博士論文

Formulation Process of Rural Roads Projects and its Effects on Poverty Reduction in Developing Countries

（途上国における村落道路整備事業の形成プロセスと貧困削減効果に関する研究）

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Abstract

More than 70% of poor people in developing countries live in rural areas, where all-weather roads are chronically insufficient. People in the areas experience limitations in their accessibility to either basic service facilities or to a variety of opportunities to participate in income generation activities and societies. To remedy the situation, international financial institutes (IFIs) have been providing those countries with financial and technical assistance to construct new roads and/or rehabilitate deteriorated and impassable roads. However, regardless of their continuous aid, some people have not benefited as anticipated when formulating rural roads projects and have remained poor, and the effectiveness of those IFIs-financed projects on poverty reduction have been questioned. In response to the critical issue, the research has two aims: (i) to clarify a causal mechanism for generating and distributing the impacts of a rural road improvement project on its potential beneficiaries' livelihoods; and (ii) to identify the implications of the process of formulating pro-poor rural roads projects in developing countries.

For the first aim, a case study was carried out employing a project recently completed in rural Cambodia. The author focuses on three selected dimensions of poverty: mobility (freedom of movement), economic levels and activities, and accessibility to social services—these are in line with the recent discourse in international development on the multidimensional features of the term "poverty." Utilizing the data collected in the project's post-completion socioeconomic survey, quantitative studies revealed that the roads' improvement increased the travel frequencies of the poor population, particularly to markets, while having less impact on those population's ownership of bi-wheeled travel modes (bicycles and motorcycles), income levels and seasonal stabilities, and accessibility to education and health facilities, compared to the population of higher income. The follow-up interview survey, conducted by the author, could help to understand what had caused the results. The road rehabilitation transformed the localities' economic systems with involving an influx of people from beyond the roadsides; it helped to change the local population's economic status and activities, and subsequently influencing their daily travel patterns. Such changes were, however, limited to people with basic educational backgrounds and/or robust economic capacities, particularly ownership of rice fields as participating in rice trading, the primary economic activity in the study areas. These findings imply that people of limited economic capacities and educational attainments may have slipped from the project's impact distribution network and not have benefitted as expected at the stage of formulating the project. These consequences would undermine the project's overall goal of contributing to poverty reduction through improving accessibility to economic opportunities and social service facilities for subsistence. Furthermore, disparities may have been widened among the local population on the accessibility. The case study revealed a possibility that there are factors requiring attentions at formulating rural roads project, particularly on individual accessibility for subsistence, which may determine effects which the improvements perform on poverty reduction.

For the second research aim, processes of formulating IFI-financed rural roads projects were examined to identify what would determine the projects' impacts on people's accessibility, particularly

for poor people, through the review of five completed/ongoing IFI-financed rural roads projects on their aims and processes of selecting areas and roads for intervention. Related to project aims was one common factor: all of the projects aimed at contributing to poverty reduction through improving individual accessibility to economic opportunities and social services in target areas. As for processes of selecting areas and roads, the criteria employed in the selection required our attention for investigation. Among the criteria for selecting areas, the common one was whether to be consistent with existing strategies of IFIs and recipient countries' governments. This is probably because synergetic effects were expected in the long run with their ongoing and planned development work. Other criteria were varied. For example, when the executing agency was not the central government for particular reasons, such as its promotion of decentralization, potential agencies' capacities for implementing the projects within the designed time and budget framework were assessed, otherwise socio-demographic indicators, including population densities or the poverty rates of concerned regions, were used. To select the roads, the criteria were more diverse and could be categorized into two types based on whether they were directly related to poverty and individual accessibility. Items directly related were population densities, location of public service facilities, and local people's views shared at preparatory meetings. Items not directly related were the connectivity to trunk road networks, and intervention viabilities or justifications. The extensive review revealed the two issues: that individual accessibility was not always addressed during the formulation and considered as one of the criteria employed when selecting roads for the intervention; and that disregarding people's accessibility to what were required for subsistence in their local contexts might remain poor people unchanged. These issues could be potential reasons for the results obtained in the case study.

Considering these results, the following measures are suggested to be taken at the beginning stage of formulating rural roads projects: (i) define the accessibility that a planned rural road project would improve so as to reduce existing poverty in its target areas, with the project's local stakeholders; (ii) include indicators related to accessibility according to the above definition, together with the conventional economic and socio-demographic indicators, such as population and poverty rates, as criteria for selecting roads for planned interventions on the list of candidate roads; and (iii) specify the location of utilities to which the local population should be guaranteed access for subsistence along candidate roads for intervention, and conduct a detailed socioeconomic survey of this population along those roads on their current access to those utilities and use of services. These could be integrated into conventional approaches employed at formulating the reviewed projects which focused on demographic items and/or viabilities of investments.

To operationalize the proposed measures, IFIs would be required to implement instruments of promoting the understanding of accessibility in contexts of their client developing countries and clarifying what the countries expect to achieve through rural roads projects. To do so, they would need to strengthen their own institutional capacities in integral manner as well. These would help to implement the proposal, which would enhance the effectiveness of those projects on improving rural population's accessibility as needed in their local contexts and eventually on poverty reduction.

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Chapter 1. Introduction

1.1 Backgrounds

More than 70% of poor people in developing countries live in rural areas (Alkire & Robles, 2017; International Fund for Agricultural Development, 2010; United Nations, 2014). Major economic activity in these areas is in the primary sector like agriculture, which makes people vulnerable to seasonality and climate (Kingombe, 2011; Stifel & Minten, 2008; World Bank, 2007). Further, people in these areas are isolated from economic and social mainstream, and accessibility to social services needed for their survival is often limited (Bird, McKay, & Shinyekwa, 2010; Njenga & Davis, 2003; Sieber & Allen, 2016; World Bank, 2016a). Such economic and physical constraints may slow down the enhancement of economic productivity, the increase in household incomes, and eventually the rise in their living standards, thus keeping rural people poor over generations. To eliminate the vicious circle, international financial institutions (IFIs) have been providing financial and technical assistance to these areas to satisfy the immediate needs of infrastructure and its associated services, improve people's livelihoods, and eventually help them out of poverty.

However, various scholars have reported the assistances' unexpected effects on socioeconomically poor people (for example, Hettige [2006]). One of these effects is that poor people benefitted less than the ones with larger economic capacity. The reason for this may be that they were not capable enough to attain the assistances' anticipated benefits. Such structural issues underlying the international development arena may lead to widening of disparities among people. Consequently, IFI-financed projects may not perform their expected function of alleviating poverty. Figure 1-1 presents recent trends of net official development assistances and aid provided by individual countries and the percentage of poverty headcount that lives below the international poverty line of US$ 1.90. The percentage has been steadily decreasing from 35.3% in 1990 to 10.7% in 2013, thanks probably to continuous provision of aid from IFIs and individual countries. However, recently, this decrease has slowed down despite increase in inputs. It is now necessary to revisit approaches of formulating projects for poverty reduction to enhance their effectiveness.

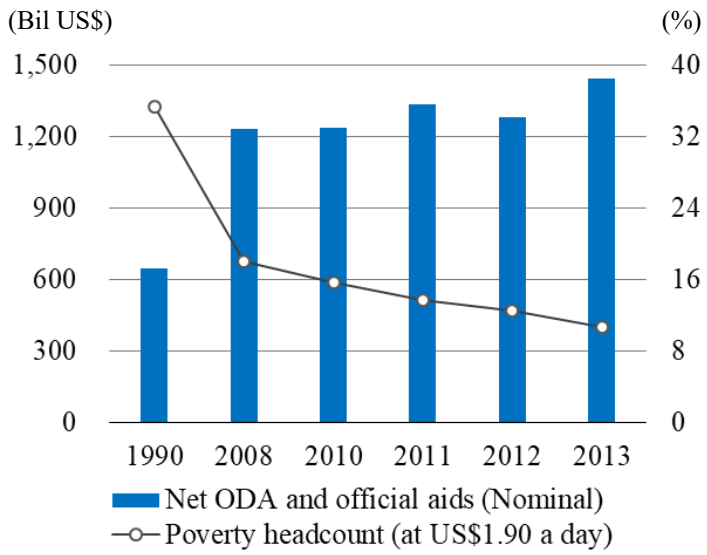


Figure 1-1 Recent Trends of Net Official Development Assistance (ODA) and Poverty Rates in the World

(Source: World Bank [2017a, 2017b])

After the World War II, the IFIs have provided various assistances to developing countries, particularly for economic development. This was done on the assumption that poverty reduction follows automatically through a trickle-down mechanism where some of the benefits gained from economic development, particularly by the rich in economic terms, would be redistributed to the poor (Aghion & Bolton, 1997; Akinci, 2016). They employed income-related indicators to measure those projects' performance (Grosse, Harttgen, & Klasen, 2008; Laderchi, 1997; Zeller et al., 2006). However, such relationships have been seen little between economic development and poverty reduction, as the receipt of benefits from economic development depends on a variety of factors and is subject to individual capacities. For example, the growth of individual economic capacity needs other capacities related to education and health, including accessibility to those. That is also true vice versa. Such complicated mechanisms are not well addressed while designing projects aimed at economic development. Consequently, poor population has stayed poor in developing countries. To break through the stagnant situation, Sen (1979) called people's attention to the multidimensionality of the term, poverty. He emphasized the necessity of comprehending both, economic and non-economic, spheres of the term while establishing aid strategies. Subsequently, pro-poor approaches were suggested that would promote or strengthen non-economic dimensions of individuals for achieving reduction of existing poverty (Klasen, 2008). The multidimensionality has also been incorporated as the human development index and the multidimensional poverty index by the United Nations Development Programme (UNDP) (UNDP, 2016a). However, it is uncertain how much has the multidimensionality of poverty concerned the IFIs and developing countries' governments when planning development strategies and policies and individual projects.

1.2 Objectives and Approaches

To make future rural roads projects more pro-poor while utilizing limited resources, developing countries and IFIs should learn about the aspects to be taken into consideration when formulating those projects. To augment effects of IFI-financed projects on poverty reduction, the multifaceted nature of poverty should be recognized and considered while formulating those projects and relevant aid policies. The research is to focus on feeder roads in rural areas in developing countries, hereinafter called "rural roads", and to assess the impact of roads' improvement on existing poverty while looking at how such impact would be generated and distributed among people in the target localities. Therefore, the research's objectives are set as:

(1) To analyze the impact of a rural roads project on potential beneficiaries' livelihoods utilizing the obtained results; and
(2) To draw essentials of designing pro-poor rural roads projects in developing countries.

To achieve the two objectives, the following approaches are taken:

For objective (1):

- To comprehend and analyze the impact of a completed rural roads project in a developing country on livelihoods of the prospective beneficiaries, including poor people.

For objective (2):

- To study methodologies of completed/ongoing IFI-financed rural roads projects in developing countries, and identify issues related to pro-poorness of those projects; and
- To propose potential methodologies for rendering future rural roads projects pro-poor.

The research employs a completed rural roads improvement project as a case project for the objective (1), namely Rural Roads Improvement Project in the Kingdom of Cambodia, where civil works was completed in 2014/2015 and the project was closed in June 2016. The reasons for selecting this project as the case are the following: (i) the project's composition was simple, which would make it easy to identify the impact of the project; (ii) rehabilitation works were carried out in several administrative areas with different socio-economic contexts; and (iii) areas and roads for intervention under the project were selected jointly by the IFIs and the recipient country, and the criteria employed in the selection process were also determined together. The first reason was essential to scrutinize the impact of only the rural roads improvement project on the population's livelihoods in the areas influenced by the project without any influence of other factors not directly related to civil works, for example, income generation activities or building other agriculture-related facilities. The second and third were found as commonalities among past projects, which were essential to help to draw implications from the research for future decision-making process while formulating similar rural roads improvement projects.

Further, the covered spheres of "poverty" in the research are comprehensive, following the recent discourse on the multidimensional characteristics of the term, which include the following three: (i) mobility, (ii) economy-related factors, and (iii) accessibility to social services essential for people's daily lives. The first item indicates an individual freedom to travel around; the second looks mainly at income levels and its seasonal stability and participation in local economic platforms; and the third is to examine how much individuals could access and avail of those services for maintaining their well-being.

