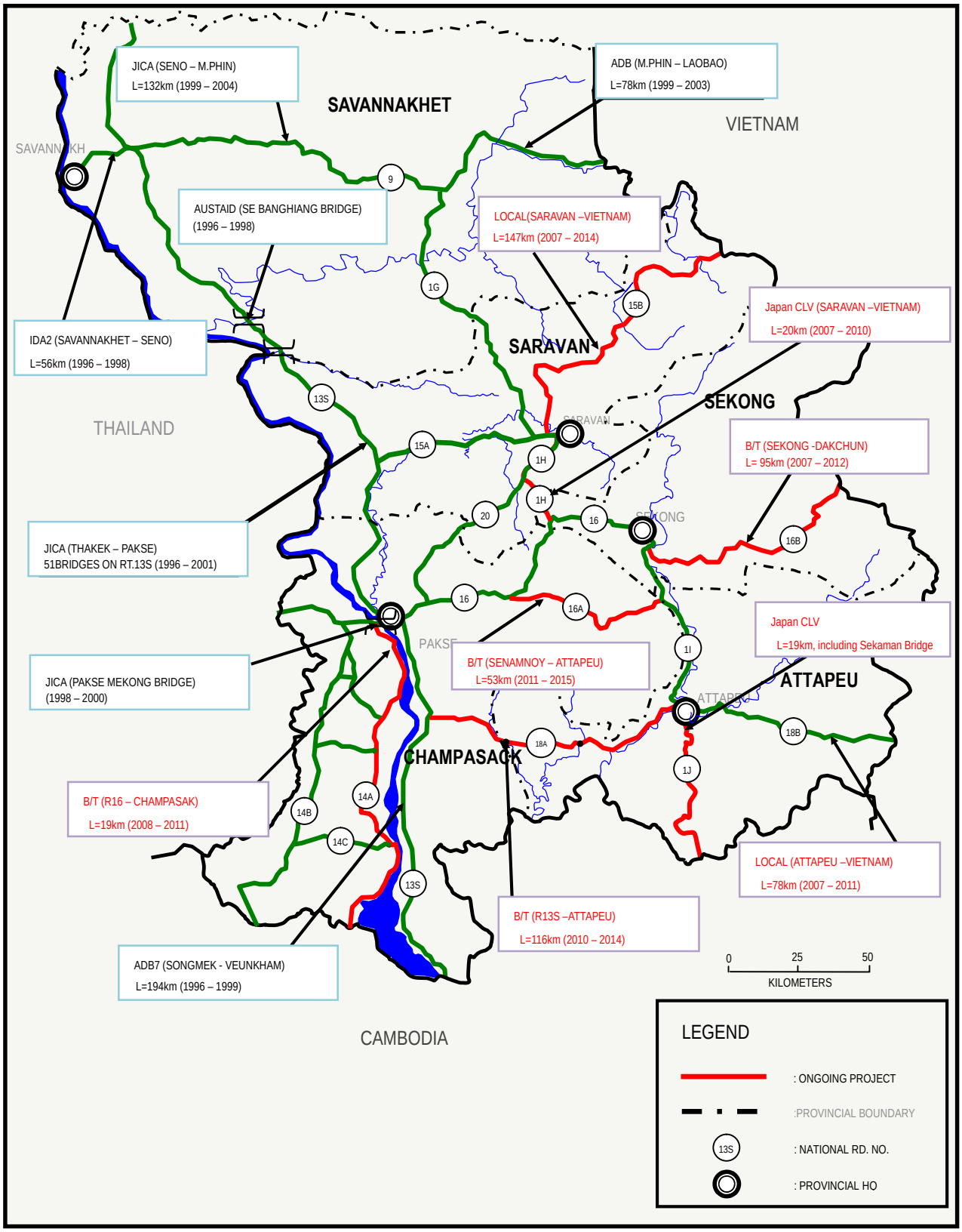


Figure 3.4.1 Ongoing Road Improvement Projects in Southern Area

(3) Project Long List

In consideration of the existing conditions of roads and bridges as well as projects vying for Japanese grant aid[4], a long list of both road and bridge improvement projects was prepared. This long list of road projects was limited to unpaved national roads, including on-going road improvement projects. The long list of bridge projects included new long-span bridge projects, such as Sekong Bridge and Sedone Bridge, as well as deteriorated and narrow bridges, observed along NR-9 and NR-20. Table 3.4.3 provides details of road and bridge improvement projects studied in this master plan.

Table 3.4.3 Project Long List

Project Road	Road Length (km)	Type of Project	Summary of Project
NR-9	244.0	Road Upgrade	Adopting the maximum axle load of 11 tons per axle, the whole stretch of the road will be upgraded to ASIAN Highway class III standard.
NR-1F	157.0	Road Improvement	The whole road section, currently with earth/gravel surface at some sections, will be improved to paved surface.
NR-1G	130.0	Road Development	Including 32 km missing link, the whole section of road will be developed/ improved to paved surface. Construction of 300 m long Sebang Hieng and 200 m long Sedone Bridge is part of this project.
NR-1J	81.0	Road Development	Including 65 km missing link, the whole section of road will be developed/ improved to paved surface.
NR-14A	137.5	Road Improvement	25 km road section from the junction of NR-16 is now under implementation. The rest of road section will be improved and paved.
NR-14B	149.0	Road Improvement	The whole road section, currently with gravel surface at some sections, will be improved to paved surface.
NR-14C	42.0	Road Improvement	The whole road section, currently with gravel surface at some sections, will be improved.
NR-15A	73.0	Road Improvement	The whole road section, currently with gravel surface at most sections, will be improved.
NR-15B	165.0	Road Improvement	Around 30 km length of road section is paved while road section of 76 km total length is under construction. The rest of the road section will also be paved.
NR-16A	71.0	Road Improvement	The whole road section will be paved and the survey and design work are currently ongoing.
NR-16B	123.0	Road Improvement	94 km road section is now under construction. The rest of the road section will be improved to paved surface.
NR-18A	112.5	Road Improvement	The whole section, including two over 150 m length bridges, is now under construction and will be paved.
NR-9		Bridge Replacement	All the bridges, constructed in mid 1980's, to be replaced. The total length of the bridge along NR-9 is 2,397m.
NR-1J	Sekaman	Bridge Construction	Around 200 m long Sekaman Bridge is currently at stage of preparation of construction work.
NR-15A	Sedone	Bridge Construction	Around 230 m long Sedone Bridge will be newly constructed.
NR-16B	Sekong	Bridge Construction	Around 280 m long Sekong Bridge will be newly constructed.
NR-20		Bridge Replacement	All the bridges, currently with bridge width of 4 m, to be replaced and widened. The total length of the bridge along NR-20 is 474m.
Total	1,485.0		

Source: JICA Study Team

[4] Projects requested for Japanese grant aid include Improvement of NR-16A, Improvement of NR 1J, Upgrade of NR 9, Bridge construction along NR-1G, Construction of Sedone Bridge (NR-15A), Construction of Sekong Bridge (NR-16B).

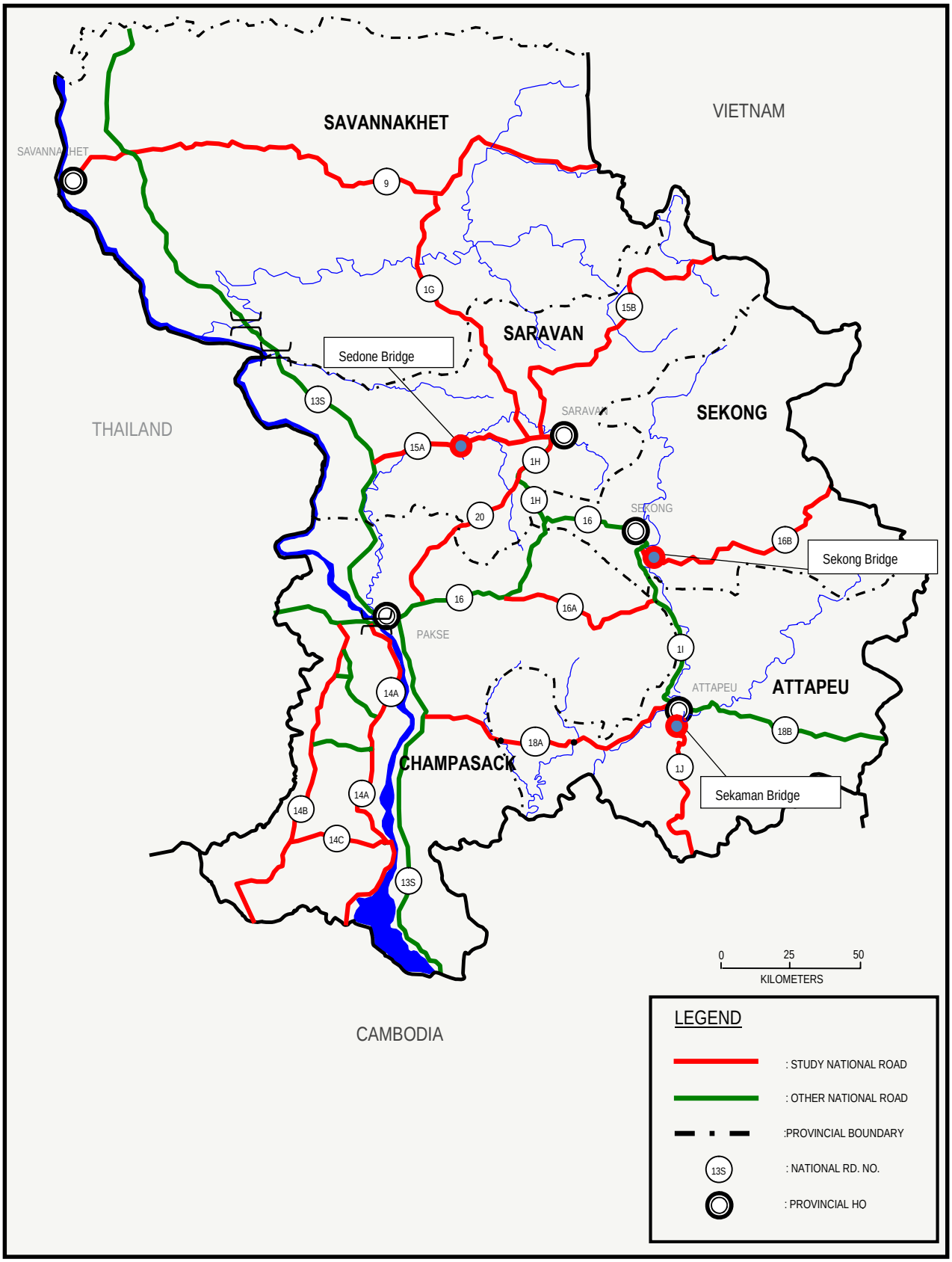


Figure 3.4.2 Location of Long Listed Projects

3.4.3 Evaluation Method and Criteria Applied

Like the previous master plan study, the multi-criteria analysis was employed to determine the priority projects from amongst the project long list. This multi-criteria analysis had to involve all the stakeholders who assisted in identification of the criteria, allocation of weights and quantitative assessment of the projects. To accomplish this, the long listed projects were first evaluated via a quantitative appreciation by which the projects were appreciated and evaluated against a set of decision criteria: (i) Economic and technical criteria, (ii) Environmental criteria and (iii) Basic need criteria.

- *Economic and technical criteria* evaluated how the project would contribute to future economic development of the region both positively and negatively. These criteria included project size, construction method, maintenance cost, reliable traffic service, traffic demand, cost effectiveness, regional development and logistics network.
- *Environmental criteria* assessed the environmental impact caused by the project. The initial environmental examination (IEE) concluded that road/ bridge improvement projects in the southern region would adversely impact on the following natural and social environment in the region: noise and vibration, air quality, water quality, environmental reserve, fauna and flora, erosion and sedimentation, involuntary resettlement, and traffic accidents.
- *Basic need criteria* evaluated how the project would contribute to poverty reduction in the southern region. These criteria included impact on the regional economy, impact on the people under poverty line, and accessibility to social infrastructure like schools and hospitals.

