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Byoungki KIM

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Byoungki KIM

Graduate School of International Cooperation Studies, Kobe University
E-Mail: kim_byoungki@hotmail.com

Abstract

Transport and electric power development are essential for attainment of the NGPES of Lao PDR, such as human resource development, rural development, and participation in development with equitable distribution of benefits. Poverty in Lao PDR is primarily a rural phenomenon connected with a slowing agricultural growth due to insufficient infrastructure. Support for integration of markets, both domestic and external, can facilitate rural development and help all provinces participate in economic growth. To access to markets easily and to increase cash income road improvements and electrification in rural area are indispensable. Lao PDR can benefit from previous development experience provided they choose the right model[1]*. However, the relationship between infrastructure and economic growth is still frequently debated. This paper will examine how roads and electricity development contribute to rural development in Lao PDR.*

Keywords: Lao PDR, Public investment, Infrastructure, Rural development, Poverty reduction

1. Introduction

A good infrastructure helps to raise productivity and lower costs in the directly productive activities of the economy, but it has to be expanded fast enough to meet the demand for infrastructure in the early stage of development. The lack of infrastructure is hindering the economic development in Lao People's Democratic Republic (PDR) and many other developing countries[2]. Infrastructure investment has the effects of contributing to increase the productivity and it is expected to contribute to future economic growth in developing countries where infrastructure is still insufficient. Therefore, infrastructure development is one of the most integral parts of the public policies in Lao PDR. This can be inferred from the fact that many advanced countries and World Bank, Asian Development Bank, and UNDP are actively promoting the improvement of infrastructure by providing various support programs to Lao PDR.

Lao PDR is a landlocked country with an inadequate infrastructure and a largely unskilled work force. According to *the population census 2005,* about 73% of its population living in rural areas and a large

[1] Yoshida (2000) and Il Sakong (1993) reviewed the Japan and Korea's experience of their infrastructure development.
[2] See Cynthia (2005), IMF (2004), Ifzai et al (2003), Hemamala (2006), Shiladitya (2004), and World Bank (1994, 2006).

majority of these people depends on agriculture, mostly subsistence rice farming, and producing 44.5% of GDP but contributes only 7.3% of registered export in 2005. The country's per capita income in 2005 was estimated to be US$511. More than 4 million people live in rural areas with about 38% living below the poverty line in 2003. Domestic savings and foreign direct investment are low, forcing the country to rely heavily on foreign assistance and concessional loans as investment sources for economic development[3].

Lao PDR has few reliable transport routes and there is no railroad, and it is one of the lowest levels of electrification in Asia. This situation restricted the movement of people and goods inter-provincially and inter-nationally, and it isolated markets throughout the country. Since 1990s, many roads and power stations are under the construction by the support of international organizations and many advanced countries[4]. According to the *National Growth Poverty Eradication Strategy* (NGPES), the Lao PDR's long-term national development goals are to be achieved through moving consistently towards a market oriented economy and building up the needed infrastructure throughout the country. To attain these goals, the government of Lao has outlined the strategic priorities. The government gives the priorities to the development and modernization of social and economic infrastructure in order to facilitate economic development in each region of the country, to accelerate regional and international economic integration, and to facilitate access to electricity for people in all areas and regions of the country in order to foster integrated economic development[5].

Prediction of demand pattern and investment allocation, which are the key factors of infrastructure development planning, must be based on a long-term economic development trend and land use planning, which predicts the country's temporal and spatial demographics and economic structure because construction expense for infrastructure is enormous and construction period is also long. However, the precise relationship between infrastructure and rural development is still frequently debated. This paper will examine how infrastructure such as roads and electricity development contribute to rural development in Lao PDR. First, the situation of poverty and infrastructure will be overviewed and then the effect of road and electricity infrastructure on poverty reduction will be estimated. Second, the patterns of demand for roads and electricity which are key infrastructures in national development will be analyzed. Finally, strategic viewpoints on future infrastructure development for economic growth long-run in Lao PDR will be discussed.

2. Empirical studies on infrastructure development in developing countries

Infrastructure is referred to as social overhead capital by Hirshman (1958). Social overhead capital

[3] In fiscal year 1999, for example, foreign grants and loans accounted for more than 20% of GDP and more than 75% of public investment.

[4] Mosley (1985) insisted that it is obviously important that aid go not only to the poorest countries but also to the poorest people within recipient countries. And the greater part of the aid budget that is devoted to rural development and the social infrastructure, rather than to industrial development, fundamental research, railways, urban housing, etc., the greater proportion of aid which goes directly to the poor.

[5] See IMF (2004) *The National Growth Poverty Eradication Strategy (NGPES).*

encompasses activities that share technical features such as economies of scale and economic features like spillovers from users to non-users. Social overhead capital contributes to enhancing productivity and assists in the realization of the potential ability of human capital, and creates situations in which that potential can fully function. It also contributes directly and indirectly to improving the safety and quality of people's lives. The social capital acts as a priming to expand private sector investment, and in contrast, social capital becomes relatively lacking along with the expansion of private capital and productive activities. When that happens, the private sector's indirect production costs gradually increase and private sector capital input declines. At this stage, demand for social capital investment recurs and such investment is expended.

Cynthia et al (2005) assessed the impacts of transport and energy infrastructure on poverty reduction. For both rural transport and energy improvements, the studies supported the hypothesis on wage employment concerning increased employment and wage rate, but found that these did not accrue disproportionately to the poor. The aggregated impact of transport and energy improvement taken together has a greater poverty reduction effect than their individual effects. This study recommended that investment in transport and energy infrastructure should be continued until national networks ensure that all people have access to quality services. And the development community should be continued to support transport and energy infrastructure and related services.