As stated above, one major reason for remaining rural areas in poor conditions is the lack of physical accessibility to necessities for subsistence of people in the areas. The insufficient accessibility deprives those people of opportunities to get involved in varied socio-economic processes in/outside their localities, due to disconnections to local socioeconomic platforms and relational networks, which makes them poor (Bird et al., 2010; J. Cook, Petts, Visser, & Yiu, 2017; Samuel, Alkire, Zavaleta, Mills, & Hammock, 2017). To resolve the issue, various interventions in transportation sectors have been carried out, such as constructing/rehabilitating infrastructure and increasing available options to services. Rural road improvements, one of the interventions, have been widely carried out on the

assumption that the improvements would provide basic access, which is defined as reliable and all-season access by the locally prevailing transport mode(s) and one of human rights (Lebo & Schelling, 2001). However, the basic access approach may not be adequate to achieve the improvement of people's accessibility to services for their subsistence. Now, we should be more aware of the term "accessibility." The term has been defined variously in the context of transportation, and Litman (2017) defines "people's ability to reach goods, services and activities." Following the definition, what should be taken into account at formulating rural rods project for letting the projects perform as expected? Recently, some scholars have urged the need for taking into account factors which may not directly related to rural roads, such as households' time and monetary budget levels and individual socioeconomic and societal status, as those factors may influence individual accessibility (Dennis, 1998; Olsson, 2009; van Wee, 2016). This implies a need for taking different approaches from the basic access approach at formulating rural roads projects in developing countries.

The research would consider the term of accessibility as the degree on how much people in areas of the influences of a rural roads project is able to physically reach and utilize services for their subsistence in rural areas in developing countries. What to be studied on individual accessibility in the research are markets, education, and health services. That is in line with the multidimensional poverty index of the UNDP (2016a) and the basic needs approaches (Hicks & Streeten, 1979; Streeten, 1984), both of which indicates complimentary relations between individual economic status and fulfillments of education and health at individual levels.

Note that, throughout the research, "developing countries" included "least developed countries, landlocked developing countries and small island developing States (United Nations Economic and Social Council, 2016a)."

1.3 Organization of the Research

The research consists of eleven chapters, including this introductory chapter. The next chapter, Chapter 2, presents an extensive review of linkages between transportation and poverty in the context of developed and developing countries. Chapter 3 reviews and discusses the methodologies of formulating rural roads in developing countries. Chapter 4 details the implementation of the data collection activities as post-completion activities in the case project and provides the collected data descriptions. Making use of the data, an analysis is carried out in Chapters 5, 6, 7 and 8 to comprehend the impact of the case project on mobility and economic status (Chapter 5), accessibility to markets (Chapter 6) and public health service facilities (Chapter 7), and children's accessibility to basic education schools (Chapter 8). Chapter 9 synthesizes those respective results, and Chapter 10 discusses and draws out implications on essential issues of formulating future rural roads projects in developing countries. Finally, the overall conclusion is presented in Chapter 11 with summarizing main findings while addressing issues for further studies. Figure 1-2 shows the overall structure.

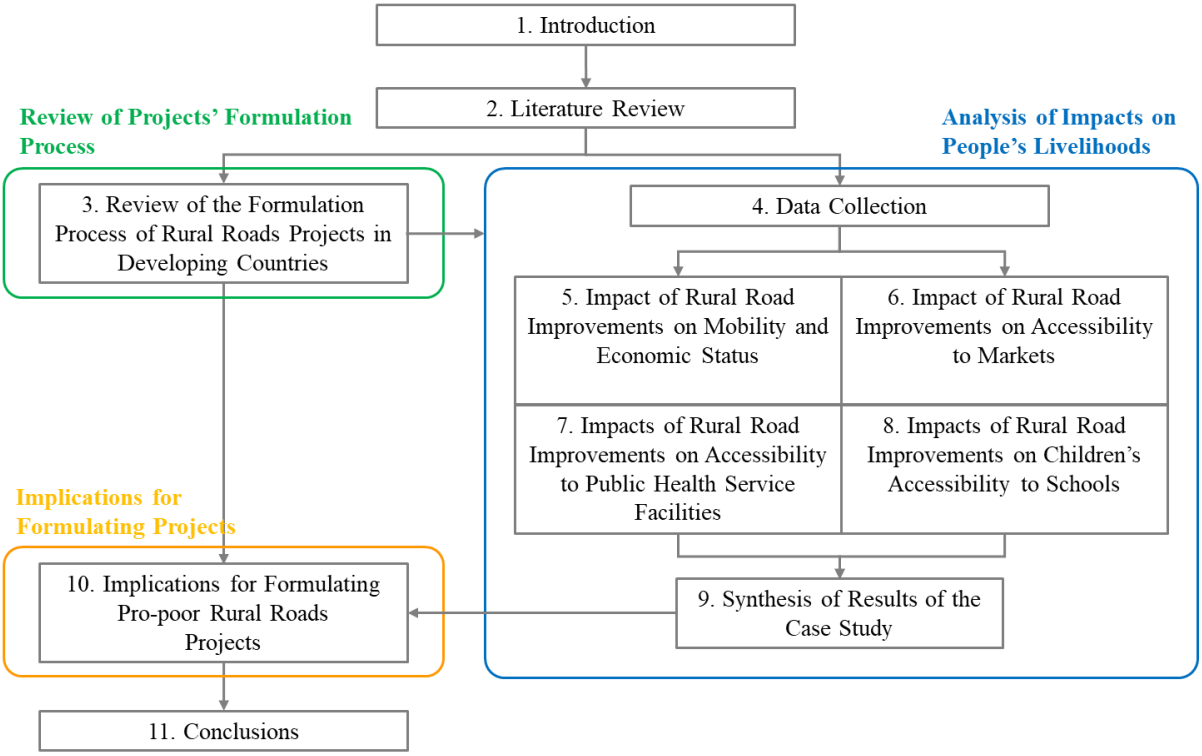


Figure 1-2 Structure of the Research

Chapter 2. Literature Review

2.1 Introduction

International communities have continuously provided financial assistances to developing countries for leveraging and expediting economic growth and poverty reduction. The effectiveness of international financial institutions (IFIs)' investments have been well recognized in terms of economic development in developing countries. However, effects to existing poor people's livelihoods in those countries have been questioned. The issue attracts scholars' attentions in international development as they have been recognizing approaches aiming at economic growth should be different from ones for poverty reduction, due to differences between them on tools to be employed in and targets.

For achieving those two, IFIs have been investing the development of transportation infrastructure continuously. The infrastructure is considered one of critical infrastructure to realize those two, which could promote individual mobility and accessibility and eventually lead to the improvement of living environment and access to various opportunities and to the establishment of economic structures.

The chapter is organized as follows. Section 2.2 provides the over view of recent trends of the international communities' aid policies to identify recent their issues on achieving poverty reduction in developing countries. In Section 2.3, effects of investments in transportation infrastructure on local populations and their livelihoods are reviewed with comparing between developed and developing countries. The review works are carried out on the three focuses, income, and gender and ethnicities, which have been recognized as causes of some setbacks of transportation investment. Then, a conclusive remark is made in Section 2.4 to present what still needs further studies.

2.2 Recent Trends of Aid Policies

2.2.1 Recent Movements in Aid Policies of International Communities

International communities have been shifting their focus from economic growth to inclusive growth, which has been reflecting in their aid policies (Kanbur & Rauniyar, 2010). Until reaching the point, the communities have framed their aid policies to promote the sustainable economic growth in developing countries with expediting the reduction of poor people in the countries. Policies have been influential with responsibilities of directing the communities' aid effectively and efficiently. The section will summarize the policies' trends since the Marshal Plan, the European Recovery Program, was enacted by the United States in 1948.

The Marshall Plan was developed for assisting the recovery of countries in Western Europe significantly damaged by the World War II, and was acknowledged as one successful aid policy with allocating effectively and strategically the available funds and resources and helping the countries' rapid recovery (Knack and Rahman, 2007). Another potential cause for its success was that the target countries originally had owned potentials and resources, including institutional capacities, to promote and sustain the economy and society on their own (Crafts, 2011). In 1950s and 1960s, the international

communities, including countries who had received financial supports in accordance with the Marshall Plan, committed to allocating their funds to supports other underdeveloped countries most of which had been colonized and became independent after the war for expediting those countries' economic growth (Pronk, 2001). However, the similar approaches to the Marshal Plan did not work effectively on those countries. There are several reasons behind the situation: their capacities were poor for managing external aid for their growth effectively; and the countries suffered from significantly accumulated debts with borrowing continuously loans for development purpose. As a result, gaps in economic development progress between developed and developing countries were widened, and the aid effectiveness was uncertain and questionable. Further, as financial aid was allocated more with the aim at economic growth with the assumption that trickle-down effects were workable (Nishigaki, Shimomura & Tsuji, 2009). However, it was revealed that the assumption could not work as economic growth and poverty reductions could not satisfy each other (S. Cook, 2006). Concerns about social aspects of people in developing countries were growing as some of the people continuously experienced hardships of accessing basic needs, including food, education, health, safe water, and suffered from poor accessibility to those needs.

Since 1970s, such questionable situations were scrutinized by the communities and new policy instruments were implemented: "Structural Adjustment Programme," initiated by the International Monetary Fund together with the World Bank in order to reform the countries' stagnated economies with accumulated debts (Collier & Gunning, 1999), and "Basic Needs Approach," focusing on individual abilities to satisfy their needs for daily survival and maintain their livelihoods (Cobbe, 1976; Palmer, 1977; Pronk, 2001). The parallel installments were expected to prompt in a balanced manner the advancement of living standards of people in developing countries, particularly those below the poverty line. Then, in 1990s, participatory approaches were developed to help those countries build inclusive societies with involving grass-root people in the process of making decisions on their development. Again, however, those grass-root tended to be eliminated from the process, as they were not properly given with opportunities to gain basic education to understand discussions in public arena. In March 1995, the World Summit for Social Development was held, where the attendants confirmed that harmonized approaches were needed among the main pillars of economic growth, social development and environmental protection for assuring sustainable development process in developing countries (United Nations, 1996).

Incorporating the new movement, people-centered approaches in development, the Millennium Development Goals (MDGs) with the target year of 2015 were established in 2000, which covered eight aspects requiring for urgent actions to achieve for reaching the level all people over the globe could live without any difficulty (United Nations, n.d.)." Though all the MDGs could not be achieved at the global level by the target year of 2015, the certain progress of development was confirmed. Based on lessons learned in the process of implementing the MDGs in 2000-2015, the Sustainable Development Goals (SDGs) were adopted in 2015, covering 17 aspects extensively related to people's life and development interventions (United Nations, Economic and Social Council [ECOSOC], 2016b). The SDGs were

established with reminding their interrelations and complexities on the way to poverty reduction. IFIs and relevant policy makers have been aware of the SDGs and their associated targets at formulating development projects, due to their continuous attention to how to alleviate poor people and strengthen their abilities to maintain their livelihoods in sustainable manners (United Nations, 2015). Table 2-1 compares the targets of the MDG and SDG.

Table 2-1 Comparison of the Millennium Development Goal and the Sustainable Development Goal

Millennium Development Goals	Sustainable Development Goals
1. Eradicate extreme poverty and hunger	1. End poverty in all its forms everywhere
2. Achieve universal primary education	2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture
3. Promote gender equality and empower women	3. Ensure healthy lives and promote well-being for all at all ages
4. Reduce child mortality	4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5. Improve maternal health	5. Achieve gender equality and empower all women and girls
6. Combat HIV/AIDS, malaria and other diseases	6. Ensure availability and sustainable management of water and sanitation for all
7. Ensure environmental sustainability	7. Ensure access to affordable, reliable, sustainable, and modern energy for all
8. Global partnership for development	8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
	9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
	10. Reduce inequality within and among countries
	11. Make cities and human settlements inclusive, safe, resilient and sustainable
	12. Ensure sustainable consumption and production patterns
	13. Take urgent action to combat climate change and its impacts
	14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development
	15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
	16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
	17. Strengthen the means of implementation and revitalize the global partnership for sustainable development

(Source: ECOSOC, 2016b; United Nations, n.d.)

2.2.2 Transformation of Concepts of Poverty in International Development

Nussbaum and Amartya (1993) proposed a term, capability, as a person's ability to achieve what he or she wants to be and/or undertake with their interpretation of a situation that "an individual is poor" as a

situation that he or she is not equipped at a sufficient level with capabilities to perform. They emphasized that poverty is a multifaceted concept and cannot be measured simply by economic capacities, and reminded a need for understanding individual poor conditions comprehensively and taking approaches of intervening non-economic aspects to relieve such conditions.

Their proposal has been taken into account by international communities who have shifted their focus to people-centered development due to slow progress in poverty reduction. One of their outstanding progresses is the Human Development Index (HDI) of the United National Development Programme (UNDP). The HDI is to measure the three dimensions of a country of life expectancy, education and standard of living and know the country's development progress. To measure those, the following are counted: life expectancy (years) for health; a value of expected years of schooling (years) divided by mean years of schooling (years) for education; and Gross National Income per capita for living standard (UNDP, 2016b). However, the HDI has been criticized on its limited scope, and the more multifaced indexes have been developed (Alkire, 2011; Alkire & Santos, 2014), and the UNDP and the Oxford Poverty & Human Development Initiative proposed the multifaced development index respectively (UNDP, 2016a, Alkire & Robles, 2017).