Table 3.4.4 Evaluation Criteria for Selection of Priority Project

1st level criteria	2nd level criteria	3rd level criteria	Evaluation items
Economic and technical criteria	Workability	Project size	Project cost
		Construction method	Locally available technique
	Sustainability	Maintenance	Maintenance cost
		Reliable traffic service	Year round traffic
	Economy	Traffic demand	Daily traffic volume
			Volume capacity ratio
		Cost effectiveness	Cost/ traffic volume
		Regional development and logistics network	External trip rate
			International trunk road
Environmental criteria	Pollution	Noise and vibration	Heavy vehicular traffic volume
		Air quality	Traffic volume and travel speed
		Water quality	Impact on river
	Natural Environment	Environmental reserve	Impact on national reservation area
		Fauna and flora	Impact on flood plain and mountain
		Erosion and sedimentation	Land cut and fill volume
	Social Environment	Involuntary resettlement	Resettlement and land acquisition
		Traffic accidents	Vehicle kilometer
Basic need criteria	Poverty Reduction	Impact on the regional economy	Size of population in project site
		Impact on impoverished people	Size of population below poverty line in project site
		Accessibility to social infrastructure	Size of population without schools in village
			Size of population without hospitals /clinics in village

3.4.4 Evaluation of Road and Bridge Projects

As discussed above, a long list of the projects was prepared while evaluation criteria to establish priority projects were determined. This section explores the evaluation process of these projects. It also provides input as regards the selection of priority projects as well as preparation of the long-term road/bridge improvement master plan for the southern region. In the course of the evaluation works, evaluation criteria for these projects were prepared in a numerical manner. These evaluation criteria were rated as follows: A (Positive), B (Neutral) and C (Negative). Once all projects had been rated for each evaluation criterion, the multi criteria analysis was then conducted to establish the most attractive projects by testing the weighted ranking of the projects.

(1) Economic and Technical Criteria

1) Project Cost

Project costs of road and bridge projects were estimated based on the unit cost. This unit cost was prepared based on those of the recent Japanese grant aid projects. Different unit costs were prepared in consideration of the topography of the road (flat, rolling and hilly, and mountainous), assuming the cut and fill volume of land preparation works. The project cost of each project is summarized in the following table. Considering the scale of the projects and capacity of the Japanese grant aid, the cost of each project was rated as follows: A (less than 15 million USD), B (between 15 and 45 million USD) and C (more than 45 million USD).

Table 3.4.5 Evaluation Result (Project Cost)

Project Road	Type of Project	Road Length (km)	Construction Cost (Million USD)			Rating
			Road	Bridge	Total	
NR-9	Road Upgrade	244	99.3		99.3	C
NR-1F	Road Improvement	157	94.0	7.0	101.0	C
NR-1G	Road Development	130	65.0	41.1	106.1	C
NR-1J	Road Development	81	51.0	3.3	54.4	C
NR-14A	Road Improvement	138	49.0	22.2	71.2	C
NR-14B	Road Improvement	149	53.0	19.1	72.1	C
NR-14C	Road Improvement	42	15.0	3.2	18.2	B
NR-15A	Road Improvement	73	28.0	11.4	39.4	B
NR-15B	Road Improvement	165	107.0	47.2	154.2	C
NR-16A	Road Improvement	71	38.0	4.5	42.5	B
NR-16B	Road Improvement	123	91.0	12.9	103.9	C
NR-18A	Road Improvement	113	45.0	32.7	77.7	C
NR-9	Bridge Replacement			60.2	60.2	C
NR-1J	Sekaman Bridge Construction			7.7	7.7	A
NR-15A	Sedone Bridge Construction			8.8	8.8	A
NR-16B	Sekong Bridge Construction			8.6	8.6	A
NR-20	Bridge Replacement			9.8	9.8	A

2) Construction Method

There is one condition that was recently introduced as a requirement for a Japanese grant aid project: that Japanese technology is preferably required for the project implementation. Accordingly, construction method of each project is reviewed and evaluated to establish whether the project requires advanced technology. A long span bridge project, exceeding bridge length of 100m would automatically require sophisticated engineering technical capacity, which is not currently available with local consultants. Besides, concrete and asphalt concrete pavements require complicated construction methods that are rarely practiced in Laos. Accordingly, NR-9, NR-1G and bridge projects over Sekaman, Sedone and Sekong River were assigned an A rating while other projects were assigned a rating of C.

Table 3.4.6 Evaluation Result (Construction Method)

Project Road	Type of Project	Road Length (km)	Rating
NR-9	Road Upgrade	244	A
NR-1F	Road Improvement	157	C
NR-1G	Road Development	130	A
NR-1J	Road Development	81	C
NR-14A	Road Improvement	138	C
NR-14B	Road Improvement	149	C
NR-14C	Road Improvement	42	C
NR-15A	Road Improvement	73	C
NR-15B	Road Improvement	165	C
NR-16A	Road Improvement	71	C
NR-16B	Road Improvement	123	C
NR-18A	Road Improvement	113	C
NR-9	Bridge Replacement		A
NR-1J	Sekaman Bridge Construction		A
NR-15A	Sedone Bridge Construction		A
NR-16B	Sekong Bridge Construction		A
NR-20	Bridge Replacement		C

3) Maintenance Cost

The maintenance cost of each road and bridge project was evaluated based on the size of the project. However, it should be noted that some of the projects, once completed, would contribute to a significant reduction in the maintenance and operation costs. For instance, the Lao Government incurs severe costs in maintaining the NR-9. Furthermore, the operation costs of the ferry boats at Sekamann, Sedone and Sekong rivers would reduce once the bridge was opened to traffic. As a result, NR-9, and bridge projects over Sekamann, Sedone and Sekong rivers were given a rating of A.

Table 3.4.7 Evaluation Result (Maintenance Cost)

Project Road	Type of Project	Road Length (km)	Rating
NR-9	Road Upgrade	244	A
NR-1F	Road Improvement	157	C
NR-1G	Road Development	130	C
NR-1J	Road Development	81	C
NR-14A	Road Improvement	138	C
NR-14B	Road Improvement	149	C
NR-14C	Road Improvement	42	B
NR-15A	Road Improvement	73	B
NR-15B	Road Improvement	165	C
NR-16A	Road Improvement	71	B
NR-16B	Road Improvement	123	C
NR-18A	Road Improvement	113	C
NR-9	Bridge Replacement		B
NR-1J	Sekaman Bridge Construction		A
NR-15A	Sedone Bridge Construction		A
NR-16B	Sekong Bridge Construction		A
NR-20	Bridge Replacement		B

4) Reliable Traffic Service

It was observed at the time of the study that some of the road sections, especially where the road crossed major rives, were impassable throughout the year or during the rainy season. Accordingly, a project on a road that contained impassable road sections was assigned a rating of A.

Table 3.4.8 Evaluation Result (Reliable Traffic Service)

Project Road	Type of Project	Road Length (km)	Rating
NR-9	Road Upgrade	244	C
NR-1F	Road Improvement	157	C
NR-1G	Road Development	130	A
NR-1J	Road Development	81	A
NR-14A	Road Improvement	138	C
NR-14B	Road Improvement	149	C
NR-14C	Road Improvement	42	C
NR-15A	Road Improvement	73	A
NR-15B	Road Improvement	165	C
NR-16A	Road Improvement	71	C
NR-16B	Road Improvement	123	C
NR-18A	Road Improvement	113	C
NR-9	Bridge Replacement		C
NR-1J	Sekaman Bridge Construction		A
NR-15A	Sedone Bridge Construction		A
NR-16B	Sekong Bridge Construction		A
NR-20	Bridge Replacement		C

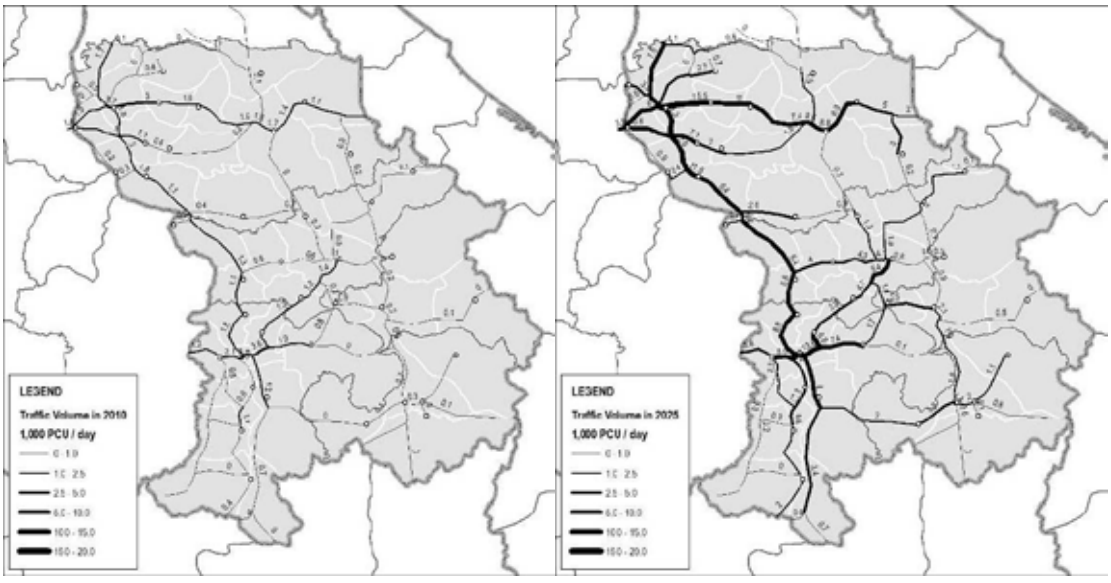
5) Daily Traffic Volume

The daily traffic volume of road and bridge project was estimated based on the traffic demand forecast that was explored earlier in this chapter. Table 3.4.9 summarizes future traffic volume of

each project road in 2025: these traffic volumes vary considerably by project road. For instance, the busiest road amongst the project roads is NR-9 where 7,500 vehicles/day are projected to pass in 2025. The least traffic is projected along NR-1J, NR-14B, NR-14C, NR-16A and 16B, where less than 500 vehicles/day are forecasted. The daily traffic volume of each project was assigned ratings as follows: A (more than 5,000 vehicles/day in 2025), B (between 1,000 and 5,000 vehicles/day) and C (less than 1,000 vehicles/day).

Table 3.4.9 Evaluation Result (Daily Traffic Volume)

Project Road	Type of Project	Road Length (km)	2025 Traffic Volume (PCU/day)	Rating
NR-9	Road Upgrade	244	7,511	A
NR-1F	Road Improvement	157	1,066	B
NR-1G	Road Development	130	892	C
NR-1J	Road Development	81	132	C
NR-14A	Road Improvement	138	2,853	B
NR-14B	Road Improvement	149	397	C
NR-14C	Road Improvement	42	256	C
NR-15A	Road Improvement	73	4,187	B
NR-15B	Road Improvement	165	1,382	B
NR-16A	Road Improvement	71	141	C
NR-16B	Road Improvement	123	383	C
NR-18A	Road Improvement	113	2,007	B
NR-9	Bridge Replacement		7,511	A
NR-1J	Sekaman Bridge Construction		646	C
NR-15A	Sedone Bridge Construction		4,010	B
NR-16B	Sekong Bridge Construction		500	C
NR-20	Bridge Replacement		4,773	B



Source: JICA Study Team

Figure 3.4.3 Forecasted Traffic Volume

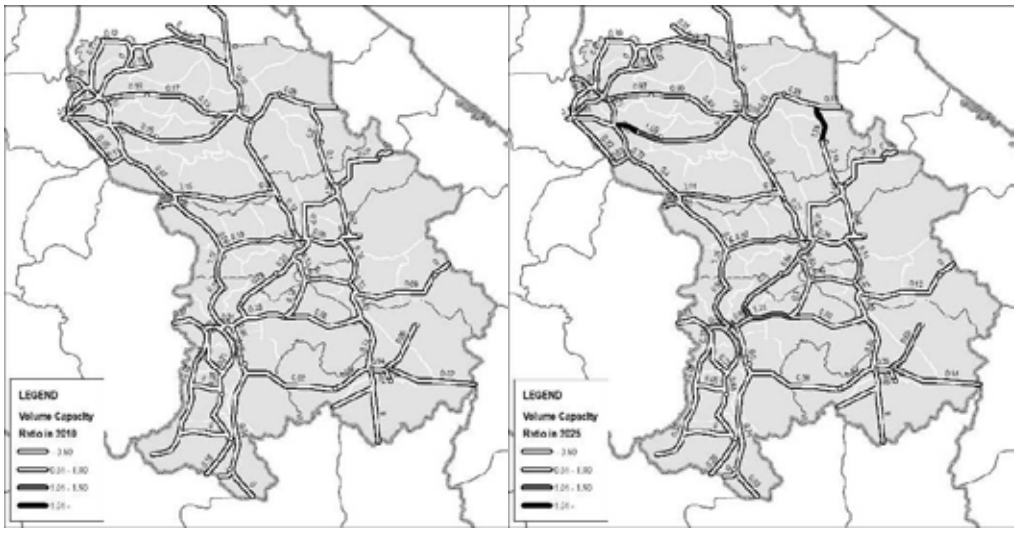
6) Volume Capacity Ratio

The volume capacity ratio of road and bridge projects was estimated based on the traffic demand

forecast. Table 3.4.10 summarizes future volume capacity ratio of each project road in 2025 and these ratios vary considerably by project road. For instance, the most congested road amongst the project roads is NR-15A and NR-20 where volume capacity ratio exceeds 0.60 in 2025. The least volume capacity ratio is projected along NR-1J, NR-14B, NR-14C, NR-16A and 16B, of which volume capacity ratio is projected to be less than 0.1. The volume capacity ratio for each project is assigned a rating as follows: A (more than 0.6 in 2025), B (between 0.2 and 0.6) and C (less than 0.2) for road projects. The ratios for bridge projects were rated separately, considering existence of the bridges.