IMF (2004) provided some evidence that rural transport improvements decrease transport costs for the poor and generates farm and non-farm income. And rural energy improvements improved the quality of education and health care for the poor, and increased information flow to the poor. They also found that both rural transport and energy improvements increased employment and wage rates, and the aggregated impact of transport and energy improvements has a greater poverty reduction effect. World Bank (1994) emphasized that there is a close relationship between infrastructure and economic growth. This is seen in the lack of infrastructure development hindering the economic growth in China and in many case studies, such as those on the direct and indirect economic impact of infrastructure in farming sector in India.

Yoshida (2000) presented a positive analysis from various angles of the correlations between economic growth and the infrastructure in Japan, such as the energy and transport sectors over the last century in order to derive lessons that can be useful to developing countries. He found that the growth rate of demand in infrastructure was much higher than that of per capita GNP in the early stage of development, and public investment in infrastructure was big. And he also found that infrastructure investment in rural area had a trend to correct the regional income disparities. Yoshino and Nakahigashi (2000) estimated the productivity effect of social capital stock by industry, sector and region, and clarified the relationship between social capital stock and economic development. As a result, (1) by industry, the productivity effect of social capital stock is large in the tertiary industry, (2) by sector, the productivity effect of social capital stock is large in information and telecommunication, and environment sectors, and (3) by region, the effect is large in regions with large urban areas. To see the result of their analysis from the view point of the development of developing countries, relationship between social capital and economic growth is examined

from statistical data.

Canning (1998) provided a data set on physical infrastructure stocks, such as roads, paved roads, railway lines, electricity generating capacity, telephones, and telephone main lines. The data contains a description of annual database of physical infrastructure stocks constructed for a cross section of 152 countries for the period 1950-95. According to this estimation, telephone and paved roads are generally most promoting economic growth, but in some countries these are oversupplied or undersupplied. On the other hand, this indicates that the electric power is generally undersupplied. Also, Shah (1992) estimated a cost function including infrastructure such as, transportation, communication, and electric power in Mexico and showed that public infrastructure has a small but positive multiplier effect on output. There are also negative results that infrastructure investment does not contribute to economic growth[6].

3. Poverty situation in Lao PDR

Rural poverty incidence is strongly correlated with geography and the natural environment[7]. Lao PDR is the thickly forested landscape consists mostly of rugged mountains with some plains and plateaus. Poverty in Lao PDR is primarily a rural area's phenomenon related with a slowing of agricultural growth at 3.9% annually in the period of 1991-2005. Table 1 shows the per capita output of agriculture and livestock during 2002-04, the total output of whole country are very low level. Output of them in Savannakhet, Vientiane, and Saravane province where infrastructure such as roads and electricity is better off than other provinces are high beyond subsistence farming. In Northern area, per capita output of agricultural products and livestock are the lowest level in the country, most households produce their products in subsistence level.

Table 1 Output of major commodities (per capita)

	Rice (kg)			Vegetable (kg)			Cattle (head)		
Province	2002	2003	2004	2002	2003	2004	2002	2003	2004
Savannakhet	501	452	526	68	109	224	0.47	0.46	0.46
Saravane	599	605	598	123	92	87	0.26	0.29	0.29
Vientiane	511	412	462	350	267	164	0.29	0.27	0.27
Borikhamxay	267	426	508	218	295	231	0.21	0.22	0.21
Champasack	410	420	423	128	89	67	0.22	0.20	0.20
Vientiane Capital	304	289	287	140	151	142	0.09	0.09	0.10
Total	326	320	339	115	117	115	0.22	0.22	0.21

Source: National Statistics Centre

[6] See Kocherlakota and Yi (1996), and Deverajan, Swaroop and Zou (1996).
[7] See the criteria for urban and rural villages in *the population census 2005*. In the population census 1995, 83%of the population lived in rural areas. Since 1995 there has been a substantial population movement from rural to urban areas across all provinces.

Rural livelihoods depend mostly on subsistence farming. The welfare of rural household remains tightly linked to the incomes from their agricultural activities. The level of diversification of rural household incomes low and the ability to generate cash income from wage sources remains strictly limited. Even marketing of agricultural products is not yet general across rural households, with about half of farming families selling livestock in a given year, and below a third of households selling rice, outside of households in the Vientiane plain. In upland areas, non-timber forest products are generally a more important source of cash income for rural families than any cultivated crop or livestock.

The Lao rural economy is opening up to and beginning to benefit from trade with dynamic cross-border markets. World Bank (2006) found that number of poor and poverty headcount were low in Thailand border and China border district, the poverty incidence remains lowest in districts along the Thailand border[8]. And dynamic economic growth in southern China, demand for agricultural products as well as growing tourism, is apparently emerging as important growth factors for Northern Lao. Infrastructure improvement in these border districts will ensure the more benefits from cross-border market. Road networks in rural areas help farmers to move their agricultural products to market. Farmers are able to generate cash income through the selling of their agricultural products and livestock, and it stimulates farmers' incentives to product more cash crops in rural areas.

According to World Bank (2006) estimation, only 39% of rural households were able to generate cash income, scarcely more than half the level of urban households in 2002/03. The proportion of cash income generating households is highest in Vientiane (70%) and Champassack (58%) provinces, while much lower in Xaysomboon (6%) and Phongsaly (6%) province. *Laos Expenditure and Consumption Survey 1997/98* (LECS II) estimated the revenue from household wages in Central area (73,000Kip), Vientiane province (155,000Kip), Vientiane capital (126,000Kip), and Savannakhet province (51,000Kip). The average revenue from household wage of whole country was 46,000Kip, and that of the rural areas was 44,000Kip. The lowest province was Phongsaly (2,000Kip) in the Northern region only 1.3% level of Vientiane province in 1997/98.