Table 2-2 Indicators Employed for Human Development Index and Multidimensional Poverty Index

Human Development Index	Multidimensional Poverty Index
・ Long and healthy life: Life expectancy at birth	・ Health: Nutrition; and Child mortality
・ Knowledge: Expected year of schooling; and Mean years of schooling	・ Education: Years of schooling; and Children enrolled
・ A decent standard of living: Gross National Income per capita (US$, Purchasing Power Parity)	・ Standard of living: Cooking fuel; Toilet; Water; Electricity; Floor; and Assets ownership

Source: UNDP (2016a, 2016b); Alkire & Robles (2017)

2.3 Roles of Transportation Infrastructure and its Contributions to Poverty Reduction

Economic structures of developing countries have been transforming from dominant reliance on farming to industrial-intensive economies, which has caused migrations from rural areas to urban areas and has enlarged disparities between the two areas on economic and socio-demographic aspects. Transportation infrastructure have been developed with the expectation of linking those two areas and their surrounding areas and boost mobilities of people and goods (S. Cook, 2006).

The insufficient provision of proper transportation infrastructure is found a cause for poverty and disadvantage in people's daily life. Using observations in Melbourne and its adjacent areas, Delbosc and Currie (2011) introduce the concept of "transportation disadvantage" as a person recognizing difficulties in performing what they want/need to do because of transportation-related problems. This

is further elaborated by Herwangi, Pradono, Suabri, & Kustiwan (2013), who highlight a shortage of available and affordable transportation options due to their limited provision and/or personal conditions related to age, gender, ethnicity, and socioeconomic status. They state that such shortages constraint people's mobility and access to goods, services, and social contacts and sometimes, even deprive such individuals from opportunities to benefit from social services requiring for daily subsistence and get involved in their societies and access employment markets. Such poor provisions would cause a vicious circle for a certain of groups toward further poverty. From reviewing a wide range of observation and findings in developing countries, it could be assumed that the following could be fundamental causes for putting people in vicious circles through the provision of transportation infrastructure, such as income, gender and ethnicities. This section summarizes previous discourses, with comparing empirical findings in developed and developing countries, on issues caused by the insufficient provision of transportation infrastructure with focusing on those three items.

2.3.1 Income Level

Findings in Developed Countries

The needs of those who are income poor are often inadequately addressed when planning investments in transportation infrastructure because they are typically under-represented or overlooked during the process of planning and determining transportation development (Barter, 1998; Dodson, Buchanan, Gleeson, & Sipe, 2006; Porter, 2014). This leads to inappropriate resource allocation and adverse effects on and various inconveniences in their livelihoods. Church, Frost, and Sullivan (2000) observed complex interrelations in London in the 1990s between income poverty and transportation provision; this is further supported by the findings of the Social Exclusion Unit of the United Kingdom in 2003 which found that job seekers aged 16–18 years confronted transportation costs as a significant burden. This is also evidenced by Hine (2004), cited in Currie and Delbosc (2010), who states that people without cars and a driving license live in inconvenient areas of urban Scotland and generally walk or rely on public transportation.

Many studies conducted in developed countries have empirically shown that transportation development influences housing markets and can even increase land prices, thus forcing income-poor groups to live outside areas that have a sound transportation infrastructure, which is also known as a "trade-off" among housing, living, and transportation costs (Dodson et al., 2006; Efthymiou & Antoniou, 2013; Hulse & Pinnegar, 2015; Starkey & Hine, 2014; Vidyattama, Tanton, & Nepal, 2013). Individuals living away from proper transportation infrastructure and services may face difficulties in terms of finances and convenience, e.g., travel duration, and subsequently, his/her mobility and social interactions would be restricted (Bouchard, 2015; Church et al., 2000; Engels & Liu, 2011; Kaufman, Moss, Hernandez, & Tydall, 2015; Kenyon, Lyons, & Rafferty, 2002; Lucas, 2012). This suggests that individuals residing in low-priced areas unavoidably shoulder financial and time burdens when accessing transportation to satisfy their daily needs. For instance, in Melbourne in Australia, Currie et al. (2010) point out "forced car ownerships" among populations residing away from major roads and

city centers. Despite their low-income levels, they are required to purchase vehicles and motorcycles to access service facilities and economic opportunities; perform daily chores; and maintain social networks. In addition, Delbosc and Currie (2011) identify population groups that fear theft and attacks when using public transportation alone, which indicate as economically poor populations are more likely than the others to face risks of unsafe and insecure situations.

Findings from Developing Countries

In urban contexts in developing countries, various transportation projects have been following fast urbanization to accommodate the growing influx of traffic and people to developing cities from rural areas in search for various opportunities (UN-Habitat, 2010). These migrants are inclined to reside in peripheral areas and slums and often experience disadvantages in using transportation infrastructure and services. This is because their residential areas are not well equipped with lifeline infrastructure and require them to travel long distances to access facilities related to jobs, education, health, and other amenities (Lucas, 2011; Salon & Gulyani, 2010). Hence, they unavoidably shoulder financial and time burdens for such travels and are subject to vicious circles of poverty (Oviedo Hernandez & Dávila, 2016; Venter, Vokolkova, & Michalek, 2007).

For instance, the adverse effects of improving public transportation networks were reported in Santiago (Muñoz, Batarce, & Hidalgo, 2014; Witter, 2010). The original coverage of public transportation services was limited to the center of the capital. To remedy this regional inequality in transportation service provision, the government modernized local public transportation systems, combined with buses and metros, and expanded route networks to outer urban areas. However, the renovation was found to be unsuccessful and instead, caused significant problems, such as financial and time burdens and other inconveniences on service reliability and costs, and this caused reluctance to continue using these systems (Witter, 2010; Yáñez, Mansilla, & Ortúzar, 2010). A similar example is the bus rapid transit system implemented in Bogotá, Colombia, in 2000 to expand the public transportation network. The system was expected to provide reasonable services for low-income groups in peripheral areas who constantly had to commute long hours for work (Bocarejo & Oviedo Hernandez, 2012). However, the newly launched services entailed unplanned increases in fares, which was beyond the groups' affordable level; additional complicated transfers between unconnected routes; and increases in crime and violence on the defined travel routes (Bocarejo & Oviedo Hernandez, 2012; Oviedo Hernandez & Dávila, 2016). Lucas (2011) examines a city adjacent to Johannesburg, the capital of South Africa, where residents travelled long hours for work, education and health services, social contacts, and other daily chores, and found that some of them faced hardships in using the existing public transportation services because of the high prices and unreliable services in terms of timing and frequency. To solve these problems, an informal service, kombis, became prevalent, but its service quality was not guaranteed in terms of safety and reliability. As a result, the poor had to continue their distant walks or pay amounts claimed for using the informal modes.

Urban slums, including informally established settlements, are also major residential locations for low-income groups in developing cities. Such groups include migrants from rural areas, female-headed households, and individuals with an informal civil status and most of them were likely to remain excluded from the economic development path (Arimah & Branch, 2011; Martinez, n.d.; Parikh, Fu, Parikh, McRobie, & George, 2015). These slums are considered to be "low livability" because they exist in inconvenient or flood-prone areas and have poor service facilities (Luttrell, 2013; UN-Habitat, 2003). Hence, their dwellers are subject to high transportation costs for daily commuting or their mobility is limited to walking distance (Arimah & Branch, 2011; Lucas, 2011). Public investments in the dwellers' livelihoods are generally inadequate because they are outside of the government's administrative coverage for planning and management and at the risk of unexpected eviction; moreover, the areas are subject to continuous population increase beyond the government's capacity and are given low priority in terms of public investment in infrastructure provisions, particularly if the country is heavily indebted (Arimah & Branch, 2011; Parikh et al., 2015; Rashid, 2009).

In rural contexts, physical and/or geographical isolation is considered a cause for economic poverty and a vulnerable social status (Bird et al., 2010). Residential locations significantly determine accessibility to opportunities to market agricultural and/or livestock products or increase non-farming employment (Bryceson, 1999; Foster, Valdes, Davism, & Anriquez, 2011; Lokshin & Yemtsov, 2005; Porter, 2002, 2014; Uteng, 2011). Further, physical isolation is found to adversely influence agricultural productivity since the costs incurred by farmers to transport their products to markets and processing factories or fertilizers and chemicals to the fields were almost proportional to their travel distance (Felloni, Wahl, Wandschneider, & Gilbert, 2001; Starkey & Hine, 2014; Stifel & Minten, 2008). It also influences the availability of technical information and extension services needed to enhance agricultural productivities (Dercon, Gilligan, Hoddinott, & Woldehanna, 2009; Stifel & Minten, 2008). Improved rural roads are expected to contribute to the reduction of such transaction costs and the enhancement of agricultural productivities, eventually increasing individual income levels.

Lastly, in interregional contexts, roads, mainly highways, foster competitive markets and benefit people engaged in interregional trades with robust capacities; however, this leads to intensified competition and some may even become more vulnerable. Latin American countries suffer from locational segregation, unequal local endowment, and geographic isolation (Mendoza, Perz, Schmink, & Nepstad, 2007). To resolve such inequalities, the Initiative for the Integration of the Regional Infrastructure in South America was constituted in 2000, under which a 2,600-km interregional highway, the Inter-Oceanic Highway, was to be constructed. Perz et al. (2013) confirm from their study on the tri-national frontier of Bolivia, Brazil, and Peru that improved regional connectivity enhances the competitiveness of local markets and increases the locals' exposure to new markets, however, this is not the case if they are isolated from their local societies and lack education and skills for non-farming activities. Another example is the Greater Mekong Subregion (GMS), where several interregional highways have been constructed to enhance interconnectivity. Iwata, Kato, and Shibasaki (2012) verify the diversified and enhanced regional trades and the subsequent improvement in regional gross

domestic products. However, the income levels of the local population did not necessarily improve because of locally given factors, such as the locations of their residence and types of income-generating activities (Yunxian & Qun, 2012). Following the road network improvements, local markets were dominated by medium- and large-scale traders from neighboring countries as they were able to transport goods in bulk, eventually changing local markets.

The implications from the two cases is that interregional road improvements do not necessarily improve the livelihood of those along the road, rather could expose them to new hardships if they lacked the skillsets and capacities needed to cope with these changes properly. However, the extent to which these repercussions are accounted for during the planning of interregional programs is questionable.

2.3.2 Gender

Findings from Developed Countries

As empirically observed in many developed countries, women are more likely than men to face risks and difficulties in using transportation infrastructure and associated services. The major causes for gender-specific transportation disadvantages are complex and fragmented travel patterns and gender-specific risks in using transportation infrastructure. These factors when combined reduce women's ability to travel and limit their social exposure, which is necessary to access opportunities and knowledge, build relationships with others, and participate in socioeconomic activities.

First, a major reason for the complex and fragmented travel patterns is that women are expected to perform multiple roles at home and in society while making the most of their limited monetary and time resources and available travel modes (Hamilton, 2002; Maffii, Malgieri, & Di Bartolo, 2014; Turner, Hamilton, & Spitzner, 2006). Markovich and Lucas (2011) also point out an increase in women who escort their children to schools because of security and safety concerns. Hence, to satisfy such needs, they generally use public transportation and bicycles or walk, which works more efficiently and functionally than private motorized modes of transportation. A reason for women's use of such economical modes is their limited exposure to labor markets and low financial capacity compared to men (Haustein & Siren, 2015; Maffii et al., 2014; Markovich & Lucas, 2011). In employment markets, most women work part-time jobs because they simultaneously engage in unpaid housekeeping and caregiving duties and their availability is limited (Hamilton, 2001; Hamilton & Jenkins, 2000). However, the market also has full-time female workers who, at the same time, are expected to perform housekeeping duties, unless they can afford to employ a helper(s). As a result, their travel routes become complex and are combined with trips of multiple purposes, which is called as "travel chaining". However, public transportation networks and time schedules do not always meet women's needs to perform multiple tasks and, as a result, riding a bicycle or walking is often preferred (Fenster, 2005; Hamilton, 2001; Maffii et al., 2014; McCray & Brais, 2007). Accordingly, gender-associated differences in the allocation of daily tasks result in huge disparities between women and men in terms of opportunities and resources generated by transportation development.