Table 3.4.10 Evaluation Result (Volume Capacity Ratio)

Project Road	Type of Project	Road Length (km)	Volume Capacity Ratio	Rating
NR-9	Road Upgrade	244	0.56	B
NR-1F	Road Improvement	157	0.19	C
NR-1G	Road Development	130	0.19	C
NR-1J	Road Development	81	0.04	C
NR-14A	Road Improvement	138	0.41	B
NR-14B	Road Improvement	149	0.06	C
NR-14C	Road Improvement	42	0.03	C
NR-15A	Road Improvement	73	0.68	A
NR-15B	Road Improvement	165	0.25	B
NR-16A	Road Improvement	71	0.03	C
NR-16B	Road Improvement	123	0.09	C
NR-18A	Road Improvement	113	0.36	B
NR-9	Bridge Replacement		0.56	B
NR-1J	Sekaman Bridge Construction		0.09	B
NR-15A	Sedone Bridge Construction		0.57	A
NR-16B	Sekong Bridge Construction		0.12	B
NR-20	Bridge Replacement		0.80	B



Source: JICA Study Team

Figure 3.4.4 Forecasted Volume Capacity Ratio

7) Cost Effectiveness

The cost effectiveness indices of the road and bridge projects were estimated, dividing unit construction cost by future traffic volume. Table 3.4.11 provides a summary of the cost effectiveness index for each project road. The most cost effective project amongst the project roads is NR-9, showing the lowest index of 0.044 (thousand USD / vehicle-km). The least cost effective projects were determined to be NR-1J, NR-14B, NR-14C, NR-16A and 16B. The cost effectiveness index of each project was rated as follows: A (less than 0.01), B (between 0.01 and 1.0) and C (more than 1.0) for road projects. The cost effectiveness indices for bridge projects were rated separately as follows: A (less than 0.01) and B (more than 0.01).

Table 3.4.11 Evaluation Result (Cost Effectiveness)

Project Road	Type of Project	Road Length (km)	Cost Effectiveness Index	Rating
NR-9	Road Upgrade	244	0.044	A
NR-1F	Road Improvement	157	0.602	B
NR-1G	Road Development	130	0.915	B
NR-1J	Road Development	81	5.084	C
NR-14A	Road Improvement	138	0.181	B
NR-14B	Road Improvement	149	1.218	C
NR-14C	Road Improvement	42	1.693	C
NR-15A	Road Improvement	73	0.129	B
NR-15B	Road Improvement	165	0.667	B
NR-16A	Road Improvement	71	4.248	C
NR-16B	Road Improvement	123	2.205	C
NR-18A	Road Improvement	113	0.344	B
NR-9	Bridge Replacement		0.003	A
NR-1J	Sekaman Bridge Construction		0.059	B
NR-15A	Sedone Bridge Construction		0.010	A
NR-16B	Sekong Bridge Construction		0.061	B
NR-20	Bridge Replacement		0.004	A

8) Internal Trip Rate

An internal trip rate of road and bridge project, indicating whether the project road is used for regional traffic or inter-regional/international traffic, was estimated based on the traffic demand forecast. Table 3.4.12 summarizes the internal trip rate for all project roads. More inter-regional and international traffic would be observed along NR-9, NR-16A and NR-18A while other roads would be used for regional traffic in the southern region. The internal trip rate of each project was assigned ratings as follows: A (less than 50% in 2025), B (between 50% and 75%) and C (more than 75%).

Table 3.4.12 Evaluation Result (Internal Trip Rate)

Project Road	Type of Project	Road Length (km)	Internal Trip Rate	Rating
NR-9	Road Upgrade	244	42%	A
NR-1F	Road Improvement	157	82%	C
NR-1G	Road Development	130	96%	C
NR-1J	Road Development	81	n/a	C
NR-14A	Road Improvement	138	89%	C
NR-14B	Road Improvement	149	86%	C
NR-14C	Road Improvement	42	86%	C
NR-15A	Road Improvement	73	92%	C
NR-15B	Road Improvement	165	76%	C
NR-16A	Road Improvement	71	66%	B
NR-16B	Road Improvement	123	n/a	C
NR-18A	Road Improvement	113	64%	B
NR-9	Bridge Replacement		42%	A
NR-1J	Sekaman Bridge Construction		85%	C
NR-15A	Sedone Bridge Construction		92%	C
NR-16B	Sekong Bridge Construction		98%	C
NR-20	Bridge Replacement		90%	C

9) International Trunk Roads

There are two international trunk roads in the southern region. One is NR-9 which is part of ASEAN Highway No.16 and the other is NR-18A which is part of ASEAN Highway No.132. Accordingly, these roads were given ratings of A for two digit international trunk roads and B for three digit international trunk roads.

Table 3.4.13 Evaluation Result (International Trunk Road)

Project Road	Type of Project	Road Length (km)	Rating
NR-9	Road Upgrade	244	A
NR-1F	Road Improvement	157	C
NR-1G	Road Development	130	C
NR-1J	Road Development	81	C
NR-14A	Road Improvement	138	C
NR-14B	Road Improvement	149	C
NR-14C	Road Improvement	42	C
NR-15A	Road Improvement	73	C
NR-15B	Road Improvement	165	C
NR-16A	Road Improvement	71	C
NR-16B	Road Improvement	123	C
NR-18A	Road Improvement	113	B
NR-9	Bridge Replacement		A
NR-1J	Sekaman Bridge Construction		C
NR-15A	Sedone Bridge Construction		C
NR-16B	Sekong Bridge Construction		C
NR-20	Bridge Replacement		C

(2) Environmental Criteria

1) Noise

The level of noise generated by a project can be gauged by the volume of heavy vehicular traffic. Besides, adverse environmental impact in terms of noise could be exacerbated in cases where more people live in the vicinity of the project road. The level of noise and its environmental impact was assigned the following ratings: A (less than 100 heavy vehicles/day), B (more than 100 vehicles/day). Since there would be no chronic environmental impact, none of the projects were given a rating of C.

Table 3.4.14 Evaluation Result (Noise)

Project Road	Type of Project	Road Length (km)	2025 No. of Heavy Vehicles (vehicles/ day)	Rating
NR-9	Road Upgrade	244	340	B
NR-1F	Road Improvement	157	4	A
NR-1G	Road Development	130	1	A
NR-1J	Road Development	81	1	A
NR-14A	Road Improvement	138	140	B
NR-14B	Road Improvement	149	21	A
NR-14C	Road Improvement	42	14	A
NR-15A	Road Improvement	73	247	B
NR-15B	Road Improvement	165	5	A
NR-16A	Road Improvement	71	9	A
NR-16B	Road Improvement	123	29	A
NR-18A	Road Improvement	113	134	B
NR-9	Bridge Replacement		340	B
NR-1J	Sekaman Bridge Construction		1	A
NR-15A	Sedone Bridge Construction		247	B
NR-16B	Sekong Bridge Construction		29	A
NR-20	Bridge Replacement		209	B

2) Air Quality

The level of impact on air quality by a project can be gauged by combination of the traffic volume and vehicle capacity ratio (travel speed). The level of impact on air quality and its environmental impact were rated as follows: A (less traffic at moderate travel speed), B (more traffic at low travel speed). Since there would be no chronic environmental impact, none of the projects were assigned a rating of C.

Table 3.4.15 Evaluation Result (Air Quality)

Project Road	Type of Project	Road Length (km)	2025 Traffic Volume (PCU/day)	Volume Capacity Ratio	Rating
NR-9	Road Upgrade	244	7,511	0.56	B
NR-1F	Road Improvement	157	1,066	0.19	A
NR-1G	Road Development	130	892	0.19	A
NR-1J	Road Development	81	132	0.04	A
NR-14A	Road Improvement	138	2,853	0.41	B
NR-14B	Road Improvement	149	397	0.06	A
NR-14C	Road Improvement	42	256	0.03	A
NR-15A	Road Improvement	73	4,187	0.68	B
NR-15B	Road Improvement	165	1,382	0.25	B
NR-16A	Road Improvement	71	141	0.03	A
NR-16B	Road Improvement	123	383	0.09	A
NR-18A	Road Improvement	113	2,007	0.36	B
NR-9	Bridge Replacement		7,511	0.56	B
NR-1J	Sekaman Bridge Construction		646	0.09	A
NR-15A	Sedone Bridge Construction		4,010	0.57	B
NR-16B	Sekong Bridge Construction		500	0.12	A
NR-20	Bridge Replacement		4,773	0.80	B

3) Water Quality

Bridge projects may cause considerable adverse environmental impact on water quality since construction itself is to be carried out mainly within river space. Furthermore, road projects may cause adverse impact where several tributaries cross the project road.

Table 3.4.16 Evaluation Result (Water Quality)

Project Road	Type of Project	Road Length (km)	Rating
NR-9	Road Upgrade	244	B
NR-1F	Road Improvement	157	B
NR-1G	Road Development	130	B
NR-1J	Road Development	81	B
NR-14A	Road Improvement	138	B
NR-14B	Road Improvement	149	B
NR-14C	Road Improvement	42	B
NR-15A	Road Improvement	73	B
NR-15B	Road Improvement	165	B
NR-16A	Road Improvement	71	B
NR-16B	Road Improvement	123	B
NR-18A	Road Improvement	113	B
NR-9	Bridge Replacement		C
NR-1J	Sekaman Bridge Construction		C
NR-15A	Sedone Bridge Construction		C
NR-16B	Sekong Bridge Construction		C
NR-20	Bridge Replacement		C

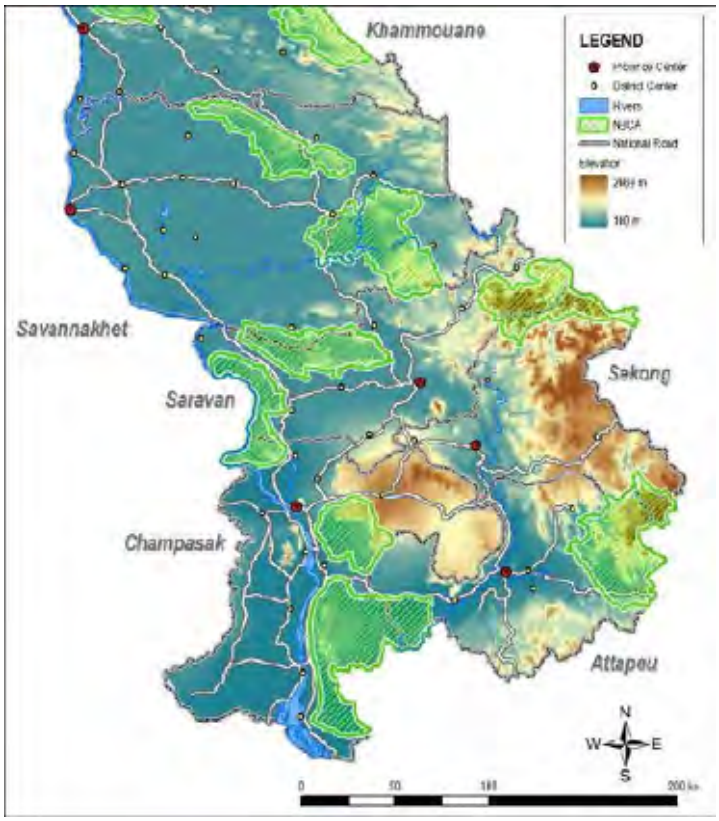
4) Environmental Reserve

There are eight National Protected Areas (NPAs) across the region. These NPAs are found in the

vicinity of NR-9, NR-1G, NR-13S, NR-15B, NR-18A and NR-18B. The projects would probably involve large-scale deforestation in case of construction of mountainous roads.