Table 2 indicates that the level of rural poverty remains highest in the Central-Southern highlands and Northern highlands where infrastructure is insufficient. Poverty incidence is lower in the Mekong corridor and Northern lowlands, where natural conditions for agriculture are generally better and where roads, electricity, and irrigation infrastructure in better off. Poverty incidence is lowest in the Vientiane plain, where the most developed infrastructure is situated. The proportion of cash income generating households is also highest in Vientiane plain. Opportunities to generate cash incomes are closely related to the proximity of urban areas.

A large proportion of farmers engage in subsistence farming or production systems that are still only marginally connected to markets. The level of participation in markets for the commercialization of

[8] In Vietnam border and Cambodia border districts, poverty incidence remains higher than non-border districts.

agricultural products by households is very low. LECS II reveals that only 9% of villages in the rural area are accessible to the permanent or periodical markets[9]. Accelerating the transition to producing higher valued output will entail a mix of public investment in better road and communication networks so as to reduce high transport costs that is impediments to cash crop movements. In the early 2000s, the government shifted its public investment programs more towards the Northern highlands, Northern lowlands, and Central-Southern highlands. As a result of infrastructure investments, many remote areas which were inaccessible before in the uplands were better linked to markets and social services.

Table 2 Poverty and cash income in Lao PDR

		1992/93	1997/98	2002/03	Cash income
Mekong Corridor	Number of poor	745,952	654,067	603,127	42%
	Poverty headcount	55.2	42.4	39.8	
Central-Southern Highlands	Number of poor	94,346	147,817	154,509	39%
	Poverty headcount	52.1	53.9	49.7	
Vientiane Plain	Number of poor	118,956	54,008	48,547	67%
	Poverty headcount	34.8	13.9	16.6	
Northern Highlands	Number of poor	460,769	522,899	476,065	23%
	Poverty headcount	61.1	53.8	45.5	
Northern Lowlands	Number of poor	385,873	415,073	329,100	38%
	Poverty headcount	50.9	41.0	32.2	

Source: World Bank (2006)

Notice: Cash income refers the share of households earning cash income in 2003.

Table 3 Household consumption by region and group of goods and services (%)

	North			Center			South		
	Urban	with road	without road	urban	with road	without road	urban	with road	without road
2002/03									
Food expenditure	29	16	10	37	21	16	43	27	15
Own produced	12	46	64	8	38	53	8	35	57
Transport	21	8	3	17	9	5	10	9	4
Others	38	30	23	38	32	26	39	29	24
1997/98									
Food expenditure	31	18	15	43	27	18	46	24	26
Own produced	18	39	55	8	36	45	9	38	48
Transport	15	15	4	14	9	13	9	12	5
Others	36	28	26	35	28	24	36	26	21

Source: *Lao Expenditure and Consumption Survey 1997/98* and *2002/03*

Table 3 shows the patterns of consumption by region in Lao PDR. With increasing income people tend to spend less on food relatively non-food items and as a result food consumption as share of total

[9] See *Lao Expenditure and Consumption Survey 1997/98*, table 22.

consumption has declined steadily from the survey 1997/98. In the rural areas the consumption of own produced food is high especially in rural area without access to road. Rural area without access to markets has fewer opportunities for marketing of products and has little multiplier effect of consumption. Transport and communications take a larger share of the total consumption in urban area but a smaller share in rural area in 2002/03. Access to road and markets seems to have a significant importance for the consumption pattern in Lao PDR.

Cynthia et al (2005) shows some evidence in the case study of China that road improvements provide the opportunity to access to market for the rural farmers. In the survey, 5 years ago 65% of the interviewed farmers went to market on foot but this proportion has declined to 42% in 1998. The proportion of farmers who take a bus to market has increased from 11% to 33%. The use of transport infrastructure is reflected not only in the choice of transport mode but also in the frequency of access to market. Five years ago, 59% of all farmers in the survey sample visited market once a month or more often. The share of farmers visiting market increased 10 percent point in 1998. Changes in transport mode and in the frequency of travel are associated with an increase in transport efficiency and time saving. Travel time to market over the past 5 years was reduced by 1.2 hours on average, although transport cost increased almost 50%. Shiladitya et al (2004) also provided the evidence that road improvement had a positive impact on income increment in rural area in Lao PDR. Road improvement increased opportunities for wage employment and cash incomes in some of the Northern provinces.

4. Infrastructure in Lao PDR

Transport and energy infrastructure is, and is seen to be, a public good, the benefits of which are available to all. Roads and electricity infrastructure investments have benefited the poor as well as the non-poor. Poor people welcome such investments, even if they are not immediately able to take advantage of them. Reduced transport costs are reflected in the prices of their products and of the goods they purchase, as well as in the increased presence of traders and service providers in their communities. Roads and electricity infrastructure create opportunities to increase the productivity of the poor. For some households, these opportunities can become powerful drivers of an escape from poverty.

According to some empirical literatures[10], transport improvements were seen as having the most significant impacts on the incomes of the poor, mainly through increasing opportunities for employment in non-farm enterprises. The impacts of electricity seemed less likely to benefit the poor in the short-term. Transport and energy investments are also important in making non-farm income generating opportunities available to land-less poor households. Comprehensive infrastructure is essential to help farmers access improved services and local, national and regional markets. A functional and well-maintained road network is a precursor to transport and trade services, and to the installation of electric power supply in rural areas.

[10] For example, Cynthia (2005), Ifzai et al (2003), Hemamala (2006), Shiladitya (2004), and Sununtar (2006).