Second, violence and harassment are critical issues for women. Many women experience sexual harassment, insecurities, fear, and physical and psychological harm including long-lasting stigmas and such adverse situations discourage them from traveling alone and using public transportation services such as buses, subways, or taxis (Hamilton, 2001; Turner et al., 2006). Recently, sexual violence in public transportation and associated facilities have been recognized as operational and institutional disturbances (Grieco, 2012; Hamilton & Jenkins, 2000). Fenster (2005) cited an incident that occurred in 1999 in which women in London reported aggressive gangs and/or drunk male passengers occupying public transportation, particularly at night, resulting in a sense of insecurity.

As a possible solution to the abovementioned issues, more women are expected to be engaged in various capacities in transportation sector operations to enhance institutional abilities so that gender-related issues can be given more attention (Olczak-Rancitelli, 2015). However, such institutional changes remain challenging because (i) the working environment in the sector itself remains unhealthy and sometimes, even dangerous, (ii) there is an underlying societal perception that the sector is male dominated, and (iii) work schedules do not suit employees' family life (European Commission, 2013; Turnbull, 2013). Thus, studies on the effects of female employment in the sector on users' satisfaction and numbers are necessitated. Sweden changed its decision-making process for planning public transport infrastructure to involve women from the beginning (Pettersson, 2013). This institutional change was designed to identify difficulties women face in similar types of infrastructure and seeking their views for further improvement.

Findings from Developing Countries

In urban contexts, women living or working in the urban areas of developing countries are faced with various types of transportation disadvantages because of gender blindness in transportation planning (Chant, 2013). For instance, women living in India's urban slums generally travel long hours and cannot afford the existing transportation modes (Parikh et al., 2015). This can be partly attributed to gender-associated differences, particularly restricted allocation of financial resources from the household and sociocultural biases for using transportation services, insufficient time to travel due to household chores and caregiving duties, and insufficient educational attainment. These issues have also been recognized in other developing countries as constrains in the use of and access to transportation facilities and services. Salon and Gulyani (2010) study on mode choice of residents in slums in Nairobi, the capital of Kenya, and evidence that the share of women with children who selected "walk" as primary travel mode was higher than that of men with children, because women studied were traditionally expected to stay within their settlements and take responsibilities for caring their children.

Lack of safety and sexual harassments have also been observed in the urban public transportation systems of developing countries. These factors generate fear and impose constraints on women's mobility and opportunities to use transportation systems. For example, Adeel, Yeh, and Zhang (2016) indicate that women in Pakistan's urban cities are not allowed to drive a car and fear using public transportation, which leaves them with the options of being driven in private cars by others or walking.

The similar case was found in Delhi, the capital of India. Madan and Nalla (2016) conducted a survey in the capital to understand gender differences in perceptions regarding the level of safety assured in public spaces in the city, including public transportation facilities. The survey revealed that a higher number of women felt unsafe using public transportation, including neighborhood streets and parks, and were less likely to use these facilities. A major reason for the differences was the risk of being sexually harassed or, sometimes, self-victimized. Using Johannesburg city as a case study, Kang (2006) points out an urgent need to introduce women-friendly transportation infrastructure and services to accommodate the recent changes in women's economic status and employment patterns as well as increases in their exposure; the need emerged from difficulties in using outdated transportation infrastructure, including dichotomized transportation service networks, unavailability of services during off-peak hours, and unaffordable fare systems. However, such inconveniences are not properly addressed in the development of urban public transportation systems. As a result, to protect themselves from unexpected harassments, harm, and anxiety when using such inconvenient facilities and services, most women prefer to remain within their homes and, as a result, are isolated from social contact (Chant, 2013).

In rural contexts, women in rural areas in developing countries use transportation more often than men to perform multiple household- and income-related tasks (Porter, 2014; Potgieter, Pillay, & Rama, 2006). Bryceson and Howe (1993) show that women in rural African areas often use roads for daily household chores. However, due to the limited provision of affordable transportation infrastructure and services and their small financial capacities, they are forced to walk or ride a bicycle and thus, suffer time poverty. On the other hand, their male family members are found to be richer and afford to utilize motorcycles and vehicles (Porter, 2002). The insufficient and improper provision of transportation infrastructure and its associated services would hamper the growth in the capacities of girls and women, which would affect the societies over generations.

This gender-associated transportation inequality is often caused by local customs which have been established for long and cannot be changed easily. In Yemen, most women's travels in the study area are limited to within their village or neighboring villages for household and farming activities; they generally walk or are accompanied by their male family members in the case of longer distances. However, there are no such boundaries in the case of men, who travel more freely by motorized modes, including public transportation, for a wider range of purposes such as attending schools outside the village, sales of agricultural products, or leisure activities (Uteng, 2011). In rural Sub-Saharan African areas, the dropout rates in early education for girls are often higher than those for boys because of various reasons, two of which are related to transportation disadvantages (Porter, 2007, 2014). First is the risk of being attacked and/or raped on desolate or hazardous roads to or from schools, making them and their family members cautious about their schooling. Second is the various household chores involving travels such as transporting water or firewood by foot often on unmaintained roads, which affect their physical conditions and cause headaches, body aches, or deformation of their spines (Bryceson & Howe, 1993; Porter, 2002, 2007, 2014). The situations would discourage/demotivate girls

to go out from their house, which would limit their interactions with others outside and the further growth of their abilities.

In interregional contexts, it has been widely acknowledged as road development does not always benefit men and women equally because of sociocultural customs established and rooted in local social structures and practices and traditional gendered differences (Kusakabe, 2012). Take, for example, the rehabilitation of regional highways in Lao PDR. The workload of women significantly increased because of the resultant surge in trading activities around their village in response to growing trade volumes of their products and opportunities along the roads, and some female traders were able to improve their sales through the increase in interactions with traders from outside (Thammanosouth, Douangphachanh, & Khounphakdy, 2012). Similar situations were observed along the area of the Kunming-Bangkok Highway (Yunxian & Qun, 2012). However, women's involvement in those two regions after the regional road improvement differed. As the one in the former case, women got to participate in business occasions and expose themselves in marketplaces equally with men. However, in the latter, women kept involved in domestic works not requiring travels and still had few opportunities to travel outside their areas, while men's mobility grew along with the road improvement through transporting their products to external markets by motorized modes and expanding their business networks with external traders. These findings draw two implications which a regional road development may entail. First is a possibility for women to increase their incomes as long as they are socially accepted to participate in their local markets and are able to manage new types of trades with external people. Second is an opposite facet that the development may expand disparities in individual mobility in men and women because of local contexts which may have been deeply established.

2.3.3 Ethnicities

Findings from Developed Countries

Issues related to ethnicity and race in developed countries have been typically found in areas with migrants or individuals with similar historical backgrounds. For instance, Giuliano (2003) identifies from a case in the United States that ethnicities and race influence people's residential locations, and subsequently, determine travel patterns and jobs. Using aggregate data from Australia, Klocker, Toole, Tindale, and Kerr (2015) raise caution towards ethnic and sociocultural differences in transportation-related behaviors during the planning and development stages of transportation development. More specifically, in their online study, car ownerships and uses were found to be higher in the Anglo-Australian groups than in other ethnic groups, including migrants. However, this observed variance was not attributable only to differences in respondents' financial capacities, but also, their customs and living environments. Preston and Rajé (2007) found gaps in the use of public buses between Asian communities and others in an area in London, indicating that the gaps could be caused by cultural and informal barriers and service networks not accommodating their residential and activity areas .

Without proper attention to ethnic and racial issues in the stage of planning development transport development projects, the projects' benefits may not be gained across the local population.

Findings from Developing Countries

An outstanding case is in South Africa, where, the apartheid led to the segregation of residential and public service provisions among racial groups until the mid-1990s. Some specific racial groups had to reside in assigned areas as per zoning policies, which were inconvenient and often distant from the city center and their travel time and cost to reach their workplaces and necessary services proved burdensome (Khosa, 1995; McCarthy & Swilling, 1985). In addition, these groups were isolated for years and are yet to be sufficiently provided with transportation infrastructure and services, despite the policies being revoked. Consequently, some of them are still required to travel long hours and incur high costs while their income levels remain lower than those of other groups due to limited participation in the labor markets and socioeconomic activities and events (Behrens & Behrens, 2004; Lucas, 2011).

Due to geographical complexes, in rural areas of Vietnam, the benefits of rural road improvement projects have been unequally distributed across specific ethnic groups (Mu & van de Walle, 2011; Sanders & Thiede, n.d.; van de Walle, 2002). Le, Lyne, Ratna, & Nuthall (2014) find that for the ethnic minorities in Vietnam, the income levels are generally lower, and their social activities are less than those of others mainly due to the silent discriminations in the endowment of and access to local assets and resources.

Then, in interregional contexts, racial discrimination has been recognized as a critical issue in the Latin American region given the number of indigenous groups and migrant descendants who have been excluded from the development path (United Nations, 2007). The situation cannot be easily overcome by constructing or rehabilitating interregional highways aimed at linking marginalized groups scattered across residential areas (Mendoza et al., 2007). Rather, this could make them more vulnerable because people with higher economic and political power could enter such areas to pursue activities of personal interest and adversely influence their livelihoods (Perz et al., 2013). In the GMS, for example, the livelihoods of ethnic and racial minorities are at considerable risk because of their weak commercial and technical competitiveness and insufficient access and opportunities to acquire knowledge needed to survive in a new business environment, such as literacy, basic education, and communication skills (Kammeier, 2012).

2.3.4 Effects of Transportation Development

International communities have invested in the development of transportation infrastructure in developing countries to promote people's mobility and facilitate goods' movement over regions, which has been believed to lead economic growth and eventually poverty reduction. However, the cases described above on the three factors of income level, gender and ethnicity reminds that the lack of addressing those factors at formulating transportation infrastructure development projects would cause exclusions of those who are disadvantaged on one/some of those factor from recipients of benefits from the projects and consequently put those into a vicious circle toward poverty.

2.4 Conclusions

This chapter reviewed recent trends of aid policies of the international communities, particularly focusing on poverty reduction in developing countries, and revisited effects of transportation infrastructure investments on livelihoods of people who are poor and vulnerable in their local contexts. The aid policies were confirmed to have recently shifted their focus to poverty reduction straightforwardly, not as a biproduct of trickle-down effects of economic development. However, the review revealed that a multifaceted concept, "poverty," has been imposing difficulties for the community to identify how to handle and resolve in effective and sustainable manners. The SDGs and their associated indicators are expected to be one common platform for the community to find ways to the complex issue, as the ultimate goal is to reduce poverty in the world. Another review on effects of investments in developing transportation infrastructure reminded us of paying more attentions to socioeconomically poor and vulnerable at formulating those investment projects. The review was carried out on the three factors: income level, gender, and ethnicity, which revealed that the investments would involve further difficulties to some particular groups which experience hardships due to one or more of those factors and sometimes worsen their situations, rather than receiving anticipated positive impacts.

This extensive review confirmed that issues deep-rooted in the societies would hamper some people's receipts of development projects' benefits but were often hard to be recognized in the projects' ordinary formulation process. This reminds us of a need for developing methodologies to formulate transportation infrastructure projects with taking into account needs of those populations, particularly for those aiming at poverty reduction. Otherwise, the populations would remain out of development path and stay in poor and vulnerable conditions, which would continue over generations.

Chapter 3. Review of the Formulation Process of Rural Roads Projects in Developing Countries

3.1 Introduction

Rural roads are vital in rural areas in developing countries to provide basic access for enhancing economic productivities and satisfying the social and economic needs of people in the areas (Gannon & Liu, 1997; Pinard, Gourley, & Greening, 2003; Robinson, 2004; TRL Limited, 2003). Further, the roads are to perform a function of "last mile" for those people to connect with adjacent national road networks and integrate themselves into larger economic platforms. To materialize such expected effects, international financial institutes (IFIs) have financed projects of constructing and rehabilitating rural roads. Van de Walle (2002) points out that investing in those projects is a cost-effective use of limited resources for reducing poverty in rural areas. However, there are criticisms that the projects do not always contribute to poverty reduction; e.g., poor people do not gain as much as anticipated while people with larger economic capacities benefit (Hettige, 2006). One cause could lie in the process of formulating rural roads projects. As the Sustainable Development Goals (SDGs) address the insufficient accessibility in rural areas in developing countries by including a relevant target statement and an indicator (United Nations, Economic and Social Council [ECOSOC], 2016b), this problem should be taken into account as one crucial development agenda.