Table 3.4.17 Evaluation Result (Environmental Reserve)

Project Road	Type of Project	Road Length (km)	Rating
NR-9	Road Upgrade	244	C
NR-1F	Road Improvement	157	C
NR-1G	Road Development	130	C
NR-1J	Road Development	81	A
NR-14A	Road Improvement	138	A
NR-14B	Road Improvement	149	A
NR-14C	Road Improvement	42	A
NR-15A	Road Improvement	73	A
NR-15B	Road Improvement	165	C
NR-16A	Road Improvement	71	A
NR-16B	Road Improvement	123	C
NR-18A	Road Improvement	113	C
NR-9	Bridge Replacement		A
NR-1J	Sekaman Bridge Construction		A
NR-15A	Sedone Bridge Construction		A
NR-16B	Sekong Bridge Construction		A
NR-20	Bridge Replacement		A



Source: JICA Study Team

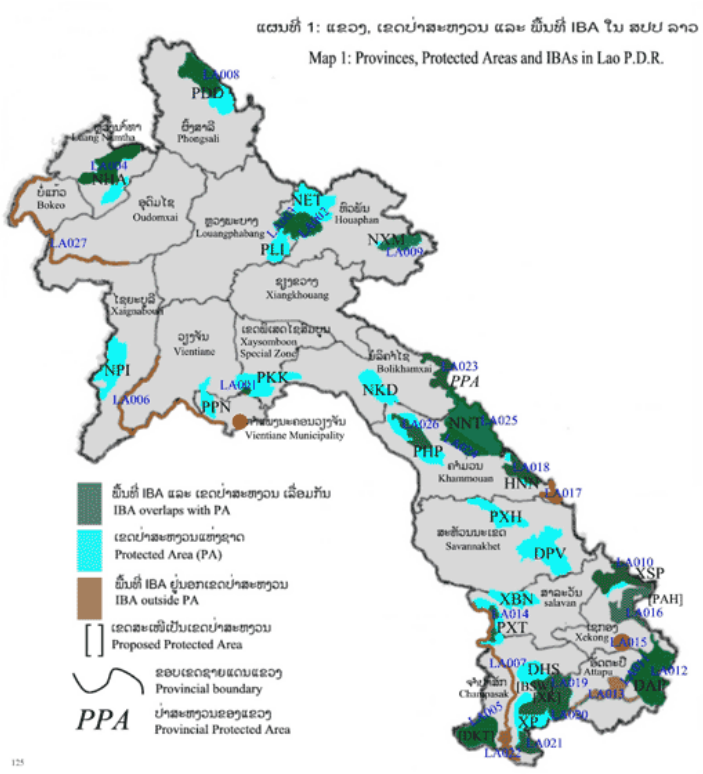
Figure 3.4.5 National Reserved Areas in Southern Region

5) Flora/Fauna

Beside the NPAs, there are several important IBAs (Important Bird Area) across the southern region and some of these IBAs geographically overlap with NPAs. Considering location and scale of the projects, the road and bridge projects were ranked as either B or C.

Table 3.4.18 Evaluation Result (Flora/Fauna)

Project Road	Type of Project	Road Length (km)	Rating
NR-9	Road Upgrade	244	C
NR-1F	Road Improvement	157	C
NR-1G	Road Development	130	C
NR-1J	Road Development	81	B
NR-14A	Road Improvement	138	B
NR-14B	Road Improvement	149	B
NR-14C	Road Improvement	42	B
NR-15A	Road Improvement	73	B
NR-15B	Road Improvement	165	C
NR-16A	Road Improvement	71	B
NR-16B	Road Improvement	123	C
NR-18A	Road Improvement	113	C
NR-9	Bridge Replacement		B
NR-1J	Sekaman Bridge Construction		B
NR-15A	Sedone Bridge Construction		B
NR-16B	Sekong Bridge Construction		B
NR-20	Bridge Replacement		B



Source: JICA Study Team

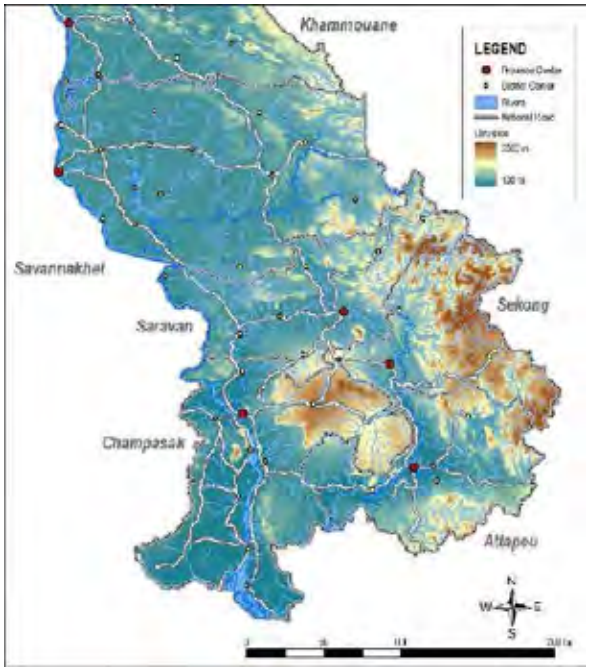
Figure 3.4.6 National Reserved Areas in Southern Region

6) Erosion/Sedimentation

There is a significant risk of erosion or landslide in construction of mountainous roads. Accordingly, the level of risk of erosion on a project can be estimated by the total length of mountainous roads section on the project. The road development projects such as NR-1G, NR-1J, NR-15B, NR-16A and NR-16B, run through mountainous areas and may require considerable amount of land cut and fill.

Table 3.4.19 Evaluation Result (Erosion/Sedimentation)

Project Road	Type of Project	Road Length (km)	Road Section in Mountain (km)	Rating
NR-9	Road Upgrade	244	0	B
NR-1F	Road Improvement	157	85	C
NR-1G	Road Development	130	35	C
NR-1J	Road Development	81	57	C
NR-14A	Road Improvement	138	0	B
NR-14B	Road Improvement	149	0	B
NR-14C	Road Improvement	42	0	B
NR-15A	Road Improvement	73	0	B
NR-15B	Road Improvement	165	102	C
NR-16A	Road Improvement	71	22	C
NR-16B	Road Improvement	123	107	C
NR-18A	Road Improvement	113	0	B
NR-9	Bridge Replacement			B
NR-1J	Sekaman Bridge Construction			B
NR-15A	Sedone Bridge Construction			B
NR-16B	Sekong Bridge Construction			B
NR-20	Bridge Replacement			B



Source: JICA Study Team

Figure 3.4.7 Topography in Southern Region

7) Land Acquisition

According to the ADB's environmental guideline, a project requires EIA-level detailed study when the project affects households exceeding 200 in number. However, it is difficult to estimate the number of affected households without any detailed study. In this study, the scale of land acquisition and resettlement was gauged by the number of households in the vicinity of the project roads, as summarized in Table 3.4.20. As a result, all the road projects more or less require land acquisition and resettlement, with the exception of NR-9, for which the right of way was already secured. The bridge projects would also probably require land acquisition and resettlement, but to a lesser extent compared to the road projects.

Table 3.4.20 Evaluation Result (Land Acquisition)

Project Road	Type of Project	Road Length (km)	No. of Household in 300 m Buffer	Rating
NR-9	Road Upgrade	244	9,293	A
NR-1F	Road Improvement	157	1,853	C
NR-1G	Road Development	130	1,495	C
NR-1J	Road Development	81	737	C
NR-14A	Road Improvement	138	3,163	C
NR-14B	Road Improvement	149	1,833	C
NR-14C	Road Improvement	42	882	C
NR-15A	Road Improvement	73	2,949	C
NR-15B	Road Improvement	165	2,195	C
NR-16A	Road Improvement	71	1,243	C
NR-16B	Road Improvement	123	640	C
NR-18A	Road Improvement	113	1,879	C
NR-9	Bridge Replacement			A
NR-1J	Sekaman Bridge Construction			B
NR-15A	Sedone Bridge Construction			B
NR-16B	Sekong Bridge Construction			B
NR-20	Bridge Replacement			B

8) Traffic Accidents

There is also a significant risk of traffic accidents where a considerable number of vehicular traffic is observed. The vehicle kilometer was estimated based on the traffic demand forecast and as a result, more traffic volume along NR-9 was projected. As such the NR-9 projects were assigned a rating of C for this particular criterion.

Table 3.4.21 Evaluation Result (Traffic Accident)

Project Road	Type of Project	Road Length (km)	2025 Vehicle Kilometer (PCU*km/ day)	Rating
NR-9	Road Upgrade	244	1,833,000	C
NR-1F	Road Improvement	157	167,000	B
NR-1G	Road Development	130	116,000	B
NR-1J	Road Development	81	11,000	B
NR-14A	Road Improvement	138	394,000	B
NR-14B	Road Improvement	149	59,000	B
NR-14C	Road Improvement	42	11,000	B
NR-15A	Road Improvement	73	306,000	B
NR-15B	Road Improvement	165	228,000	B
NR-16A	Road Improvement	71	10,000	B
NR-16B	Road Improvement	123	47,000	B
NR-18A	Road Improvement	113	227,000	B
NR-9	Bridge Replacement			C
NR-1J	Sekaman Bridge Construction			B
NR-15A	Sedone Bridge Construction			B
NR-16B	Sekong Bridge Construction			B
NR-20	Bridge Replacement			B

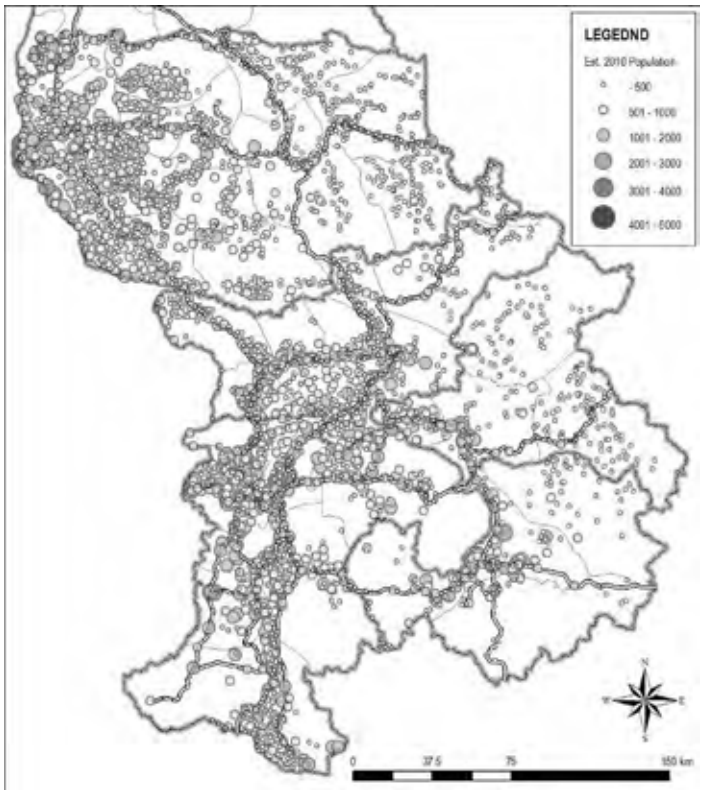
(3) Basic Needs Criteria

1) Impact on Local Economy

The extent to which a project will contribute to the local economy can be gauged by the size of the population in the affected area. Using GIS data prepared in this study, the population within a 5 km buffer zone of the project road was estimated for each project. Projects such as NR-9, NR14A and NR-15A, which were located within more populous areas, were expected to contribute more positively to the local economy. The bridge replacement projects (NR-9 and NR-20) were rated separately since such projects generate less impact on local economy compared to road projects.