Table 4 Electricity, communication and market access by provinces and regions (% of villages)

	Electricity	Permanent market	Over 6km to main road	Access in rainy season	Access in dry season	Scheduled passenger transport
Lao PDR	31	9	35	53	79	50
Urban	91	33	9	100	100	93
Rural	19	4	41	44	75	42
North	14	6	45	40	56	40
Phongsaly	5	4	42	32	44	25
Luangnamtha	7	9	42	31	41	27
Oudomxay	14	0	66	36	50	32
Bokeo	8	9	38	41	77	37
Luangprabang	19	2	48	45	49	47
Huaphanh	16	15	66	36	40	36
Xayaboury	15	8	27	47	82	57
Center	50	12	29	66	96	61
Vientiane C	100	14	21	100	100	91
Xiengkhuang	18	9	11	43	85	41
Vientiane P	53	11	47	74	95	58
Borikhamxay	34	18	23	49	89	51
Khammuane	33	14	38	44	95	45
Savannakhet	32	7	31	57	100	38
Xaysomboon	8	27	39	45	68	36
South	17	6	32	46	78	42
Saravane	15	5	19	51	100	47
Sekong	10	7	39	57	69	30
Champasack	20	5	37	43	68	46
Attapeu	11	17	32	35	78	18

Source: *Lao Expenditure and Consumption Survey 1997/98*

The infrastructure is very low level in Lao PDR, particularly in the rural areas. IMF (2004) presented the relationship between poverty and access to basic infrastructure in 1997/98 in Lao PDR[11]. Clearly, the poor have much less access to infrastructure, compared to the less poor. Only 38.4% and 17.1% of poor people have access to an all season road and electricity respectively. In terms of distance, the poor are on average 13kilometers from a road, compare to 9kilometers for the less-poor. Poor people in rural areas do not use electricity to meet many of their household energy needs, but electricity can help meet other needs of the poor through community services, such as potable water pumping and education.

Table 4 shows the situation of infrastructure in Lao PDR in 1997/98. It reveals only 19% of the rural villages have electricity and only 4% of the rural villages are able to access to permanent markets. In the dry season 75% of villages are accessible but less than half of them are accessible by truck in the rainy

[11] Sawada (2000) insists that infrastructure, including roads and irrigation, has a role to play in relation to transient and structural poverty. In addition to increasing economic opportunities and to reduce structural poverty, infrastructure helps minimize the risks of agricultural production, which are the main cause of transient poverty in Asia.

season. Accessibility to villages is generally lower in the Northern than in Southern or Central part of the country. In the Northern region, all provinces except Bokeo and Xayaboury province, half or more of the villages are not trafficable by truck in the dry season either. The situation of road network in the Southern and Central region, Vientiane, Savannakhet, and Saravene province, are better off. More than half of villages in only 4 provinces, Xayaboury, Vientiane, Borikhamxay, and Vientiane capital, have scheduled passenger transport services.

The government of Lao has increased its investment to economic sector, especially for the transport development. Table 5 indicates actual and planned amount of public investment by sectors. More than half of public investment had been used for the economic development, and over a third of investment in economic sector had been for the transport development in the period of fiscal year from 2001/02 to 2004/05.

Table 5 Actual and planned amounts for public investment program by sectors (in billion of Kip)

	2001/2002 (actual)		2002/2003 (actual)		2003/2004 (planned)		2004/2005 (planned)		2005/2006 (planned)	
Sectors	value	%	value	%	value	%	value	%	value	%
Economic	980	50.9	1,549	59.4	1,540	59.7	1,712	58.1	1,792	56.0
1.Agricuture	310	16.1	461	17.7	464	18.0	561	19.0	640	20.0
2.Industry	79	4.1	95	3.6	129	5.0	162	5.5	192	6.0
3.Transport	585	30.3	985	37.7	921	35.7	960	32.6	896	28.0
4.Other	7	0.4	8	0.3	26	1.0	30	1.0	64	2.0
Social	528	27.4	720	27.6	766	29.7	928	31.5	1,077	33.7
5.Education	216	11.2	299	11.5	310	12.0	384	13.0	447	14.0
6.Public health	152	7.9	229	8.8	245	9.5	299	10.2	352	11.0
7.Other	160	8.3	192	7.4	212	8.2	245	8.3	277	8.7
Other	419	21.8	341	13.1	273	10.6	310	10.5	331	10.4
Total	1,927	100.0	2,610	100.0	2,580	100.0	2,950	100.0	3,200	100.0

Source: IMF(2004)

4.1 Road infrastructure

The key to future sustainable economic growth and poverty reduction in Lao PDR is the development of an integrated market economy. Road network development is critical to providing increased access to markets and economic opportunities. With the high priority given to road development by government during the last decade, according to ADB (2000), half of the national road network is paved with about 70% of the national road network trafficable throughout the year. Nevertheless, less than 2% of the provincial roads are paved and most rural communities still do not have all season road access to market. LECS II indicates that 41% of rural villages are 6 kilometers or more from a main road and more half of the rural villages are not accessible during the rainy season.

There is a close correlation between the absence of essential transport infrastructure and poverty,

especially for remote areas. Many districts are not linked to the main national road networks and most villages are not linked to the main district or provincial roads. Rural development is therefore hampered and poverty persists in Lao PDR. Roads access to market has to be provided in remote areas to support generating of cash income though selling their agricultural products and livestock. The share of households with any income from businesses was much higher in households with access to road than households without access to road[12]. Rural roads lead farmers to increase their agricultural products and to change the subsistence farming yields to commercial farming. Rural road improvement will increase rapidly the production of crops that are perishable and it will allow farmers to take advantage of price differentials for perishable crops.