This chapter aims at identifying issues in formulating rural roads projects in developing countries. To achieve its aim, two review exercises are carried out. The first review is executed to understand recent discourses on formulating rural roads projects in such countries. The other is to review the formulation processes of completed/ongoing projects financed by the IFIs in order to learn how the projects were formulated. The IFIs selected for review are the Asian Development Bank (ADB) and the World Bank, which are multilateral agencies with different regional coverages, and the Department of International Development (DFID), which is a bilateral agency based in the United Kingdom. These three IFIs have continuously financed rural roads projects. In particular, DFID has been implementing a comprehensive research program; namely, Research for Community Access Partnership (ReCAP),[1] which is a flagship initiative in the rural transportation sector in developing countries. The selected projects are geographically varied, covering Cambodia (Southeast Asia), Nigeria (Western Africa), and Bangladesh and Nepal (South Asia). The comparative analysis of the five projects is carried out with their project documents, which are available on the websites, and interviews with their concerned persons (project officers and project consultants) in January and April 2017 and January 2018. (Interview notes are in Appendices 1, 2, and 4.)

[1] The ReCAP began in 2014 and currently covers 12 African countries and five Asian countries. The program started in the form of the Africa Community Access Programme for the seven African countries and the Asian Community Access Programme for the five Asian countries. The ReCAP functions as an active research platform on data management related to rural roads and associated assets.

3.2 Recent Discourses on Integration of Poverty-Related Aspects in Transportation Infrastructure Development Projects

To enhance the effects of investments in transportation infrastructure on poverty in developing countries, DFID published a guideline; namely, "Overseas Road Note 22: A Guide to Pro-Poor Transport Appraisal – The inclusion of social benefits in road investment appraisal" (DFID, 2004). The note reminds that rural roads could perform a major role in alleviating poverty and should be prioritized for investments as well as other large-scale transportation infrastructure. In addition, the note provides general directions on what should be considered benefits relating to poverty at the decision-making in terms of investing in transportation infrastructure development and considering how to collect and measure relevant data. Mitiku (2009) also developed a guidance note on how to formulate pro-poor transportation strategies, particularly in the context of Sub-Saharan Africa. He emphasized the importance of integrating non-economic benefits into policies or strategies of transportation infrastructure development together with the needs of other sectors in the target region. These two notes commonly suggest integrating non-economic aspects when formulating transportation development policies and individual projects, which has been widely recognized for achieving sustainable growth in developing countries. Véron-Okamoto and Sakamoto (2014) created the Sustainable Transport Appraisal Rating (STAR) to assess the sustainability of upcoming projects of developing transportation infrastructure in developing countries from the economic, poverty, and social environmental dimensions, as well as to assess these projects' risks to sustainability. (Details are shown in Figure 3-1.) However, those guidelines and rating system have not been well operationalized, and their effectiveness is yet uncertain.

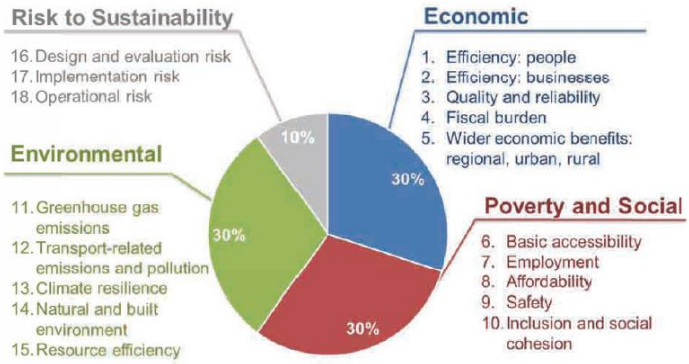


Figure 3-1 Rating Composition of the STAR

(Source: Véron-Okamoto and Sakamoto, 2014)

The SDGs include a target and an indicator related to physical accessibility in rural contexts: "Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all" and "Indicator 9.1.1: Proportion of the rural population who live within 2 km of an all-season road" (ECOSOC, 2016b). These approaches are more straightforward than those discussed above and could be among the standard indicators to employ when formulating rural roads projects in developing countries. It may be worth discussing how we could consider the incorporation of the SDG 9.1, because international communities would be required for considering the provision of reasonable and equitable access to all people in the world as one approach to improving access to economic and welfare opportunities necessary for survival (ECOSOC, 2016b).

To respond such needs, in 2016, the World Bank redevised the Rural Access Index (RAI) according to the original definition, "share of people who live within 2 km (or about 25 minutes walking time) of the nearest all-season road in rural areas" (World Bank, 2016a).[2] An "all-season road" is defined a "road that is drivable year-round by the prevailing means of transport (typically a pickup or truck that does not have four-wheel drive)" (Plessis-Fraissard, 2007). The RAI was based on the original concept of Roberts and Rastogi (2006), which, however, was not fully utilized due to its involvement of complicated demographic and socio-economic data. Such data were expected to be collected through household surveys. The newly developed RAI was established on three principles: sustainability of assuring regular updates in rural areas in developing countries; consistency to perform as a global index; and simplicity of easing the update. To ensure their proper implementation, the RAI was designed to be calculated using the data available from the worldwide database of demographic information and the geographic information system (World Bank, 2016a). That would decrease the burden to officials in developing countries, be less affected by their personal and technical resource capacities in comparison with the original RAI and help to level qualities of the collected data. The employment of the new RAI would help planners of the development of rural road networks in developing countries identify areas needing all-weather roads immediately.

3.3 Uniqueness of Rural Roads in Developing Countries

Rural roads in developing countries have the following unique characteristics, amongst others: (i) traffic volumes are low; (ii) technical standards are not necessarily high; (iii) investments required for civil works are not large; (iv) primary travel modes are paratransit; (v) physical access for satisfying local people's social and economic needs is served; and (vi) distributions of impacts from their construction/rehabilitation are not clearly known (Dennis, 1998; Pinard et al., 2003; Robinson, 1999; Sarkar & Ghosh, 2008; TRL Limited, 2003; van de Walle, 2002).

The first can be explained as the number of the roads' users being low, which is attributable to low population densities in rural areas. Second, technical/engineering requirements for roads are determined by anticipated traffic volumes of a road section. Hence, rural roads are often classified into the country's administrative road categories of low technical requirements or are unclassified. This, however, may cause a problem where the roads' pavements are not sufficiently durable against damages by overloaded vehicles and are at risk of being damaged faster than anticipated (Pinard et al., 2003). The third may be related to the second, as high technologies and expensive materials are not required for constructing/rehabilitating rural roads; rather, very basic technologies are often considered appropriate (Falck-Jensen, 2004; Fukubayashi & Kimura, 2014; Keller, 2016; World Bank, 2008). The fourth relates to income levels of people in the areas. Income levels are generally low, mainly because people in these areas rely heavily on farming activities as their primary income source and are not given many opportunities to earn high profits. That would render them unable to afford decent motorized

[2] The RAI has been employed mainly in the eastern part of the African countries with DFID and the World Bank under the initiative of the ReCAP to measure the progress of the development of rural road networks, identify areas needing all-season roads, and assess existing roads' conditions and local socio-economic profiles.

modes, such as motorcycles and automobiles, and eventually force them to continuously use paratransit modes, such as walking or bicycling, as their primary travel modes (Bryceson, Bradbury, & Bradbury, 2008; Ellis, 1997). The fifth is a reminder that rural roads are to provide social access for satisfying substantial needs in their daily livelihoods, as well as economic access for performing income generation activities such as farming, trading, and other services (van de Walle, 2002; World Bank, 2016a). The sixth is because benefits to be generated through rural roads projects are not always tangible or quantifiable in monetary terms; particularly changes in people's travels for social purposes, which will not necessarily generate monetary values. Hence, the improvements' impact distributional mechanisms are often considered unclear, causing underestimation of the economic efficiencies of investing in rural roads projects (John Hine, 1982; van de Walle, 2002; Beuran, Gachassin, & Raballand, 2015). The interrelation among these six is presented in Figure 3-2.

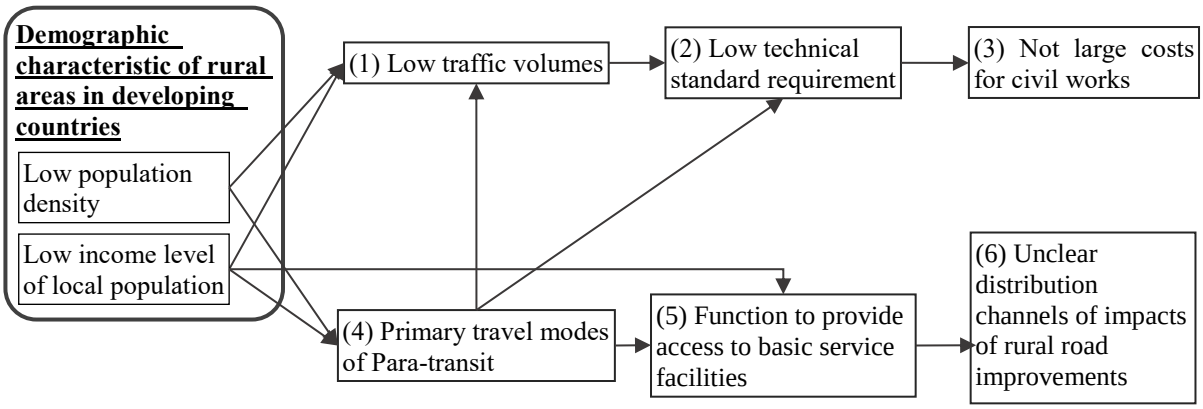


Figure 3-2 Interrelation of Major Characteristics of Rural Roads in Developing Countries

When appraising projects of rehabilitating roads with large traffic volumes, quantifiable items are employed to estimate project benefits. One of the items is "consumer surplus," a direct benefit that users of a road in question would presumably receive from the investment in improving the road. The surplus is computed using the Highway Development and Management Model (HDM) and could be disaggregated into two types: vehicle operation costs (VOCs) and journey travel time. VOCs are estimated by calculating costs to be incurred from using a road in question, composed of consumptions of fuel and lubricating oil, spare parts, vehicle maintenance, crew costs for commercial-purposed vehicles, depressions of vehicles and associated parts, and road roughness predictions (Archondo-Callao, 2001; Robinson, 2004; Raballand, Macchi, & Petracco, 2010). Journey travel time is expected to be reduced after the improvements, through increases in travel speeds and/or changes in the use of travel modes of the concerned road. Upon estimating savings in travel time, the average travel time after the road improvements is calculated for each mode and is converted into monetary terms using conversion factors that are subject to the given contexts (Robinson, 2004).

Various scholars have claimed that using "consumer surplus" when computing expected benefits is not appropriate for appraising rural roads projects in developing countries. One difficulty is

collecting the data required for calculating the above benefits due to insufficient personnel and technical and financial resources to conduct data collection activities and maintain the collected data for use, which is more critical and significant in rural areas than in urban areas (Falck-Jensen, 2004; Lebo & Schelling, 2001; World Bank, 2016a). Another is that the above methodology may overlook details of prospective road users' social and economic profiles. Modes being examined in the methodology are only wheeled and motorized ones, which may disregard people without such modes who are generally of low-income (Lebo & Schelling, 2001; Robinson, 1999; van de Walle, 2002; Raballand et al., 2010). Related to this point, it is implied that a benefit of improving rural roads is to provide accessibility itself rather than savings in travel costs (World Bank, 2008).

There has not been any systematic method to compute the benefits of rural roads projects. When appraising investment in larger transportation infrastructures such as highways and railways, cost-benefit analysis (CBA) is often used. CBA requires only quantifiable items in the examination of transportation infrastructure projects, which does not allow the inclusion of unquantifiable benefits, particularly on social and environmental items (Annema, Mouter, & Razaei, 2015; Barfod & Salling, 2015; van de Walle, 2002). Those unquantifiable items are considered together with CBA's results when appraising some transportation projects, which would obscure trade-offs between planned inputs (costs and time for overall works to complete those projects) and expected benefits in the decision-making process (Gühnemann, Laird, & Pearman, 2012). Olsson (2009) points out that CBA is not able to capture indirect effects to be generated uniquely by rural road improvements. As an alternative to CBA, several methods have been invented, including cost-effective analysis (CEA) and road economic decision (RED).

CEA is also developed for projects to generate benefits that are not quantifiable in monetary terms, and it is often used for appraising projects in the social sector including education and health. If employed, the following two processes are requested to be cautioned: clarifying the planned intervention's objective and ensuring intervention as the least-cost approach (Institute of Transport Studies, 2003). RED was also developed as an economic evaluation tool for low-volume rural roads because of the needs for customizing the conventional CBA, as discussed above, and the unique characteristics of rural roads (Archondo-Callao, 2001). RED was developed to estimate the level of services of concerned rural roads; hence, the model is simpler and requires fewer input parameters than the HDM (Raballand et al., 2010). Table 3-1 compares those three techniques of CBA, CEA, and RED.