Table 3.4.22 Evaluation Result (Impact on Local Economy)

Project Road	Type of Project	Road Length (km)	Population near Project ('000)	Rating
NR-9	Road Upgrade	244	239	A
NR-1F	Road Improvement	157	33	B
NR-1G	Road Development	130	49	B
NR-1J	Road Development	81	24	B
NR-14A	Road Improvement	138	180	A
NR-14B	Road Improvement	149	45	B
NR-14C	Road Improvement	42	13	B
NR-15A	Road Improvement	73	71	A
NR-15B	Road Improvement	165	48	B
NR-16A	Road Improvement	71	28	B
NR-16B	Road Improvement	123	26	B
NR-18A	Road Improvement	113	60	B
NR-9	Bridge Replacement		239	B
NR-1J	Sekaman Bridge Construction		24	B
NR-15A	Sedone Bridge Construction		71	A
NR-16B	Sekong Bridge Construction		26	B
NR-20	Bridge Replacement		104	B



Source: JICA Study Team

Figure 3.4.8 2010 Population by Village

2) Population in Poverty

Implementation of road and bridge projects is one of the key measures to alleviate poverty; helping people under the poverty line access basic infrastructure and providing them low cost public transport. Assuming the projected degree of poverty reduction achieved by a project is gauged by analysing the size of impoverished populations living in the vicinity of the project road, it can be deduced that the road projects NR-9, NR-1G and NR-14 will contribute significantly towards poverty alleviation in the region. The bridge replacement projects (NR-9 and NR-20) are rated separately since such projects tend to generate less impact on poverty reduction, in comparison to road projects. This study will conduct further analysis to establish how the road projects help poor people and the results of this analysis will be presented in the Draft Final Report.

Table 3.4.23 Evaluation Result (Impact on Poverty Reduction)

Project Road	Type of Project	Road Length (km)	Population under Poverty ('000)	Rating
NR-9	Road Upgrade	244	82	A
NR-1F	Road Improvement	157	32	A
NR-1G	Road Development	130	31	A
NR-1J	Road Development	81	7	C
NR-14A	Road Improvement	138	59	A
NR-14B	Road Improvement	149	10	B
NR-14C	Road Improvement	42	11	B
NR-15A	Road Improvement	73	0	C
NR-15B	Road Improvement	165	23	B
NR-16A	Road Improvement	71	0.4	C
NR-16B	Road Improvement	123	8	C
NR-18A	Road Improvement	113	16	B
NR-9	Bridge Replacement		82	B
NR-1J	Sekaman Bridge Construction		7	C
NR-15A	Sedone Bridge Construction		0	C
NR-16B	Sekong Bridge Construction		8	C
NR-20	Bridge Replacement		31	B

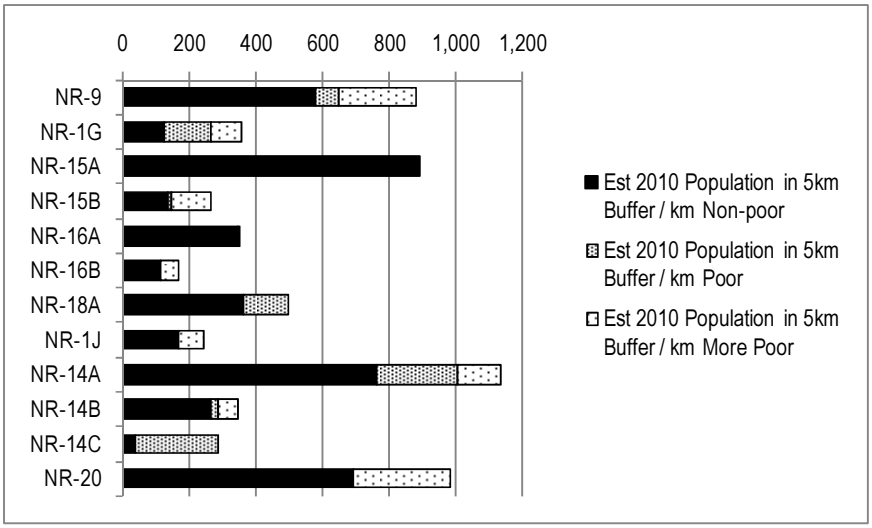


Figure 3.4.9 Population in 5 km Buffer Zone of Project Roads (Poor/Non-poor)

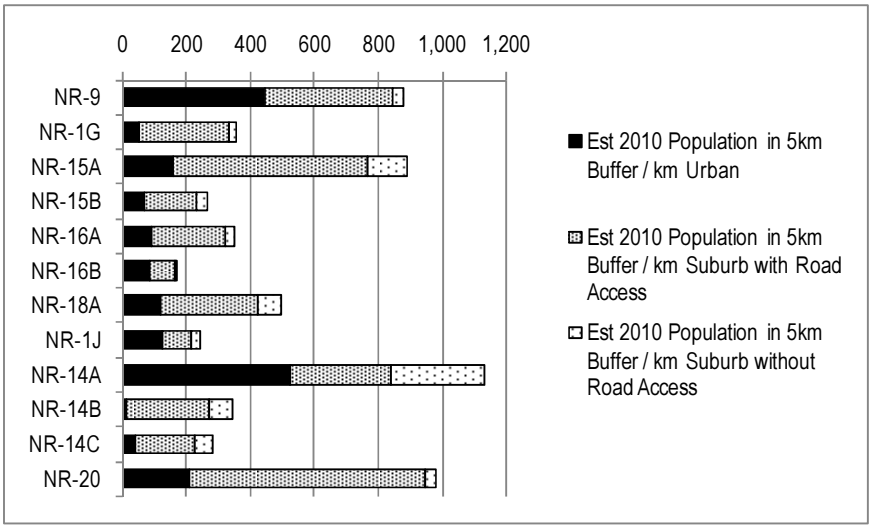


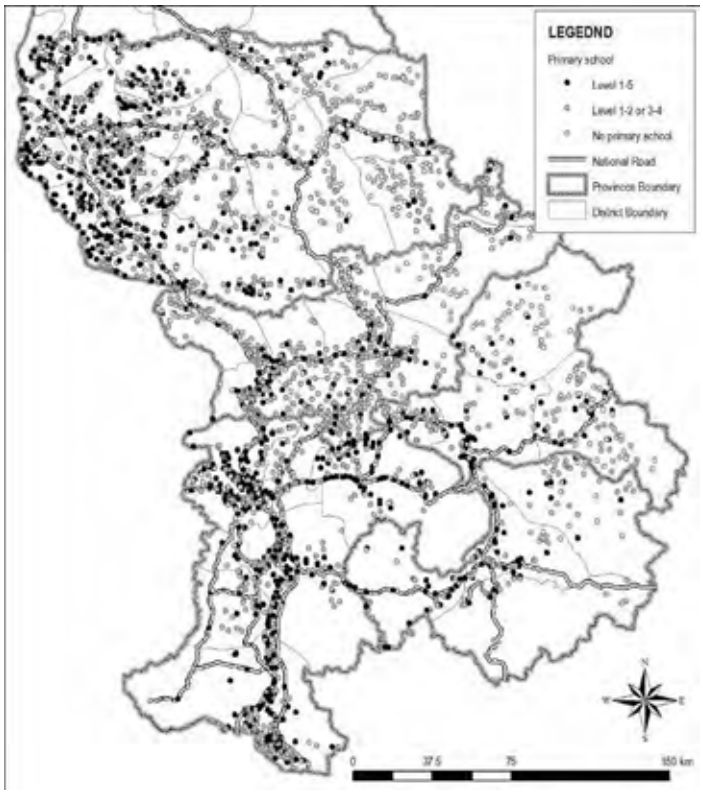
Figure 3.4.10 Population in 5 km Buffer Zone of Project Roads (Urban/Suburb)

3) Accessibility to Schools

Accessibility to schools may be improved with the implementation of road improvement projects; providing all weather passable roads and low cost public transport. Using GIS data prepared in this study, populations without primary schools in their villages and/or those that had to endure long distances of travel to schools, were estimated. The results of the estimation revealed that many people without primary schools were observable along NR-9 and NR-14A. The bridge replacement projects (NR-9 and NR-20) were rated separately since such projects tend to generate less impact on access improvement, in comparison to road projects.

Table 3.4.24 Evaluation Result (Improved Accessibility to Schools)

Project Road	Type of Project	Road Length (km)	Population without School ('000)	Rating
NR-9	Road Upgrade	244	77	A
NR-1F	Road Improvement	157	10	B
NR-1G	Road Development	130	43	B
NR-1J	Road Development	81	0.1	C
NR-14A	Road Improvement	138	43	A
NR-14B	Road Improvement	149	13	B
NR-14C	Road Improvement	42	0.5	C
NR-15A	Road Improvement	73	7	B
NR-15B	Road Improvement	165	8	B
NR-16A	Road Improvement	71	4	B
NR-16B	Road Improvement	123	0.77	C
NR-18A	Road Improvement	113	0	C
NR-9	Bridge Replacement		77	B
NR-1J	Sekaman Bridge Construction		0.1	C
NR-15A	Sedone Bridge Construction		7	B
NR-16B	Sekong Bridge Construction		0.77	C
NR-20	Bridge Replacement		20	B



Source: JICA Study Team

Figure 3.4.11 Schools by Village

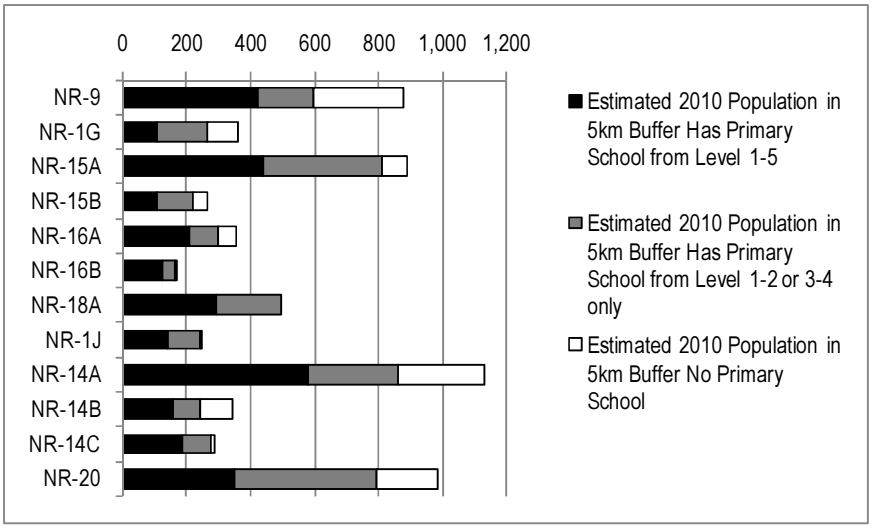


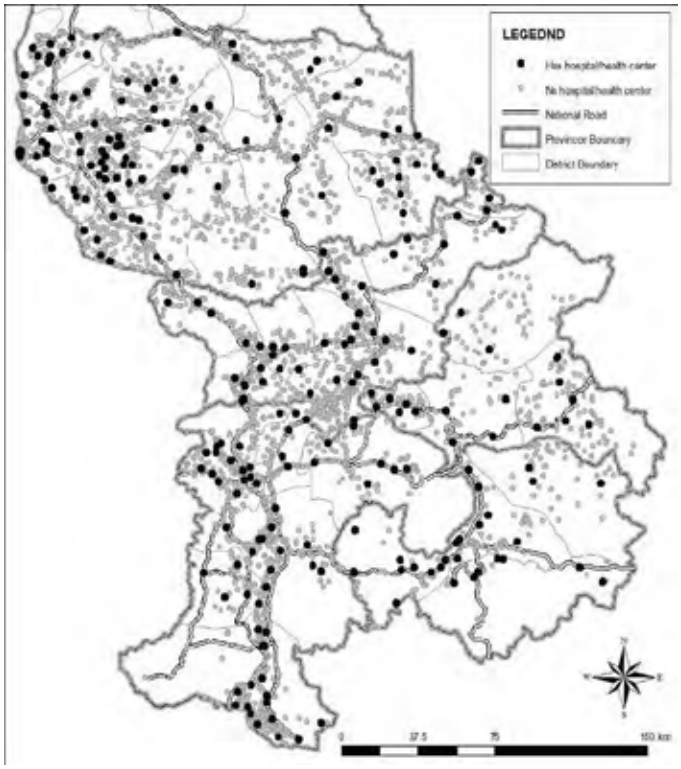
Figure 3.4.12 Population in 5 km Buffer Zone of Project Roads (School)

4) Accessibility to Hospitals

As is the case with schools, accessibility to hospitals may be improved by the implementation of road improvement projects; providing all weather passable roads and low cost public transport. Using GIS data prepared in this study, populations without hospitals and clinics in their villages and/or those who had to travel long distances to reach health centres were estimated. The results revealed that many people with limited access to health centres were observable along NR-9, NR-14A and NR-15A. The bridge replacement projects (NR-9 and NR-20) were rated separately since these projects tend to generate less impact on access improvement, compared to road projects.