Continued improvements in road networks in Lao PDR are fundamental to supporting economic growth and realizing the goals and objectives in the NGPES. While considerable progress has been made over the past decade in extending and upgrading road networks, there are still many districts that are remote and isolated. Due to the difficulty in accessing markets to sell their surplus agricultural products, livestock, and other goods, the rural poor are locked into subsistence farming. Lack of access to all season roads, or roads of any kind, has also meant lack of access to schools, health facilities and other basic services, such as electricity and potable water. Road construction generates substantial direct and indirect employment effect[13]. Farmers' contributions to road construction were mainly in the farm of unskilled labor, but their earnings and expenditures had a multiplier effect in the local economy. Thus, the lack of infrastructure results in intergenerational poverty for poor people has limited opportunity and capacity to climb out of their poverty.

There has been a very strong growth in the Lao tourism sector since 1991, from only 4,929 international arrivals to 1,095,315 arrivals in 2005[14]. 74.3% of the international arrivals were from neighboring five countries. Tourists from Thailand were 603,189 (55.1%) and from Vietnam were 165,151 (15.1%). Better road networks will ensure to increase tourists from neighboring countries dramatically in the future. Tourism is a labor intensive industry and contributes directly to poverty reduction. Tourism is now a major contributor to national income and employment. Long-run viewpoint, the Lao PDR has to change itself as a land linked country from landlocked country through connecting of road networks[15]. Strengthen transport linkages with neighboring countries will strengthen regional integration and trade opportunities, to extend beyond limited domestic market. The Lao PDR's partners in development have been very supportive in helping to realize both this vision and the more immediate task of connecting villages to districts, districts to provincial capitals, and the capitals or districts to National Road 13[16].

[12] LECS II table 3 estimates the percent of households with any income from businesses by provinces and regions.
[13] Cynthia et al (2000) estimated that railway and road construction had substantial direct and indirect employment effect in China, Thailand, and India case studies.
[14] Tourism data is referred from the Lao National Tourism Authority.
[15] A framework agreement for investment in transport infrastructure has been signed by the governments of Cambodia, Lao PDR, Thailand, and Viet Nam to facilitate the cross-border movement of goods and people.
[16] Japan and Australia have been involved in roads and bridge construction over the past decade. Sweden, Germany, UNDP

Table 6 Demand for road infrastructure and length of roads

	Freight traffic		Passenger traffic		Total length of roads	
	1000ton	%	1000person	%	km	%
1976	271	-	2,196	-	11,462	-
1980	415	53.1	5,817	164.9	12,223	6.6
1985	686	65.3	9,884	69.9	12,383	1.3
1990	668	-2.6	13,178	33.3	13,971	12.8
1995	1,470	120.1	13,789	4.6	18,363	31.4
2000	2,309	57.1	18,761	36.1	25,090	36.6
2004	4,044	75.1	45,381	141.9	31,209	24.4

Source: National Statistics Centre, Ministry of Communication, Transport, Post and Construction

Table 7 Import of transport equipment

	Truck	Sedan car	Bus	Motorcycle	Bicycle	Tractor
1976	404	7	9	-	3,000	159
1985	358	90	18	-	12,000	50
1995	586	481	1,576	7,640	41,604	596
2004	21,370	1,254	203	439,493	113,402	92,204

Source: National Statistics Centre, *Statistics 1975-2005*

Table 6 shows that the demand for roads is increasing much faster than the supply of roads during 1976-2004. The government of Lao gives the high priority to the road network development since 1980s[17]. The arterial road network has been substantially rehabilitated and developed over the past two decades, and total length of roads increased rapidly. Table 7 shows that import of transport equipment has been increasing very fast. Import of vehicles and associated transport equipment amounted to 87 million us dollar in 2005. These two tables reveal that the demand for roads has trend to speed up recently. Therefore, rural accessibility needs urgent attention, the government's priority is to strengthen the provincial, district, and community road network to all season accessible. This will ensure that the benefits from arterial road improvements flow through to the rural population. Lower transport costs and better integration of the economy will stimulate farmers to produce more agricultural products in rural areas and contribute significantly to poverty reduction.

4.2 Electricity infrastructure

Power System Development Plan (2004) summarized two national priorities of electric power sector. First is promotion of economic and social advancement by providing a reliable and affordable domestic power supply. Second is earning of foreign exchange from electricity export. On a domestic level, the Lao power system is still in an early stage of development. In 2004, only 41% of households in Lao PDR are

and UNDCP have assisted rural roads development.

[17] Hemamala (2006) pointed out that the government has to take adequate account of the needs and requirements of the rural poor. The roads needs of the rural poor are largely for the movement of small loads over relatively short distances between

electrified but the government has committed itself to increasing this to 90 % by 2020. On an international level, due to Lao PDR's energy surplus and geographical location at the hub of the Greater Mekong Sub-region, Lao PDR is strategically positioned to play a significant role in promoting regional electric power trade. The primary markets for Lao electric power are Thailand and Vietnam.

Lao PDR is endowed with significant indigenous energy resources, but energy use within the country is still dominated by the use of firewood which accounts for 90% of total energy requirements. Hydropower is the most abundant and cost-effective energy source in Lao PDR. ADB (2000) estimated that Lao PDR has 18,000Mw of hydropower generation potential, but only 623Mw have been developed in 1999. Lao PDR is one of the lowest levels of electrification in Asia. In spite of this large potential, only 17% of the Lao population, particularly only 2% of rural households, only 20% of all villages, and 34% of all households are connected to the power grid. According to LECS II, electrified villages in the Northern areas, Phongsaly (5%), Luangnamtha (7%), and Bokeo province (8%), were very low. The government has decided to accelerate the development of hydropower generation in order to substantially increase domestic electricity supply and exports to neighboring countries, particularly to Thailand.