To complement these, multi-criteria analysis (MCA) has been employed and their criteria are often developed in consideration of local contexts and people's needs. MCA is said to be an extended technique of CEA with weights assigned to criteria respectively, particularly when the intervention has multiple goals (Institute of Transport Studies, 2003). Robinson (2004) specified the three methods to satisfy at the determination: (i) the criteria should be in line with the project's objective; (ii) factors to be assessed (each criterion) should be measured in their own units; and (iii) weighting parameters of those determined criteria should be assigned to reflect their impacts against the project's individual outputs and objectives. However, Robinson raised two concerns about employing MCA: subjective and

arbitrary biases as determining criteria, and the risks of double-counting some benefits. As rural roads projects are expected to bring such unquantifiable benefits more than the other types of transportation projects, MCA is considered more appropriate than CBA and CEA, particularly at scoring for prioritizing roads for intervention (Bhandari, Shahi, & Shrestha, 2016; Taplin, Min, & Zhi, 1995).

Table 3-1 Comparison of the Methods of Evaluating Benefits to Be Generated from Rural Road Improvements

	Cost-Benefit Analysis	Cost-Effective Analysis	Road Economic Decision
When employed	· To verify benefit/cost ratios of developing (constructing, rehabilitating, or maintaining) roads of traffic volumes of above 200 vehicles per day	· Preferable to be employed for projects to construct/rehabilitate roads with low traffic volumes and may be considered uneconomic · The frequent threshold of traffic volumes to use may be below 50 vehicles per day	· To prioritize roads of traffic volumes of less than 200 vehicles per day for improvement
Purposes to use	· To verify whether a proposed program's/project's total benefits to society exceed the costs to be invested · To compare quantitatively several programs/projects in terms of expected benefits against costs to be invested	· To enable an estimate of benefits to be generated by developing (constructing, rehabilitating, or maintaining) a road of low traffic volume	· To simplify more than the HDM, with customizing to projects of developing/ maintaining roads of low traffic volumes
Items to be collected/ considered	· Estimated investment costs · Expected traffic volumes and speeds each assumed mode	· Items to be subject to a project's contexts, including the project's objective, and criteria will be assigned appropriately to their respective units · Weighting parameters of those determined criteria to be set, reflecting their impacts on the project's outputs and objectives.	· Consumer surpluses by measuring benefits of rural roads users' reduced transport costs when using the concerned improved road(s) · Estimated speeds of designated transportation modes · Roughness in the first and subsequent years after a project's completion
Estimation	· Net benefits (= Total benefits – Total costs: All values should be presented in monetary terms) · Discount costs and benefits with using a set discount rate · Net present value	· Total investment cost to provide basic access · Total beneficiaries served · Cost-effectiveness ("total investment costs" divided by "total beneficiaries served")	· Net present value at the given discount rate · Internal rate of return · Modified rate of return, considering the reinvestment rate assumed at the discount rate · Cost-effectiveness ("total investment costs" divided by "total beneficiaries served") · First-year benefit/cost ratio

Reference: Archondo-Callao (2007); Cellini and Kee, (2010); Lebo and Schelling (2001); Robinson (2004)

3.4 Project Appraisal Methods: Selected Rural Roads Projects Financed by the International Financial Institutes

Projects improving rural roads' conditions were designed differently from projects rehabilitating other types of linear transportation such as highways and railways. In preparation for those larger projects, alignments and, at least, target areas for their interventions are identified prior to the project formulation stage, following the concept of an "iron triangle" requiring balances of time, cost, and scope/quality (Atkinson, 1999; Polydoropoulou and Roumboutos, 2009). However, a quick glance at IFI-financed ongoing and completed projects indicates that selecting target roads within the limitation of the given timeframes and budgets was one of the tasks at that stage. Further, its associated difference is related to methods of identifying and estimating benefits, particularly unquantifiable, to be generated from the projects. This section compares major methods employed when formulating projects for improving rural roads in developing countries to prioritize rural roads with potential for further development and to select for civil works.

3.4.1 Asian Development Bank: Rural Roads Improvement Project (2010–2016: Cambodia)[3]

This project aimed at improving the rural road network in Cambodia by rehabilitating rural roads in seven selected provinces with high poverty rates. The assumption was that better physical access would ameliorate local people's livelihoods and eventually alleviate poverty in the project areas. The project had another component, aiming to strengthen the institutional capacity of the project's executing agency (Ministry of Rural Development [MRD]) to manage roads under the agency and ensure their sustainability, but this component is not discussed in the research. The project's implementation period was 2010–2016. The physical outputs originally designed into the project were about 500 kilometers of rehabilitated two-lane feeder roads (one lane each direction) in the selected seven provinces around Tonle Sap Lake, where the poverty rates were higher than in the other provinces, mainly because of high population densities and an overreliance on rice farming. To rehabilitate the roads selected, a double-bituminous surface treatment was chosen to ensure all-weather durability.

[3] This section was developed largely with reference to the three documents produced for preparing the case project: Final Report for Preparing the Provincial/Rural Road Asset Management Project (MRD, 2010); Report and Recommendation of the President to the Board of Directors: Proposed Loan: Kingdom of Cambodia for Rural Roads Improvement Project (ADB, 2010); and Report and Recommendation of the President to the Board of Directors: Proposed Loan: Kingdom of Cambodia for Rural Roads Improvement Project II (ADB, 2014a). In addition, an interview survey was carried out with the project officer at the ADB in April 2017 (Appendix 4).

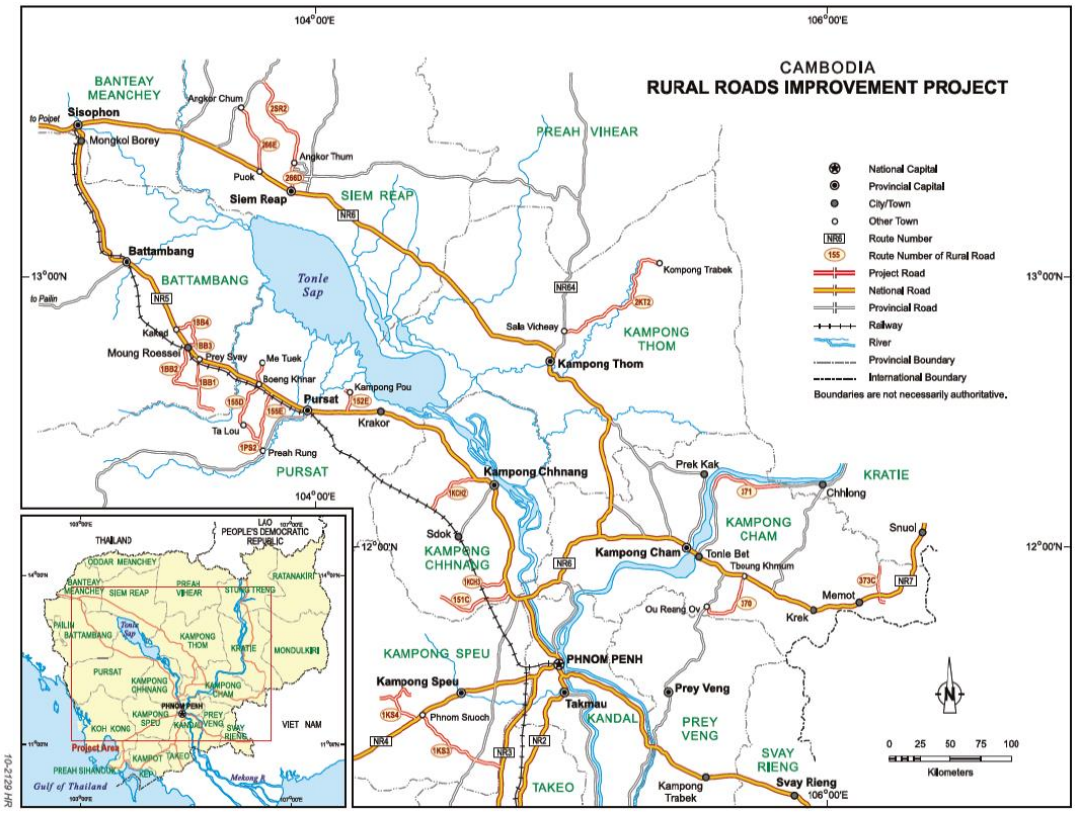


Figure 3-3 Area of Rural Roads Improvement Project (Cambodia)

(Source: ADB, 2010)

Project Design and Selection Procedure and Criteria

To select roads for rehabilitation, the lead international financial agency (ADB), the MRD, and a consultant team engaged in helping the MRD formulate the project were involved.

Prior to selecting the roads, the above three parties selected the project's seven target provinces. There were three selection criteria: (i) poverty rates; (ii) population densities; and (iii) the experiences of the ADB's interventions at the provincial level. Criteria (i) and (ii) were relevant to the project's pro-poor characteristic. The population density was critical because populated areas were expected to generate large traffic volumes, and the project's benefits on poverty reduction would be better distributed to more people, compared with less-populated poor areas.

The three parties selected the roads to be rehabilitated under the project from a long-list of candidate roads prepared by the MRD and the selected provinces' departments of rural development (PDRD). The prioritization was conducted in order of five criteria: (i) direct connection to existing paved road national and provincial networks; (ii) institutional consistencies with the ADB's partnership strategy with the country in the geographical areas and sectors to be financed; (iii) consistencies with the MRD's priorities and policies on rural development and decentralization; (iv) no outstanding issues on safeguards related to the environment or the resettlement/involuntary relocation of indigenous peoples; and (v) socio–economic requirements, including compliance with an economic internal rate of return (EIRR) threshold of 12%. The criteria were proposed by the ADB to the MRD, and they agreed to proceed the process of selecting roads for intervention under the project.

For items (iii), (iv), and (v), the consultant team investigated the listed roads and their adjacent areas mainly from the perspectives of engineering and safeguards. The engineering investigations were for estimating the costs of each listed road for civil works (pavement works and foundation construction) and other associated works, if any. When calculating the economic internal rate of return (EIRR), the HDM-4 software was employed to estimate the traffic volumes to be generated on each road after completion of the civil works. VOCs were also estimated for each road for the 14 modes assumed to be commonly used in areas of influence of the long-listed roads: bicycles, animal carts, motorcycles, three-wheelers, cars, jeeps/four-wheel drives, pickups, minibuses, buses, small and large koyons, and light, medium, and heavy trucks. The safeguard assessments were conducted during a field investigation, in accordance with the ADB's Safeguard Policy Statement (2009). Environmental assessments were conducted for each candidate road to confirm whether any adverse effects were anticipated in their adjacent areas during and after the civil works. Social safeguards were assessed to confirm whether there were any critical issues related to land acquisition and resettlement. When land acquisition and resettlement were found to be unavoidable and significant, the concerned roads were dropped from the shortlist.

Consequently, the shortlist was agreed upon in a tripartite meeting of the MRD, the consultant team, and the ADB. The results were transmitted to the PDRDs of the seven selected provinces and became effective for further implementation. The PDRDs then disclosed the results to the populations in their respective provinces. The total period for the selection was eight months, from June 2009 to January 2010. The above selection works were done under the project's preparatory technical assistance, financed by the ADB.

Issues

It could be assumed that population density, one of the criteria for selecting the target provinces, be interpreted as the density of public service facilities. However, such assumptions were not verified or confirmed in the process. The following could be worthy of further consideration: access to public service facilities (education and health) and markets. Those facilities were not explicitly considered in the selection process, leading to the potential overlooking of people's needs related to their accessibility. As stated in Chapter 1, access to those public service facilities could be essential for satisfying daily subsistence. The impacts of this project on the local population's access to those facilities will be further examined in Chapters 4–9.

3.4.2 World Bank: Rural Access and Mobility Project - Kaduna (2008–2016: Nigeria)[4]

In Nigeria, more than half of the population lives in rural areas, of which only 47% were provided with access to all-weather roads. Such insufficient physical accessibility would entail travel burdens in terms

[4] This section was referred to the Project Appraisal Document on a proposed credit in the amount of SDR37.80 million to the Federal Republic of Nigeria for a Rural Access and Mobility Project-Kaduna (RAMP I) on February 28, 2008 (World Bank, 2008); the Implementation Completion and Results Report on a credit in the amount of SDR 37.8 million to the Federal Republic of Nigeria for a Rural Access and Mobility Project (RAMP I) on May 10, 2017 (World Bank, 2017c).

of money and time and were considered a major cause of poverty in those areas. Hence, the country adopted the National Policy on Rural Travel and Transport with the World Bank's support of the Sub-Saharan Africa Transport Program. In line with this policy, the project was formulated as a pilot project to improve rural roads under the state government's oversight and aimed at improving physical accessibility in rural communities in Kaduna state (the state) and improving management of the state's road network. It had two components: (i) upgrading, rehabilitating, and maintaining the transportation infrastructure by implementing output- and performance-based road contracts (OPRCs); and (ii) institutional strengthening, reforms, and capacity building. In the research, component (i) was featured. The project's design was simple, being the first project to be administered by the state government. The physical outputs originally designed into the project were about 427 kilometers of rehabilitated feeder roads in the state, and 475 kilometers were rehabilitated at completion.