Table 3.4.25 Evaluation Result (Improved Accessibility to Hospitals)

Project Road	Type of Project	Road Length (km)	Population without Hospital/ Clinic ('000)	Rating
NR-9	Road Upgrade	244	217	A
NR-1F	Road Improvement	157	31	B
NR-1G	Road Development	130	43	B
NR-1J	Road Development	81	20	B
NR-14A	Road Improvement	138	162	A
NR-14B	Road Improvement	149	38	B
NR-14C	Road Improvement	42	10	B
NR-15A	Road Improvement	73	61	A
NR-15B	Road Improvement	165	42	B
NR-16A	Road Improvement	71	25	B
NR-16B	Road Improvement	123	23	B
NR-18A	Road Improvement	113	50	B
NR-9	Bridge Replacement		217	B
NR-1J	Sekaman Bridge Construction		20	B
NR-15A	Sedone Bridge Construction		61	A
NR-16B	Sekong Bridge Construction		23	B
NR-20	Bridge Replacement		94	B



Source: JICA Study Team

Figure 3.4.13 Hospitals and Clinics by Village

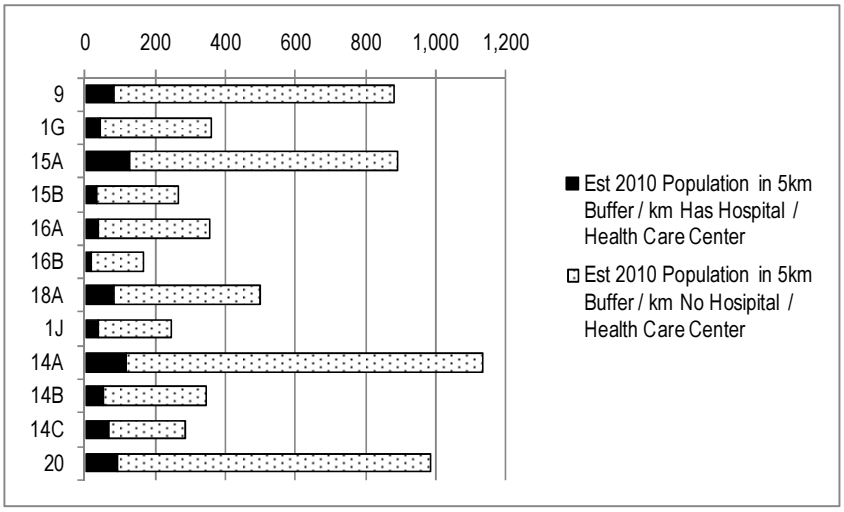


Figure 3.4.14 Population in 5 km Buffer Zone of Project Roads (Hospital and Clinic)

(4) Evaluation Result

As discussed above, the evaluation criteria were assigned ratings of A, B and C for the various projects. The final evaluation results were obtained by weighting the ratings of the evaluation criteria. Three sets of weights to be allocated to the different evaluation criteria were prepared to aid the decision making process: economy oriented weights (43% for economic and technical criteria, 34% for environmental criteria, and 23% for basic need criteria), Balanced (33%, 33% and 33%) and Basic needs oriented (23%, 34% and 43%).

Table 3.4.26 Weights for Evaluation Criteria

Evaluation Criteria	Economy Oriented	Balanced	Basic Needs Oriented
Economic and technical criteria	43%	33%	23%
Environmental criteria	34%	33%	34%
Basic needs criteria	23%	33%	43%

Using the above mentioned weighting system, the total scores for each project were derived from the sum of the products of the weight of each decision parameter and its rating: A (+1), B (0) and C (-1). The total scores of each project are tabulated in the Table 3.4.27 to Table 3.4.29.

Considering the budgetary constraints (assuming the total investment of 150 million USD up to 2015 can be utilized for transport infrastructure projects), the following priority projects up to 2015 are suggested. Some of the ongoing projects score low marks in the multi criteria analysis but are selected as priority projects. The reasons for selecting the priority projects are summarized below.

(i) Upgrade of NR-9 (Project No.1): this project scores the highest marks for balanced and basic needs oriented weighting of decision parameters and the second highest mark for economy oriented weighting; suggesting it will contribute to expansion of regional economy and poverty alleviation and it would have less adverse impact on environment in spite of its scale.

(ii) Construction of Sedone Bridge (Project No.14): this project scores the highest marks for economy oriented weighting of decision parameters and the second and third highest marks for balanced weighting and basic needs oriented weighting respectively; suggesting it will contribute to the expansion of the regional economy and would have less adverse impact on the environment.

(iii) Replacement of Bridge along NR-9 (Project No.12): this project scores the third highest marks for all weighting systems of decision parameters. Together with the Upgrade of NR-9 (Project No.1), it may generate multiple impacts on economic growth and social development in the region.

Table 3.4.27 Summary of Evaluation Result (Economy Oriented Weighting)

No.	Project Road	Type of Project	Total Score
1	NR-9	Road Upgrade	0.304
2	NR-1F	Road Improvement	-0.429
3	NR-1G	Road Development	-0.268
4	NR-1J	Road Development	-0.482
5	NR-14A	Road Improvement	-0.018
6	NR-14B	Road Improvement	-0.429
7	NR-14C	Road Improvement	-0.393
8	NR-15A	Road Improvement	0.071
9	NR-15B	Road Improvement	-0.429
10	NR-16A	Road Improvement	-0.429
11	NR-16B	Road Improvement	-0.750
12	NR-18A	Road Improvement	-0.429
13	NR-9	Bridge Replacement	0.161
14	NR-1J	Sekaman Bridge Construction	0.036
15	NR-15A	Sedone Bridge Construction	0.375
16	NR-16B	Sekong Bridge Construction	0.036
17	NR-20	Bridge Replacement	0.000

Table 3.4.28 Summary of Evaluation Result (Balanced Weighting)

No.	Project Road	Type of Project	Total Score
1	NR-9	Road Upgrade	0.378
2	NR-1F	Road Improvement	-0.327
3	NR-1G	Road Development	-0.202
4	NR-1J	Road Development	-0.465
5	NR-14A	Road Improvement	0.132
6	NR-14B	Road Improvement	-0.333
7	NR-14C	Road Improvement	-0.341
8	NR-15A	Road Improvement	0.072
9	NR-15B	Road Improvement	-0.377
10	NR-16A	Road Improvement	-0.388
11	NR-16B	Road Improvement	-0.706
12	NR-18A	Road Improvement	-0.405
13	NR-9	Bridge Replacement	0.140
14	NR-1J	Sekaman Bridge Construction	-0.047
15	NR-15A	Sedone Bridge Construction	0.315
16	NR-16B	Sekong Bridge Construction	-0.047
17	NR-20	Bridge Replacement	0.000

Table 3.4.29 Summary of Evaluation Result (Basic Needs Oriented Weighting)

No.	Project Road	Type of Project	Total Score
1	NR-9	Road Upgrade	0.443
2	NR-1F	Road Improvement	-0.229
3	NR-1G	Road Development	-0.142
4	NR-1J	Road Development	-0.441
5	NR-14A	Road Improvement	0.277
6	NR-14B	Road Improvement	-0.232
7	NR-14C	Road Improvement	-0.283
8	NR-15A	Road Improvement	0.069
9	NR-15B	Road Improvement	-0.330
10	NR-16A	Road Improvement	-0.342
11	NR-16B	Road Improvement	-0.659
12	NR-18A	Road Improvement	-0.384
13	NR-9	Bridge Replacement	0.120
14	NR-1J	Sekaman Bridge Construction	-0.127
15	NR-15A	Sedone Bridge Construction	0.250
16	NR-16B	Sekong Bridge Construction	-0.127
17	NR-20	Bridge Replacement	0.000

3.4.5 Draft Road Development and Improvement Plan towards 2025

(1) Road Development Plan 2011 - 2020

The Road Development Plan 2011–2020 lists the prioritized projects for improvement and new construction towards the year 2020. These projects are prioritized based on the criteria developed by the Ministry of Planning and Investment and categorized into the following groups. The government is currently in the process of finalising the selection of the projects to be implemented by the year 2020.

Roads for Economic Development at National Level

Twenty one projects, totaling 1,514 km in length of national road, have been identified as contributors to economic development at national level. These projects require the estimated funding of LAK 15,035 billion. In the southern region, construction of NR-1J (Project No. 14 in the following table) and improvement of NR-16B (No. 16) are listed amongst these projects.

Table 3.4.30 Road Development Plan 2010-20 (1/2)

No	Project Name	Distance (km)	Estimated Cost	
			(mill kip)	(milli USD)
1	Maintain National Road		1,394,000	164.5
2	Improvement of NR4 (NR13N - Nakha)	368	753,100	88.9
3	Improvement of NR2E (Khoua -Taijang)	69	365,590	43.1
4	Improvement of NR13N (Nateu -Oudomxai)	78	360,080	42.5
5	Mekong Bridge Construction (Thakek-Nkhonphanom) Thai Grant	0.78	431,438	50.9
6	Mekong Bridge Construction (Houaysay-Xiengkhong) Thai 50%, Chinese 50%	0.48	465,459	54.9
7	Mekong Bridge Construction (Thadeua-Pakkhone) NDCF Korea Loan	0.4	136,100	16.1
8	Mekong Bridge Construction (Pakbeng) Chinese Loan	0.45	595,080	70.2
9	Improvement of NR1A (Bounneua-Lantui) Chinese Loan	145	688,500	81.2
10	Improvement of NR1B (Paknamnoy-Ban Yor) WB	109	101,225	11.9
11	Improvement of NR6A (Sopbao -Ban Dan) WB	60	53,915	6.4
12	Improvement of NR6A and 6B (Hanglong - Pahang) ADB	86	104,932	12.4
13	Construction of NR11(Sikhay -Namsang Bridge) NEDA Thai Grant	92	170,060	20.1
14	**Construction of NR1J (Attapeu -Cambodia border)**	**81**	**297,550**	**35.1**
15	Improvement of NR13N, (Pakmong -Oudomxai)	82	348,580	41.1
16	**Improvement of NR16B (Sekong -Vietnam Border)**	**94**	**424,031**	**50.0**
17	Expressway Construction (Vientiane -Phonhong)	70	6,375,000	752.3
18	Expressway Construction, (Km 21-Ban Hay)	40	1,700,000	200.6
19	Improvement of NR17B, (M. Sing-Xiengkok)	97	45,000	5.3
20	Mekong Bridge Construction (Lao-Myanmar)	n/a	225,000	26.6
21	Improvement of NR19 (Bounneua-Pakha (China boder))	41	14,400	1.7

Note: The projects show in bold text are in the study area.

Source: MPWT (2009) Road Development Plan 2010 - 20

Roads for Economic Development at Local Level

Sixteen projects, totalling 420 km in length of national road, have been identified as contributors to economic development at local level. These projects require the estimated funding of LAK 7,556 billion. In the southern region, construction of NR-14A (Project No. 1 in the following table), improvement of NR-15B (No. 3), NR-16A (No. 10), 14C (No. 11) and 1G (No. 13) are listed amongst these projects.

Table 3.4.31 Road Development Plan 2010-20 (2/2)

No	Project Name	Distance (km)	Estimated Cost	
			(million kip)	(million USD)
1	**Construction of NR14A (Mekong Bridge – Cambodia border)**	**131**	**297,000**	**35.0**
2	Improvement of Road (Jinaimo-Hatdokkeo-Thadeua)	37	252,000	29.7
3	**Improvement of NR15B (Napong - Saravane)**	**76**	**171,000**	**20.2**
4	Improvement of NR4B (Xiengman-Hongsa)	128	288,000	34.0
5	Upgrade of NR1C (Pakmong-Phoulao)	254	1,079,500	127.4
6	Mekong Bridge Construction (Ban Houay-Khong District) Chinese Loan	0.56	295,800	34.9
7	Mekong Bridge Construction (Louang prabang - Chomphet District)	n/a	405,000	47.8
8	Mekong Bridge Construction (Kokkhaodor -Paklay District(NR11))	0.4	108,000	12.7
9	Upgrade of Road NR1E (Yommalath - Khamkheut)	93	369,000	43.5
10	**Improvement of NR16A (Pakxong - Attapeu)**	**71**	**504,000**	**59.5**
11	**Improvement of NR14C (Ban Nongnga -Cambodia border)**	**63**	**0**	**0.0**
12	Improvement of NR1F (NR12 Mahaxai-Xethammouk NR9)	133	477,000	56.3
13	**Improvement of NR1G (Phin District -NR15A Saravane)**	**129**	**330,750**	**39.0**
14	Improvement of NR1H (Ban Beng -Thateang)	20	36,000	4.2
15	Provincial, District and Rural Road Maintenance		2,804,000	330.9
16	Fund Management, Road Safety, Urban Development Administration Authority		139,400	16.4

Note: The projects show in bold text are in the study area.