The improvement of energy sector's capacity to meet demands for rural electrification in Lao PDR has to be promoted. UNDP (2006) estimated that electricity consumption per capita in 2003 is 135Kwh, which is two times increase from 1998 level. Domestic energy consumption was growing at 8% to 10% annually in last decade. The Lao National Committee for Energy forecasts that the average annual growth rate of energy consumption in 2005, 2010, 2015, and 2020 will be 23%, 9%, 6%, and 6% respectively[18]. However, table 8 shows that electricity production and export during 2001-04 were decreasing in spite of rapid growth of domestic energy consumption recently. The import of electricity for the Northern region was increasing rapidly at the same period.

Table 8 Production, export, and import of electricity (Million Kwh)

	Production	Export	Import
2001	3,589	2,823	182
2002	3,602	2,798	201
2003	3,179	2,316	217
2004	3,348	2,422	277

Source: National Statistics Centre, *Statistics 1975-2005*

Cynthia et al (2005) provided the evidence that households with access to electricity performed better than those without electricity in income and consumption growth over the period 1998-2001 in the case study of China. The average per capita income growth rate among households with electricity was 16%, while in households without electricity it was only 8%. Consumption expenditure in households with

farmers' homes and their fields, pastures, woods, and water sources.

[18] Average annual growth rate of energy consumption that forecasted by aggregate EdL demand forecast was 24% in 2005, 9% in 2010, 6% in 2015, and 5% in 2020.

electricity also grew by about 15%, while they grew hardly at all among households without electricity. Hemamala (2006) also found that the average incomes of households with electricity were twice those of households without electricity.

According to World Bank (2002), willingness to pay for energy services is as high as the cost of providing grid electricity in rural areas in the case study of the Philippines. Many households without electricity are using more expensive and risky alternatives, such as kerosene lamps and auto batteries. The high cost per consumer is the main difficulty in expanding rural electricity services. If electricity connection fee is eliminated for the poor and grid electricity lowers costs, electricity consumption is expected to increase dramatically in rural areas. Hydropower production is the major non-agriculture industry in Lao PDR in terms of contribution to GDP, the government's budget, and export revenues. It is important to support private sector to participate in energy development for accelerating energy supply to industry sector and the cost down. Substitution of electricity generated domestically for import from neighboring countries will improve the balance of payments.

4.3 Estimation of the effects of road and electricity infrastructure

World Bank (1994) shows that China's transport investments amounted to only 1.3% of GNP annually during 1981-90, a period of rapid growth in transport demand. Since the onset of China's open door policy in 1979, economic growth averaging 9% a year has resulted in an unprecedented expansion in inter-city traffic with growth averaging 8% a year for freight and 12% a year for passengers. This traffic growth has imposed tremendous strains on the transport infrastructure, as manifested by the growth of bottlenecks in the railway network, the severe rationing of transport capacity on railway lines, and the poor quality of service experienced by shippers and passengers. A conservative estimate is that the annual economic costs of not having adequate transport infrastructure in China during the past several years amount to about 1% of China's GNP. This relationship is also shown in cross-section data analyses that indicate positive relationship between the levels of infrastructure, such as electricity, telecommunications, roads and other facilities and economic growth.

Ifzai (2003) summarizes the links from infrastructure investments through these determinants to the poor's wages and employment, on the one hand, and rural economic growth that influences the supply and prices of basic goods, on the other. The final links are to real income and consumption of the poor and, consequently, poverty reduction. He concludes that rural infrastructure investments can lead to higher farm and non-farm productivity, employment and income opportunities, and increased availability of wage goods, thereby reducing poverty by raising mean income and consumption. Xianbin (2003) insists that infrastructure investments enable markets to develop and function efficiently, and fragmented markets become barriers to transactions on a large scale.

Hemamala (2006), in Thailand case study, shows that nearly all respondents in household survey said that transport improvements had increased their ability to earn income. Improved transport made it easier to

get to school and thus helped increase educational attainment. Most poor people in this study believed that transport and energy contributed to poverty reduction, and that roads contributed most of all. In the case of India, the poverty reduction effect of road construction is to employ the poor as laborers. Road improvements resulted in greatly increased school enrollments for both boys and girls. This study suggested significant differences in household and per capita income between households close to and households far away from improved roads. Bjorn et al (2005) also concluded that road access is one of the factor associated with poverty in Lao PDR.

We estimated the relationship between poverty incidence, and road and electricity infrastructure in Lao PDR. The result of estimation is as follows;

$$Poverty = \underset{(7.55)^{***}}{75.1593} - \underset{(-2.36)^{**}}{0.3529}\,Road - \underset{(-1.77)^{**}}{0.2492}\,Electricity$$

Adjusted $\bar{R}^2$ =0.51, DW=2.45, F=9.72, SD=15.57

Notice: Estimation based on the data of *Lao Expenditure and Consumption Survey II*.
Poverty, Road and Electricity refer poverty incidence, percent of villages which are accessible in dry season, and have electricity respectively. Figures in parentheses are the t statistics, and ***, **, * are 1 percent, 5 percent, and 10 percent level of significance respectively.

Road and electricity infrastructure have a positive impacts, especially the road infrastructure has a significant impact on poverty reduction. This result suggests that continued investment to infrastructure such as, road and electricity will reduce poverty in Lao PDR. The government of Lao has to give high priorities to public investment especially to infrastructure and many advanced countries also have to support road and electricity infrastructure continuously.