The state, located in the central and northern part of the country, was selected as the most appropriate to implement this pilot project because it was adopting the Federal Government Procurement Reform Program and was also strengthening its public financial management with technical and financial supports from the World Bank. Hence, the state was considered to ensure transparency during implementation, particularly procurement and financial management. The state had also completed the preparatory technical studies for implementing the project, with financial help from the World Bank in the form of a project preparation advance, a conditional advance loan disbursement from the project loan.

The project was to satisfy the state's immediate needs for rehabilitating unpaved roads in rural areas. In the state, about 80% of the population was engaged in farming activities, but the existing rural roads around those farmers' houses were not well maintained. Therefore, the state included the rehabilitation and maintenance of those roads in their development agenda to help the farmers' income generation activities.

The project implementation period was originally set from 2008 to 2014 but was extended to 2016 for three main reasons: (i) delays in procedures related to developing the project administration agreements between the World Bank and the country and between the country's central government and the state government; (ii) delays in procurement, particularly the lengthy procedures of inviting bidders who were not familiar with OPRC schemes; and (iii) delays in the state's disbursement of the project's counterpart funds to the civil works contractors. The project's overall implementation agency was the State Project Monitoring Committee at the state level, for day-to-day operations, and the Federal Project Monitoring Unit at the federal level, for the overall coordination related to the implementation of the National Policy on Rural Travel and Transport with the other international financiers and the relevant governmental agencies and providing high-level technical oversights to the project state on the project's implementation when needed.

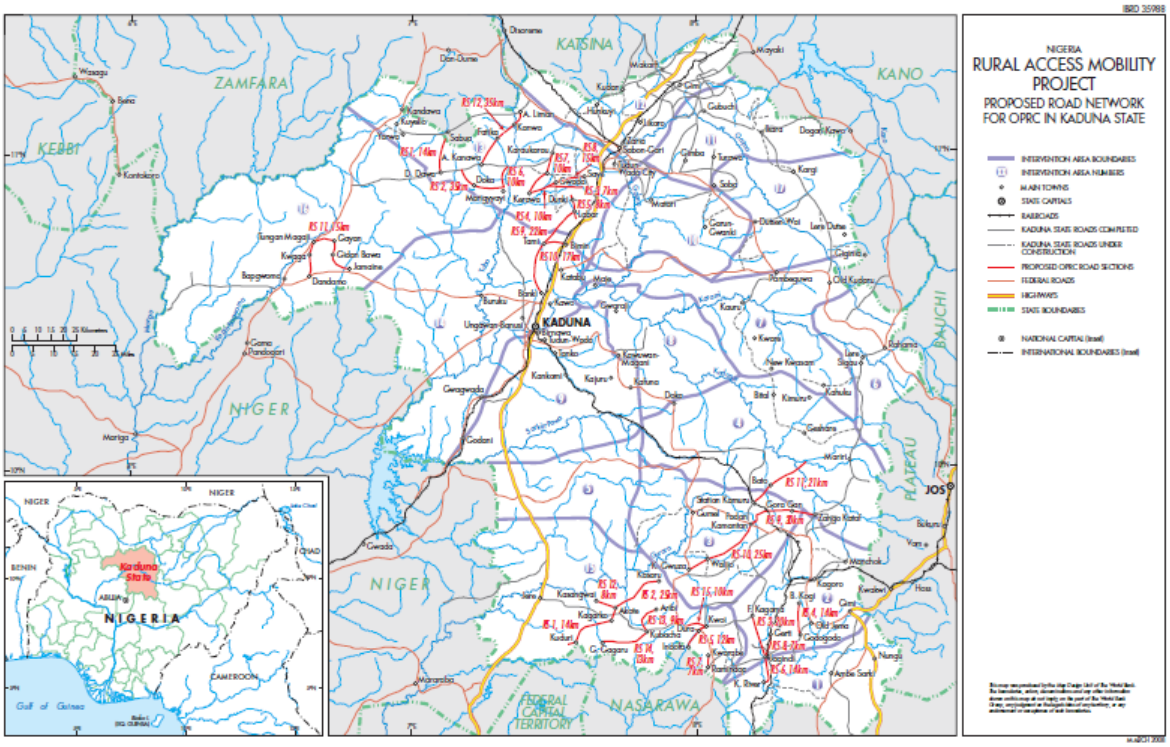


Figure 3-4 Area of Rural Access and Mobility Project-Kaduna (RAMP I) (Nigeria)

(Source: World Bank, 2008)

Project Design and Selection Criteria

First, 17 areas in the state were selected to be prioritized because they were considered to need immediate rehabilitation of rural roads under the project. Those areas were groups of neighboring administrative communities. To select the areas, links to trunk roads were considered apart from the following socio-demographic information and inventories of candidate roads, which were collected through field surveys:

- Socio–economic aspects: population, land areas, population density, and poverty rates;
- Accessibility to public facilities: number of primary/post primary schools, school enrolments, school-to-land area ratios, number of health facilities, health-facilities-to-land-area ratios, and number-of-boreholes-to-land-area ratios; and
- Accessibility to economic activities: number of markets, agricultural outputs, FADAMA (Nigeria irrigation project)/irrigation farms, and the existence of cottage industries.

To select roads for rehabilitation (double-bituminous surface pavement or gravel wearing courses), a multi-criteria analysis was conducted using the selected benchmarks of cost effectiveness, populations of adjacent communities, traffic volumes, and community preference, which was an expression of the local people's opinions, including their immediate desire to improve their living environments, obtained through state-level consultation workshops in potential target regions. Expected economic benefits were calculated differently between candidate roads of low traffic volume and ones of high traffic volume. For roads whose estimated traffic volumes after the improvements had an annual

average daily traffic (AADT) of less than 50, the cost effectiveness was computed, whereas for those with an AADT of more than 50 but less than 200, a cost–benefit analysis was conducted using the RED model. During the overall selection process, the abovementioned community preference was respected the most. The number of roads for rehabilitation was determined using five criteria: (i) the cost to invest within the project budget; (ii) the network coverage among roads rather than the linkages between towns and cities; (iii) the avoidance of overlapping ongoing externally financed interventions; (iv) the significance of the project's overall impacts; and (v) the potential grouping of civil works contracts. For the (ii), roads without any physical link to other localities were not selected, as their expected impacts and their distribution could be limited.

A safeguards-related assessment was conducted for each road in accordance with the World Bank's relevant policies related to environmental assessment (Operation Policy (OP)/Bank Policy (BP) /Good Practice (GP) 4.01) and involuntary resettlement (OP/BP 4.12) to confirm that no adverse impact was anticipated to livelihoods of people in areas of the project's influence during the implementation of the project.

Issues

The observation at completion was largely positive, as road usage by local populations along the improved roads was significantly increased for various purposes, one of which was to transport farm products. The approach taken for selecting roads for rehabilitation was considered comprehensive as taking into account people's accessibility to primary facilities they needed to reach for daily subsistence, which may be worth to see how the approach would have been influenced by the improvement of the roads conditions.

3.4.3 World Bank: Second Rural Access and Mobility Project (RAMP-2) (2012–2018: Nigeria)[5]

This project was a scale-up of the Rural Access and Mobility Project-Kaduna, discussed in the above subsection, to "improve transportation conditions and bring sustained access to the rural population, by rehabilitating and maintaining key rural transportation infrastructure in a sustainable manner in selected Nigerian states." The project consisted of the three components: (i) upgrading and rehabilitating the transportation infrastructure; (ii) community-based road maintenance and annual mechanized maintenance; and (iii) project management and strengthening of state/federal institutions. Discussions in the research relate only to component (i). The physical outputs originally designed into the project were about 1,450 kilometers of rehabilitated feeder roads in four selected states. The project's executing agency at the federal level is the Ministry of Agriculture and Rural Development, which is mainly responsible for financial management. At the state level, the primary responsible agency was the State Project Implementation Unit established each state, consisting of staff from the state ministry of the

[5] This section was developed based on the Project Appraisal Document on a proposed credit in the amount of SDR112.80 Million to the Federal Republic of Nigeria for a Second Rural Access and Mobility Project (RAMP-2) on August 29, 2012 (World Bank, 2012a) and an interview survey with the project officer at the World Bank in January 2017 and 2018 (Appendix 1).

sectors related to rural roads, which are responsible for day-to-day implementation, excluding financial management.

Prior to the project, a feasibility study was conducted by a consultant team utilizing the World Bank's financial modality of the project preparation advance. In the study, districts in the selected states provided a list of roads needing rehabilitation, and the consultant team surveyed those roads and related information, including demographics, agricultural productivities, engineering aspects and conditions, safeguard-related sensitivity, and the locations of social service facilities and markets. All of this was consolidated into inventories. An approach of selecting states and road is explained below.

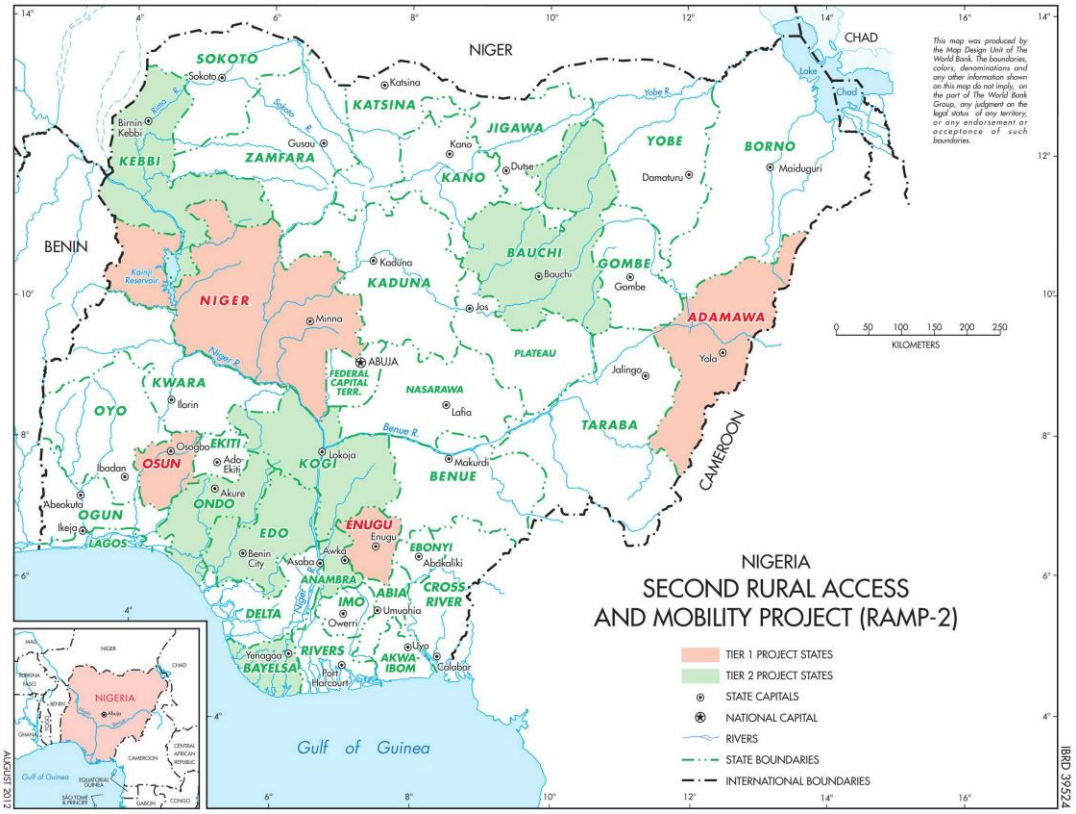


Figure 3-5 Area of Second Rural Access and Mobility Project (RAMP-2) (Nigeria)

(Source: World Bank, 2012a)

Project Design and Selection Criteria

Candidate states for intervention by the project were selected through a two-step process, and the selection of roads was subsequently carried out. In this process, the financier (the World Bank), governments at the federal, state, and local level, and the project consultant team were involved.