Source: MPWT (2009) Road Development Plan 2010 - 20

Provincial and District Roads (Local Roads)

Four hundred and three projects have been identified, of which 188 projects, totaling up to 4,717 km length, are provincial roads; while 215 projects, totaling up to 3,812 km length, are district roads: all requiring the estimated funding of LAK 6,569 billion.

Special Roads

One hundred twenty projects have been identified requiring the estimated funding of LAK 8,324 billion. The special roads come under the responsibility of many different agencies including the Ministry of Defense, the Ministry of Agriculture and Forestry, the Ministry of Energy and Mines and the National Tourism Authority.

The total required funds for the road network improvement and construction was estimated at LAK 40,153 billion, excluding the funds allocated to the on-going projects and funds already earmarked for the planned projects. Considering the southern region, five projects (NR-16B, 14A, 15B, 16A, and 14C) have been earmarked for local funding while two projects (NR-1J and 1G) will be implemented with the help of external funding that is currently being sought (see table 3.4.32).

Table 3.4.32 Road Development Plan 2010-15 in Southern Province

No	Project Name	Distance (km)	Possible Period	Estimated Cost (million kip)			Possible Fund
				Internal	External	Total	
1	Construction of NR-1J (Attapeu - Cambodia border)	81	2011-13	50	297,500	297,550	External
2	Improvement of NR-16B (Sekong - Vietnam Border)	94	Ongoing	424,031		424,031	Gov (Private)
3	Construction of NR-14A (Mekong Bridge – Cambodia border)	131	Ongoing	297,000		297,000	Gov (Private)
4	Improvement of NR-15B (Napong - Saravane)	76	Ongoing	171,000		171,000	Gov (Private)
5	Improvement of NR-16A (Pakxong - Attapeu)	71	2010-12	504,000		504,000	Gov (Private)
6	Improvement of NR-14C (Ban Nongnga - Cambodia border)	63	Ongoing	137,700		137,700	Gov (Private)
7	Improvement of NR-1G (Phin District - NR15A Saravane)	129	n/a		330,750	330,750	External

Source: MPWT (2009) Road Development Plan 2010 - 20

(2) Draft Road Development and Improvement Plan towards 2025

As discussed above, three projects; Upgrade of NR-9, Construction of Sedone Bridge and Replacement of Bridge along NR-9, scored the highest marks after the multi criteria analysis and were promptly recommended as the priority projects up to the year 2015. The entire analysis, including the project long list, the evaluation criteria and weighing parameters, the traffic demand forecast, and socio-economic analysis as well as engineering study, should all be carefully reviewed by concerned agencies so as to establish consensus as regards priority projects up to the year 2015. Afterwards, the study team will draft long-term road development and improvement plan towards 2025 in the southern region, considering the budgetary constraints and on-going projects, as well as maintaining consistency with the above mentioned Road Development Plan 2010 – 2020.

3.5 Road Operation and Maintenance Policy

3.5.1 Review of Road Maintenance Program

For sustainable preservation of road assets, the Road Maintenance Program (RMP) led by the World Bank and ADB has been under implementation. The program comprises two phases that span 8 years starting from 2001. The program assists the Lao PDR in strengthening the financing and management capacity for road maintenance at central and local levels in the public and private sectors, and strengthens the capability of the RMF with the following objectives in the respective phases.

- Phase-1 (2001-2005): Initiation and establishment of a financing framework for road maintenance, introduction of a road management system and heavy truck control, establishment of a scheme for periodic maintenance and rehabilitation of all roads, and strengthening the capability of MPWT.
- Phase-2 (2005-2009): Expansion and scaling up of the phase-1 for sustainable capacity of road maintenance

Approximately 65% of the funding is undertaken by international donors as shown in Table 3.5.1. The major program components and the summary of the expenditures on the components of Phase-2 are shown in Table 3.5.2.

Table 3.5.1 Summary of Source of Funds for RMP Phase-2

(Unit: Million USD)

Source of Fund		Budget Allocation	
Donors	Category	Amount	Proportion
IDA	Credit	24.39	36%
PHRD	Grant	4.80	7%
SIDA	Grant	11.06	16%
ADB	Loan	1.00	1.5%
JSDF	Grant	1.00	1.5%
Government of Lao	General Account	9.55	14%
Government of Lao (RMF)	Special Account	15.11	22%
AusAID	-	1.71	2%
Total		68.62	100%

Source: DOR, MPWT (2009), Road Maintenance Program-Phase2, 1st Semi-Annual Project Progress Report FY2008/09, Edited and Summarized by JICA Study Team

Table 3.5.2 Summary of Expenditure by Project Component of RMP-2

(Unit: Million USD)

No	Component	Budget Allocation	Remarks
1	Road Preservation	54.86	
1-1	- National Roads	25.38	Including routine, periodic maintenance and Rehabilitation
1-2	- Local Roads	29.5	
1-3	- Implementation Support	3.16	
2	Capacity Building	9.94	Including RMF support, road and traffic surveys, IT equipment installation, road safety equipment, environmental and social capacity development
2-1	- Road Management and Financing	3.06	
2-2	- Road Transport and Safety	0.65	
2-3	- Institutional Capacity Building	6.22	
3	Project Administration	0.80	
3-1	- Project Monitoring	0.22	
3-2	- Incremental Operation Costs	0.42	
3-3	- Technical and Financial Audit	0.16	
	Total	68.75	

Source: DOT, MPWT (2009), Road Maintenance Program-Phase2, 1st Semi-Annual Project Progress Report FY2008/09, Edited and Summarized by JICA Study Team

3.5.2 Mid-term Road Operation and Maintenance Plan

Funding for roads falls into the following two broad categories:

- Maintenance and preservation of the existing road network, and
- Upgrade and expansion of the road network.

The total requirement for road funding for the period up to 2015 is estimated at 27,103 billion kip, of which 16,555 billion kip is for upgrade and expansion of the road network while 10,548 billion kip is for road maintenance. On the other hand, the total available funds for the period up to 2015 are estimated at 7,614 billion kip, which is far less than the required amount as shown in Table 3.5.3.

Table 3.5.3 Required Cost and Estimated Available Fund by 2015

(Unit: Billion Kip)

Required Cost in Total	27,103
Required Cost for Upgrade and Expansion	16,555
Required Cost for Maintenance	10,548
Estimated Available Fund	7,614

Source: DPC (2009), Strategy for Transport Sector Development for the Period 2008-2010 and Direction for 2011-2015, Edited and Summarized by JICA Study Team

The required funds for upgrade and expansion of the road network by 2015, of which the requirements are identified by the Master Plan, Strategy for Transport Sector Development for the Period 2008-2010 and Direction for 2011-2015, are summarized by type of road in Table 3.5.4.

Table 3.5.4 Required Funds for Upgrade and Expansion of Road Network by 2015

Road Classification	No of Projects	Total Length in Km	Estimated Cost (Unit: Billion Kip)
National Roads linking with neighboring countries	17	638	2,965.5
National Roads connecting within country	15	706	3,947.4
Provincial Roads	118	3,813	4,789.2
District Roads	215	4,716	1,815.5
Special Roads	27	765	3,037.5
Total	392	10,638	16,555.2

Source: DPC (2009) Strategy for Transport Sector Development for the Period 2008-2010 and Direction for 2011-2015

Table 3.5.5 Required Funds for Road Maintenance by Province by 2015

Provinces	Fiscal Year						
	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Vientiane Capital	70,423	17,482	51,049	49,557	55,813	12,136	66,112
Phongsaly	75,098	34,968	31,676	31,453	4,308	9,120	7,771
Louangnamtha	36,700	48,977	33,597	39,051	9,186	9,128	27,651
Oudomxay	168,872	35,248	29,424	176,551	52,685	68,152	34,076
Bokeo	63,857	6,144	2,818	20,796	9,482	10,456	22,360
Louangphabang	310,822	16,271	42,667	136,196	46,395	73,054	88,763
Xayaboury	130,130	3,355	62,330	114,126	39,063	22,065	50,605
Houaphan	69,538	13,322	91,366	74,331	26,146	52,865	38,160
Xiengkhouang	336,563	26,034	183,903	76,451	7,912	45,137	28,358
Vientiane	260,321	44,415	39,909	59,519	46,089	71,757	43,879
Borikhamxay	127,470	33,558	74,706	62,369	7,255	45,967	18,821
Khammouan	239,708	33,799	95,283	115,702	86,683	96,194	64,271
Savannakhet	987,078	393,372	131,419	200,994	208,606	121,155	85,729
Saravan	905,684	65,295	28,303	110,691	30,021	40,396	27,773
Champasack	940,092	43,002	118,283	93,158	62,926	62,561	56,945
Xekong	87,799	6,812	42,037	16,879	7,884	21,201	27,197
Attapeu	96,764	27,872	37,222	32,757	48,552	44,509	43,716
Total	4,906,919	849,923	1,095,992	1,410,582	749,005	805,852	732,186

Source: DPC (2009) Strategy for Transport Sector Development for the Period 2008-2010 and Direction for 2011-2015

The required funds for road maintenance for the period running from 2008 to 2015 by province are summarized in the Table 3.5.5. The costs are estimated based on the data collected by the Public Works and Transport Institute (PTI) in 2008. The data includes the total road length of 30,585km, of which the national roads are 6,917km, provincial roads are 6,098km, district roads are 4,262km and rural roads are 13,308km.

The estimated available funds by 2015 are summarized in Table 3.5.6. At present, the fund for roads relies on different sources including government revenues such as fuel levy, toll collection and over-weight fines managed by Road Maintenance Fund, development partners and communities. It is also planned that a portion of revenue from the NT-2 Hydropower Project will be provided as a source of the road fund from the fiscal year of 2010/11.

Table 3.5.6 Funding Sources and Estimated Available Fund by 2015

(Unit: Billion Kip)

Revenue Source	08/ 09	09/ 10	10/ 11	11/ 12	12/ 13	13/ 14	14/ 15	Total
1. Direct Fund	166	182	200	220	250	275	300	1.593
2. Road Maintenance	180	225	270	324	378	441	513	2.331
3. NT2	-	90	90	90	90	90	90	540
Sub-total (Government Fund)	346	497	560	634	718	806	903	4.464
Donor fund	450	450	450	450	450	450	450	3.150
Total	796	947	1.010	1.084	1.168	1.256	1.353	7.614

Source: DPC (2009) Strategy for Transport Sector Development for the Period 2008-2010 and Direction for 2011-2015

As observed hitherto, the overall budgetary features of Lao PDR can be summarized as follows:

National Budget

- The budgetary performance in recent years is approaching the target to be achieved by the year 2010 set out by the 6th NSEDP (2006-2010),
- However, the fact is that the target in the 6th NSEDP was adjusted to a more achievable level for Lao PDR in consideration of major failures in achievement of the target set out by the 5th NSEDP, and the fact that national/ministerial budget is characterized by;
- Expenditure constantly exceeding the revenues over the previous years with chronological budgetary deficit and external indebtedness,
- The majority of foreign direct investment being directed towards the hydropower sector, followed by agriculture and services, and then being spread evenly across the remaining different sectors,
- Low rate of increase of foreign direct investment due to inadequacy of attractive environment for investment despite the improving performance observed in recent years.
- The fact that trade in Lao PDR consistently features a chronic trade deficit due to a number of constraints such as reliance on unprocessed and low value added agricultural products as major export products, concentration on smaller markets, general lack of market information, etc.,

Ministerial Budget:

- Capital investment in the Lao PDR is the largest sector of expenditure and nearly half the national budget has been expended on infrastructure development.
- The road sector seizes the majority of expenditure at 85% of the total amount on average in the MPWT,
- More than 80% of the entire expenditure of MPWT and the road sector comes from foreign aid,
- The total requirement for road funding, estimated at 27,103 billion kip up to 2015, is expected to be far in excess of the available funds, estimated at 7,614 over the same the period,

- The Road Maintenance Fund was established for the purpose of mobilizing a steady and adequate domestic funding source. However, the current revenue of the RMF covers only approximately one-third of the total costs incurred.