5. The effects of infrastructure on export and foreign direct investment

The resources must be mobilized for otherwise the Lao PDR will be unable to take advantage of new opportunities as it becomes more market based and integrated with neighboring countries. Neighboring countries have maintained strong economic growth and in the vicinity of Laos the Greater Mekong Sub-region represents a market of 200 million people with growing incomes and effective demand for agricultural products in which Lao farmers have an actual or potential comparative advantage.

Table 9 shows that Lao PDR has been dependent heavily on neighboring countries in its export and import. Over half of export was towards neighboring three countries, Thailand, Vietnam, and China in last two decades. The share of export to these three countries decreased but it remains still high level in 2005. And more than 80% of import was also from these countries in 2005. Principal export commodities do not increase fast but garment has a trend to increase recently. Road and electricity infrastructure is fundamental to increase export of agricultural products and garments to neighboring countries.

Table 9 Share of export and import with neighboring countries (%)

	Export				Import			
	Total	Thailand	Vietnam	China	Total	Thailand	Vietnam	China
1990	77.3	62.6	5.6	9.2	71.2	48.7	11.8	10.7
1995	57.8	26.8	28.2	2.8	56.6	48.9	4.1	3.7
2000	51.8	11.2	38.8	1.9	81.4	55.9	22.5	3.0
2005	45.3	29.5	12.5	3.3	82.0	66.0	7.0	9.0

Source: ADB (2006)

Rapid economic growth in South, East, and South-East Asia has contributed to the continued increase in foreign direct investment (FDI) inflows. The highest growth in FDI inflows in these areas was recorded in a number of member nations of the ASEAN, such as Cambodia, Thailand and Indonesia. Table 10 shows that FDI inflows to Thailand rose from 1.4 billion dollar in 2004 to 3.7 billion dollar in 2005. FDI inflow to Lao PDR in 2005 is only 0.8% of Thailand, 1.4% of Vietnam, and less than 10% of Cambodia and Myanmar. The low level of infrastructure development and landlocked geography are hindering FDI inflows to Lao PDR[19].

The government of Lao gives the high priorities to the infrastructure development since the late of 1980s. Road and electricity infrastructure were developed rapidly over the past two decades. Fixed telephone lines increased from 6,373 in 1991 to 217,106 in 2004[20], and the number of mobile phone subscribers increased from 29,545 in 2001 to 317,484 in 2004. However, the figure is considerably lower than in neighboring countries, also in per capita terms. According to Suiwah (2006), the charges for international calls and electricity in the major cities of Lao PDR were the highest among Southeast Asian cities, even though their labor costs were relatively low. Lao PDR has significantly lowered their international call charges in the last three years but the charge for electricity is still high level in 2005[21].

UNCTAD (2006) emphasized that FDI affects the economic welfare, growth and development of host countries in a number of ways. First, foreign affiliates interact with the local economy by building production facilities and hiring workers, many of whom will require training. Second, they establish backward with suppliers and forward linkages with distributors and sales organizations, which can stimulate production in supplier and distributor firms and organizations in the host country and constitute a channel for the transfer of technology. Third, the affiliates might have a variety of indirect, spillover effects

[19] UNDP (2006) presented about landlocked developing countries. Lesotho is a small landlocked LDC, entirely surrounded by the Republic of South Africa, with a population of about 1.8million, mostly engaged in subsistence agriculture in 2004. GDP per capita was 764 dollar in 2004. Despite of its geographical disadvantages, since the mid of 1990s, Lesotho has been quite successful in attracting increased inflows of FDI, as a result of government efforts combined with trade privileges. FDI inflows in recent years have increased, from 27million dollar in 2002 to 52 million dollar in 2005, and they go mainly into manufacturing, in particular apparel, mostly aimed at markets in industrialized countries. Textiles and clothing became Lesotho's main manufacturing industry, employing 56,000workers.

[20] Use hours of phone increased dramatically, from 106 thousand hours in 1990 to 20,153thousand hours in 2004. The increase of demand for telecommunication was much higher than supply of it.

[21] According to Suiwah (2006), electricity cost for business in Vientiane was much higher than that of neighboring countries, Thailand (0.042 us$/Kwh), Hanoi (0.055), Ho Chi Minh (0.055), Vientiane (0.080), Phnom Penh (0.190) in 2005.

on local firms, for example through the impact of competition that might spur local firms to improve their performance.

Table 10 FDI flows and stock (millions of dollars)

	FDI flows			FDI stocks		
	2003	2004	2005	1990	2000	2005
Thailand	1,952	1,414	3,687	8,242	29,915	56,542
Vietnam	1,450	1,610	2,020	1,650	20,596	31,135
Cambodia	84	131	381	38	1,580	2,471
Myanmar	291	251	300	281	3,865	4,862
Laos	19	17	28	13	556	669

Source: UNCTAD (2006)

6. Conclusions

Roads and electricity has been improved since a couple of decade ago but they are still insufficient, especially in the rural areas in Lao PDR. Infrastructure development in rural area plays an important role in developing market access and supporting market expansion. Market access and strengthened market linkages enable the poor to participate fully in the opportunities to generate their income by the growth process. Transport and energy are commonly considered primarily as agents of economic growth that contribute to poverty reduction by raising incomes. Increasing labor mobility and agricultural wages, reducing transport and electricity costs, and generating opportunities for non-farm employment facilitated improvements in poor people's incomes and assets. Access to non-farm employment opportunities, in both rural areas and urban centers, becomes increasingly important as the poverty reduction process gathers momentum and economies diversify. A good infrastructure also attracts foreign direct investment into various sectors and tourists.

When motorized transport replaces animal drawn carts in rural area, farmers tend to shift from their subsistence crops to commercial crops. And the movement of perishable crops that generate cash income to market will increase rapidly. Rural transport improvements stimulate farmer's incentive to produce more agricultural products beyond subsistence farming and promote the development of non-farm activities in rural areas. As a result of rural road improvements, the export of agricultural products to the neighboring countries will be promoted. Labor intensive road construction also has a direct employment effects for the poor in rural areas. The government of Lao has to improve village roads and agricultural roads together with major and secondary roads.

Rural electrification will reduce energy costs and risks for the poor in rural area, and it will improve farm and non-farm productivity. Households with electricity are able to work longer and it makes households generate more agricultural income. In spite of a large hydropower generation potential, only a third of villages in Lao PDR are able to access electricity in 2002/03. The high cost of electricity for the

poor in rural areas is the main difficulty in expanding rural electricity services. If electricity connection fee is eliminated and electricity cost is lowered for the poor in rural areas the demand for electricity will increase dramatically. It is important to support private sector to participate in energy development for accelerating energy supply and the cost down. By substituting domestic supply of electricity to imported electricity supply the balance of payment will be improved.

References

ADB (2000), *Country Assistance Plan (2001-2003), Lao People's Democratic Republic*, Philippines.

ADB (2006), *Key Indicators 2006*, Philippines.

Bjorn L, Claude S, and Jostein N (2005), *Poverty and Environment Nexus Study in Lao PDR –Some National Perspectives*, World Bank, Washington.

Canning David (1998), A Database of World Infrastructure Stocks, 1950-95, *Working Paper*, World Bank.

Cynthia C, Tyrrell D, Somchai J, Anil S, and Wu G (2005), *Assessing the impacts of Transport and Energy Infrastructure on Poverty Reduction*, ADB, Philippines.

Devarajan, Swaroop, and Heng-fu Zou (1996), The Composition of Public Expenditure and Economic Growth, *Journal of Monetary Economics*, 37, pp.313-44.

Government of the Lao PDR (1994), *Public investment program 1994-2000*, Vientiane.

Hemamala Hettinge (2006), *When do rural roads benefit the poor and how?* ADB, Philippines.

Hirshman Albert O (1958), *The Strategy of Economic Development*, Westview Press.

Ifzai Ali, Ernesto M. Pernia (2003), Infrastructure and Poverty Reduction- What is the Connection? *EDR Policy Brief* No. 13, ADB, Philippines.

Il Sakong (1993), *Korea in the World Economy*, Institute for International Economics.

IMF (2004), *Lao People's Democratic Republic: Poverty Reduction Strategy Paper.*

IMF (2006), Lao People's Democratic Republic: Selected Issues and Statistics Appendix.

Lao National Statistics Centre (1999), *The Households of Lao DPR, Social and economic indicators, Lao Expenditure and Consumption Survey 1997/98*, Vientiane.

Lao National Statistics Centre (2004), *The Households of Lao DPR, Social and economic indicators, Lao Expenditure and Consumption Survey 2002/03*, Vientiane.

Lao National Statistics Centre (2006), *Statistics 1975-2005*, Vientiane.

Lao National Statistics Centre (2006), *National Growth Poverty Eradication Strategy*. Vientiane.

Lao National Statistics Centre (2006), *Results from the Population Census 2005*, Vientiane.

Mosley Paul (1985), The Political Economy of Foreign Aid: A model of the Market for a Public Goods, *Economic Development and Cultural Change*, Vol.33, No.2, pp.373-93.

Naoyuki Yoshino and Masaki Nakahigashi (2000), Economic Effects of Infrastructure; Japan's Experience after World War , *JBIC Review*, No.3. pp.3-19.

Narayana R. Kocherlakota and Kei-Mu Yi (1996), A Simple Time Series Test of Endogenous vs.

Exogenous Growth Models, *The Review of Economics and Statistics*, Vol.78, No.1, pp.126-34.

Nick J. Freeman (2002), Foreign Direct Investment in Cambodia, Laos and Vietnam: A Regional Overview, *Conference on Foreign Direct Investment: Opportunities and Challenges for Cambodia, Laos and Vietnam*, Hanoi.

Sawada Yasuyuki (2000), Dynamic Poverty Problems and the Role of Infrastructure, *JBIC Review*, no. 3 December, pp.20-40.

Shiladitya C, Tyrell D, Colandavelu N, and Brahm P (2004), Scaling-Up Poverty Reduction Potential of Infrastructure Projects: Lessons from the Asia-Pacific Region, *Poverty and Social Development Papers*, ADB, Philippines.

Suiwah Leung (2006), Integration and transition – Vietnam, Cambodia and Lao, *Seminar "Accelerating Development in the Mekong Region – the Role of Economic Integration"*, Cambodia.

Sununtar Setboonsarng (2006), Transport Infrastructure and Poverty Reduction, *ADBI Research Policy Brief* No.21, ADB, Philippines.

The Lao National Committee for Energy (2004), *Power System Development Plan*, Final Report, Vientiane.

Tsuneaki Yoshida (2000), Japan's Experience in Infrastructure Development and Development Cooperation, *JIBC Review*, No.3, Dec, pp.62-92.

UNCTAD (2006), *World Investment Report 2006*, New York.

UNDP (2006), *Landlocked Developing Countries*, New York.

World Bank (1994), *World Development Report*, Oxford University Press.

World Bank (2002), Rural Electrification and Development in the Philippines: Measuring the Social and Economic Benefits. *ESMAP paper* no. 255, Washington.

World Bank (2006), *Lao PDR: Rural and Agriculture Sector Issues Paper*, May, Washington.

Xianbin Yao (2003), Infrastructure and Poverty Reduction- Making Markets Work for the Poor, *EDR Policy Brief* No. 14, ADB, Philippines.