3.6 Economic Analysis

3.6.1 Basic Assumption

The economic effect of the master plan is evaluated in this section. At first, the following basic assumptions were employed:

- Methodology of economic analysis: In this analysis, economic cost and economic benefit of 16 projects in the master plan were added and assumed as a single project.
- With project case and without project case: with project case in this analysis was that all 16 projects in the master plan are implemented.
- Project implementation schedule: Project implementation schedule consists of 2 years of engineering service, 3 years of construction and 30 years of operation.
- Lifetime: Lifetime of civil works for the projects was assumed to be 50 years. Residual value which is 80% of project cost was evaluated and calculated in the final year of operation.
- Physical contingency, tax, consultant services and administration cost: Physical contingency and tax were not included in the economic analysis. Cost for consultant services which is 6% of the cost of the projects and administration cost which is 2% of the cost of the projects were added.

3.6.2 Economic Benefit

Economic benefit of the master plan consists of reduction in Vehicle Operating Costs (VOC) and savings in travel time. Reduction in VOC was calculated from the product of unit VOC and reduction in vehicle travel distance, while savings in travel time were calculated from the opportunity cost of a person which is equal to the product of GDP-derived time value of labor and reduction in travel time.

Table 3.6.1 Reduction in Vehicle Travel Distances

(Unit: Vehicle-km)

Vehicle Type	2015	2025
Motorcycle	804,048	1,876,582
Passenger Car	3,491,680	5,477,847
Bus	75,514	129,542
2 Axles Truck (Loading)	64,329	140,685
3Axles and more (Loading)	151,367	211,936
Trailer (Loading)	132,869	89,638
2 Axles Truck (Empty)	89,851	287,593
3Axles and more (Empty)	108,315	-63,203
Trailer (Empty)	-756,916	-913,843
Total	4,161,056	7,236,775

Source: JICA Study Team calculated from demand forecast model

Table 3.6.1 shows reduction in vehicle travel distances calculated for 'with project case' and 'without project case' considering traffic demand forecasts in 2015 and 2025. Since operation of roads was projected to start in the 6th year from the beginning of 2010, it was translated that reduction in vehicle travel distances will start in 2016. The reduction in vehicle travel distances from the 6th year to the 25th year; i.e. from 2016 to 2035 was estimated from the annual average growth rate.

Table 3.6.2 shows unit VOCs by vehicle type which were calculated by JICA Study Team based on data from "Preparatory Survey on Construction of the Neak Loeung Bridge in Kingdom of Cambodia." The reduction in VOCs was calculated from the product of reduction in vehicle travel distance and associated unit VOC.

Table 3.6.2 Unit VOC by Vehicle Type

Vehicle Type	Unit VOC
Motorcycle	26.3
Passenger Car	207.8
Bus	344.2
2 Axles Truck (Loading)	191.6
3Axles and more (Loading)	313.7
Trailer (Loading)	334.6
2 Axles Truck (Empty)	191.6
3Axles and more (Empty)	313.7
Trailer (Empty)	334.6

Source: Calculated by JICA Study Team based on "Basic Design on 2nd Mekong Bridge Development Project in Kingdom of Cambodia"

Table 3.6.3 Reduction of Vehicle Travel Time

Vehicle Type	2015	2025
Motorcycle	51201	24124
Passenger Car	33868	15428
Bus	1115	484
2 Axles Truck (Loading)	1058	463
3Axles and more (Loading)	437	194
Trailer (Loading)	453	195
2 Axles Truck (Empty)	1112	481
3Axles and more (Empty)	357	166
Trailer (Empty)	307	118

Source: JICA Study Team

Table 3.6.4 shows the calculation of the time value of labor from 2010 to 2025, which was calculated from forecasts of GDP and labor force. Calculated time value of labor is USD 0.79/hour, which is 3 times higher than the value in the previous master plan (USD 0.24/hour) due to 7% GDP growth rates and appreciation of LAK against USD after 2004.

Table 3.6.4 Calculation of Time Value per Labor

	2010	2015	2020	2025
GDP (LAK billion)	47,855	68,312	99,397	139,409
Labor population (000 persons)	3,222	3,644	3,985	4,350
GDP per employee (USD)	1,732	2,186	2,909	3,737
Time value of Labor (USD/hour)	0.79	1.00	1.33	1.71

Note: USD1=LAK8575

Source: Calculation by JICA Study Team using Statistical Yearbook 2008

Table 3.6.5 shows the number of passengers, and time value of vehicle and cargo by vehicle type. Time value of a vehicle is calculated from the product of time value of labor (in Table 3.6.4) and the number of passengers by vehicle type. Regarding time value of cargo, the amounts which were calculated in "The Comprehensive Study on Logistics Strategy in Lao PDR" were employed.

Table 3.6.5 Time Value of Vehicle and Cargo by Vehicle Type in 2010

Vehicle Type	Number of Passengers (Persons)	Vehicle (USD/hour)	Cargo (USD/hour)	Vehicle + Cargo (USD/hour)
Motorcycle	1.5	1.2	-	1.2
Passenger Car	2.5	2.0	-	2.0
Bus	30	23.8	-	23.8
2 Axles Truck (Loading)	1.5	1.2	0.4	1.6
3Axles and more (Loading)	1.5	1.2	1.1	2.3
Trailer (Loading)	1.5	1.2	2.7	3.9
2 Axles Truck (Empty)	1.5	1.2	-	1.2
3Axles and more (Empty)	1.5	1.2	-	1.2
Trailer (Empty)	1.5	1.2	-	1.2

Source: JICA Study Team

The time value of a vehicle will increase in accordance with the increase in time value of labor every year. However, the time value of cargo will remain constant during the project implementation period. The total time value of vehicles and cargo was calculated from the product of reduction in vehicle travel time and the total time value of vehicles and cargo.

3.6.3 Economic Cost

Table 3.6.6 shows the construction cost of roads and bridges. Total construction costs were estimated at USD641.3 million for roads and USD292.6 million for bridges. The above costs are financial costs including physical contingency; therefore, the economic costs were established by the following calculations.

- Exemption of physical contingency (10% of total project cost), and
- Conversion of domestic portion of the construction cost by use of "Standard Conversion Factor"

Table 3.6.6 Construction Cost: Roads

Route	Road Length (km)	Construction Cost (million USD)	Total Proposed Length (m)	Bridge Construction Cost (million USD)
NR-9	244.0	99.3	2,397	60.2
NR-1G	130.0	65.0	1,571	41.1
NR-1J	81.0	51.0	170	11.0
NR-14A	137.5	49.0	1,061	22.1
NR-14B	149.0	53.0	926	19.1
NR-14C	42.0	15.0	158	3.2
NR-15A	73.0	28.0	786	20.2
NR-15B	165.0	107.0	2,117	47.2
NR-16A	71.0	38.0	215	4.5
NR-16B	123.0	91.0	920	21.5
NR-18A	112.5	45.0	1,283	32.7
NR-20	-	-	474	9.8
Total	1,348.0	641.3	12,078	292.6

Source: JICA Study Team

Proportion of domestic portion and foreign portion of the project was estimated at 70:30 for road projects and 50:50 for bridge projects. Regarding the Standard Conversion Factor, 96.4% of the SCF was employed. The figure comes from "Study on Integrated Distribution Center in Savannakhet and Vientiane in Lao PDR," conducted by JETRO in 2005. After these calculations, economic costs of road projects and bridge projects were established as USD568.3 million for road projects and USD261.2 million for bridge projects.

Table 3.6.7 Annual Investment Amount

(Unit USD million)

Year	1	2	3	4	5	Total cost	Remarks
Construction Cost: Roads	-	-	189.4	189.4	189.4	568.3	89% of financial construction cost
Construction Cost: Bridges	-	-	87.1	97.1	87.1	261.2	89% of financial construction cost
Consulting Service	19.6	19.6	5.6	5.6	5.6	56.0	6% of financial construction cost
Administration	8.1	8.1	8.1	8.1	8.1	40.6	2% of financial construction cost
Total Investment Cost	27.7	27.7	290.2	290.2	290.2	926.1	-

Source: JICA Study Team

Table 3.6.7 shows annual investment cost. Total investment cost including cost for consulting services and administration will amount to USD926 million.

Table 3.6.8 shows operation and maintenance costs for roads. The costs consist of routine maintenance costs disbursed every year and periodic maintenance costs which are disbursed every 5 years for DBST and 10 years for asphalt concrete. The operation and maintenance costs also vary for DBST and asphalt concrete. Asphalt concrete will be used only for NR9 while DBST will be used for other roads. Total of the routine maintenance costs was estimated to be USD 1.0 million while total of the periodic maintenance costs was estimated at USD 30.7 million every 5 years and USD 56.0 million every 10 years.

Table 3.6.8 Operation and Maintenance Costs of Roads

(Unit: USD million)

Kind of Pavement		DBST		Asphalt Concrete	
Route	Road Length (km)	Routine Maintenance Costs (Every year)	Periodic Maintenance Costs (Every 5 year)	Routine Maintenance Costs (Every year)	Periodic Maintenance Costs (Every 10 year)
Unit Cost (USD/km)		657	27,908	1,149	97,513
NR-9	244.0	-		0.3	25.7
NR-1G	130.0	0.1	3.6	-	-
NR-1J	81.0	0.1	2.3	-	-
NR-14A	137.5	0.1	3.8	-	-
NR-14B	149.0	0.1	4.2	-	-
NR-14C	42.0	0.0	1.2	-	-
NR-15A	73.0	0.0	2.0	-	-
NR-15B	165.0	0.1	4.6	-	-
NR-16A	71.0	0.0	2.0	-	-
NR-16B	123.0	0.1	3.4	-	-
NR-18A	112.5	0.1	3.1	-	-
NR-20	-	-	-	-	-
Total	1,348.0	0.7	30.3	0.3	25.7

Source: JICA Study Team

3.6.4 Calculation of EIRR

Table 3.6.9 shows the annual economic cost, annual economic benefit and net cash flow. Economic Internal Rate of Return (EIRR) calculated from the Net Cash Flow is 7.8%. The amount is lower than substitution cost, which is set at 12%.

The various road and bridge projects included in the master plan have various high economic effects. Therefore, if the economic effects of each route were evaluated singly, it is expected that some projects would have enough feasibility as regards the national economy.

The other reason for the low EIRR in the economic analysis is the limited population in the study area. The populations of Sekong and Attapeu Provinces were only 85,000 and 112,000 respectively in 2005. Besides that, the populations of Savannakhet and Champasak Provinces are concentrated in the provincial towns and western sides of the provinces. It is thus necessary to consider not only the contribution to the national economy but also to the provision of national minimum service to the Lao nation.

Table 3.6.9 Cash Flow of the Master Plan

(Unit USD million)

Economic Cost	Economic Benefit		Net Cash Flow
	Reduction in VOCs	Time savings	
27.7			-27.7
27.7			-27.7
290.2			-290.2
290.2			-290.2
290.2			-290.2
1.0	4.2	15.4	18.6
1.0	4.4	17.9	21.2
1.0	4.6	20.7	24.3
1.0	4.9	23.9	27.8
31.3	5.1	27.7	1.6
1.0	5.4	32.1	36.5
1.0	5.7	37.1	41.8
1.0	6.1	43.0	48.0
1.0	6.4	49.8	55.2
57.0	6.8	57.6	7.4
1.0	7.2	66.7	72.9
1.0	7.2	77.3	83.5
1.0	7.2	89.5	95.7
1.0	7.2	103.7	109.9
31.3	7.2	120.1	96.0
1.0	7.2	139.1	145.3
1.0	7.2	161.1	167.3
1.0	7.2	186.7	192.9
1.0	7.2	216.3	222.5
57.0	7.2	250.6	200.8
1.0	7.2	250.6	256.8
1.0	7.2	250.6	256.8
1.0	7.2	250.6	256.8
1.0	7.2	250.6	256.8
31.3	7.2	250.6	226.5
1.0	7.2	250.6	256.8
1.0	7.2	250.6	256.8
1.0	7.2	250.6	256.8
1.0	7.2	250.6	256.8
-308.1	7.2	250.6	565.9
EIRR			7.8%

Source: JICA Study Team