The first step in selecting the states was divided into two phases. The objective of the first phase was to select eight states based on the three governance-related criteria, which were determined during the process of formulating the World Bank's partnership strategy for the country. There were three criteria: (i) performance of donor-funded projects; (ii) completion of a public expenditure review or a public expenditure and financial accountability review; and (iii) readiness of a draft of fiscal responsibility and public procurement bills. In this phase, two states were shortlisted in each geopolitical

zone (northwest, northeast, southwest, and southeast) to ensure a geographic balance in the distribution of aid. Then, the second phase screened out the other states, except for the one covered by the Rural Access and Mobility Project (RAMP-1), employing criteria to measure the readiness for intervention under the project: (i) establishment of a project implementation unit; (ii) feasibility of implementing institutional and financial arrangements for maintaining roads to be rehabilitated under the project; (iii) preparation of a list of candidate roads for rehabilitation; and (iv) total length (kilometers) of prioritized roads with completed feasibility studies. As a result, 12 districts were selected for intervention by the project.

Subsequently, the candidate roads each state were scored for prioritization by employing three criteria: (i) social impacts (population served and connection to hospitals and schools); (ii) economic efficiency (road investment costs, travel revenues generated, and connection to major markets); and (iii) accessibility and mobility (connection to a main road and all-weather road connections). A weighted value was assigned to each criterion to score and prioritize the roads through a multi-criteria analysis. This process included an economic viability analysis using the RED model because the present traffic volumes of those roads were less than 50 vehicles per day. The overall procedure took about six months.

The approach was expected to avoid political influences. To ensure the accountability of the whole process, representatives at the local and state levels participated in the two workshops. The first workshop was held prior to the scoring work in order to explain the project's overview, the above criteria, and the upcoming data collection surveys. The second workshop was held after the shortlist was finalized, to seek their agreement.

Subsequently, the government conducted detailed design work, including safeguards and gender assessments, and subsequently proceeded to civil works, including procurement document preparatory work. The safeguard aspects of the shortlisted roads were assessed in accordance with the World Bank's requirements on environment assessment (OP/BP 4.01), natural habitats (OP/BP 4.04), physical cultural resources (OP/BP 4.11), and involuntary resettlement (OP/BP 4.12) to confirm that no significant adverse effects would occur during/after the project's implementation.

Issues

The approaches taken seemed to consider a function that rural roads were expected to perform: providing access to public service facilities. In the mid-term review of October 2016 by the World Bank and the other financiers, the impacts of the road rehabilitation were found mainly in agricultural markets around/adjacent to the improved roads, e.g., reduction in the time and cost of transporting farm products to markets and improvement in the prices of those products. That indicates that the rural road improvements could enhance the economic activities, particularly trading agricultural products, which led several questions on the following: who could enjoy such positive changes; what could need for enjoying such benefits; and how the approach taken at the road selection process would relate changes

in local people's accessibility to public service facilities which were considered essential for their livelihoods. These are expected to be assessed at completion.

3.4.4 World Bank: Rural Transport Improvement Project (2003–2016: Bangladesh)[6]

This project aimed at achieving two objectives: (i) providing rural communities with improved access to social services and economic opportunities; and (ii) enhancing the capacity of the relevant government institutions to better manage the rural transportation infrastructure. The physical outputs originally designed into the project were about 1,600 kilometers of rehabilitated rural roads in the 21 selected districts, and 1,638 kilometers were rehabilitated at completion. The project's regional coverage was changed after the large-scale flood of 2007, which severely damaged roads and hampered people's mobility and accessibility to services.

The project rehabilitated two types of rural roads: Upazila roads (UZR) and union roads (UR). The daily traffic volume of the UZRs was above 600, whereas that of the URs was less. The review was carried out by focusing on the component of rehabilitating URs in the country.

Figure 3-6 Area of Rural Transport Improvement Project (Bangladesh)

(Source: World Bank, 2003)

[6] This section was developed based on the Project Appraisal Document on a proposed credit in the amount of SDR 138 million to the People's Republic of Bangladesh for the Rural Transport Improvement Project on May 22, 2003 (World Bank, 2003), the project's Implementation Completion and Results Report (World Bank, 2013), the project's Performance Assessment Report (World Bank, 2016b), and the Project Appraisal Document on a proposed credit in the amount of SDR 195 million to the People's Republic of Bangladesh for a Second Rural Transport Improvement Project on August 23, 2012 (World Bank, 2012b). Those are supplemented by the interview survey with the relevant project officer in the World Bank in January 2017 (Appendix 1).

Project Design and Selection Criteria

In the selection process, the executing agency was responsible for disseminating the information related to the project through media, including newspapers, and providing the inventory list of roads in the target districts for prioritization. The list was developed based on a combination of the following criteria: (i) connectivity to Union Parishad headquarters; (ii) community ranking; (iii) cost effectiveness (i.e., the population served per unit investment); and (iv) status of the higher-volume connecting URs.

This prioritization was conducted at the project appraisal stage for the first year only, and several criteria were employed: (i) population possibly served; (ii) poverty rate (rate of population in extreme poverty, as identified by the district); and (iii) need for immediate maintenance works. The districts were given the indicative total length of roads to be rehabilitated, which varied among the districts, and the prioritization task was conducted by each district respectively. The overall work took one month on average. After the selection was completed, safeguard assessment works were conducted in accordance with the World Bank's requirements for environmental assessment (OP/BP 4.01), cultural property (Operation Policy Note 11.03), indigenous peoples (Operational Directive 4.20), and involuntary resettlement (OP/BP 4.12). However, no poverty or social assessment was conducted.

People in the areas selected for intervention by the project experienced difficulties related to their limited provision of all-season accessibility, which was due to insufficient road maintenance budgets. Furthermore, their economic situations were stagnated because local economic platforms such as markets and jetties for river trade were deteriorated and not fully operational. In addition, the regional coverage of ongoing projects rehabilitating rural roads and markets was also considered as part of the selection process.

Issues

After the completion in 2012 of all the civil works under the project, a social assessment was carried out in the areas of project intervention. It revealed that the project contributed to an improvement of the livelihoods of populations in the target areas, in terms of accessibility to social services such as health service or education. In addition, most of the surveyed population was able to increase their income levels, although the last quantile did not report such a change. Similarly, concerning the level of accessibility to health services, there was an increase of about 30% compared with that before the project. This indicated that some local populations benefited from the improvements offered by the project, whereas others could not. Further investigation may be required to understand why the project benefited economically poorer people less than others. Such investigations could help us be aware of preventive installments against the potential expansion of social and economic disparities among local populations in the areas of the project's influence.

3.4.5 Department for International Development, United Kingdom: Rural Access Programme (1999–2007: First Phase: Nepal)[7]

This project started in 1999 as a poverty alleviation program and aimed at improving the access of poor and marginalized populations to the goods and services that were essential for their livelihoods. Aside from rehabilitating roads, the project provided an assistance program aiming to improve their livelihoods in a sustainable manner, particularly by enhancing income generation and employment opportunities. The physical outputs originally designed into the project were about 354 kilometers of rehabilitated feeder roads in six districts (four in the eastern part of the country and two in the western part) where high poverty incidents were envisaged. Apart from a civil works component implemented on the selected roads, a socio–economic development component was designed and implemented in the areas selected for rehabilitation works under the program.

The project's original implementation period was 1999–2007 but was extended to 2008, due to suspensions caused by political conflicts from 2001 to 2005. These conflicts changed the local situations for continuing the project and subsequently involved changes to the program's overall scope. The works were resumed in 2006, and all of the components were completed in 2008 with a total rehabilitation of 207 kilometers of roads.

The district development committees (DDC) of the selected districts were given responsibility, following the decentralization policies of the central government, to implement all of the related works.

Figure 3-7 Area of Rural Access Programme (Nepal)

Project Design and Selection Criteria

For the project, seven districts were selected by the Department for International Development, United Kingdom (DFID), its consultant team, and the Nepali government as the areas where (extremely) poor

[7] The section was developed with referring to the draft final completion report of the Rural Access Programme (Phase 1), prepared in July 2008 by the WSP International Management Consulting (currently, IMC Worldwide Limited) in association with HELVETAS Nepal. Further, an interview with the project consultant was carried out in January 2017 (Appendix 1), and follow-up communication with him and his colleagues in January 2018 was referenced.

and marginalized populations resided. Rehabilitating feeder roads in the districts under the project was expected to expand stable regional road networks, hence linkages of existing/planned strategic trunk road networks and feeder roads in candidate districts which would be rehabilitated under the project were considered as one essential factor at selecting district for the intervention, in addition to population densities, agricultural potential and incidence of poverty at district levels.

To select access roads for rehabilitation under the project, a district transport master plan (DTMP) was formulated for each selected district by employing the integrated rural accessibility planning (IRAP) approach[8]. To develop the DTMPs in accordance with the IRAP approach, a team of designated planners from the selected districts' DDCs invited their local populations to community meetings to collect their needs and demands related to infrastructure, including roads, and incorporated their feedback into the DDC plans. Involving the local population in the process is one traditional practice in the country, and staff of the DDCs were lectured and trained on basic concepts and procedures related to the IRAP, and their local populations were invited. DDC plans are usually updated annually by the DDC officials, representatives of political parties and the populations, whereas the strategic development directions of the districts were formulated with time spans of 5, 10, and 20 years. The DTMP was the basis to prioritize and select feeder roads for intervention under the project.

During the above process, the consultant and the district officials held meetings with the local population to identify households who were extremely poor, and those identified households were to provide one worker to participate in paid construction works.

Issues

In selecting roads for rehabilitation within the project's framework, political influence by outspoken local stakeholders was a concern. The project was intended more for social purposes, e.g., providing basic access to services to poor people, as those people needed to be addressed for avoiding further exclusion from their societies. Hence, economic viabilities of the project were not aware by the financier because of the project's objective. In fact, neither economic assessments were carried out on the entire process nor criteria related economic benefits was employed.

3.4.6 Overview of the Reviewed Projects

IFI-financed rural road improvement projects with an ultimate objective of reducing existing poverty were selected and reviewed. In the course, it was found that effects of those projects on people's livelihoods could be determined by how to select areas and roads prior to/during the projects' implementation. In this sub-section, criteria employed in the reviewed projects are to be compared, and

[8] The IRAP approach is based on the assumption that people are guaranteed with physical accessibilities to satisfy their needs for services, opportunities, and resources for their daily survival. The approach is to understand people's needs related to their physical accessibility and problems underlying target areas are often examined through participatory approaches by inviting people in the areas. Such needs are identified prior to providing external interventions. (ILO-DoLIDAR, 2003)

commonalities and differences in the selection process of areas and roads for interventions under those projects are identified and discussed.

First, the criteria employed are looked at. They are categorized into six as shown in Table 3-2: (i) donor's aid strategies to the project's recipient country; (ii) the country's development policies including directions; (iii) governance and project administration capacities of potential areas/regions for intervention; (iv) geographic distributions; (v) poverty rate of (potential) target areas; and (vi) population or its densities of the areas/regions.

Table 3-2 Categorization of Criteria for Selecting Areas for Intervention

Project name	**Cambodia**	**Nigeria (1)**	**Nigeria (2)**	**Bangladesh**	**Nepal**
Primary executing agency	National	State	State	National	District
Donor's aid strategies	x	x	x	x	x
Recipient's development policies	x	x	x	x	x
Governance/ Project administration capacity		x	x		
Geographic distribution			x	(x)	
Poverty rate of target areas/regions	x			x	x
Population (densities)	x			x	

There are two common criteria among the five projects. The (i), donor's aid strategies, would be considered as those agencies are responsible for their institutional mandate of "poverty reduction in developing countries" Such strategies could include development strategies to the recipient countries. The (ii), recipients' development policies and relevant priorities for investing, could be based on their expectation to expedite their own development process with optimizing their resources. The two were for responding to expectations of synergetic effects with projects (to be) financed.

The following are varied among the projects. The (iii), governance-related aspects of project administration agencies, is to respond to institutional requirements from the financiers for executing the projects within the originally designed time and budgets. Issues related to administering projects in developing countries have been often concerned, and the countries' commitments are one of the keys to minimize risks of delays or cost overrun which often slow down their development progress (An, Garvin, & Hall, 2017; Williams, 2017). The reviewed projects in Nigeria were implemented by the state governments, which might attract the financier's attentions more to this matter. The (iv), geographic distributions, was considered essential for assuring the equality on allocating the aid in a country. As for the project in Bangladesh, the areas affected by floods in 2007 were included at the later stage because roads in those newly added districts were damaged and needed immediate recovery. Lastly, the (v) and (vi), poverty rates and population (densities) of potential target areas, would indicate how much poor people could benefit through the projects' implementation, e.g., investing in areas of a higher poverty rate and a larger population are expected to benefit more people who live in poor conditions. RAMP-1 and RAMP-2 in Nigeria (stated in the table as "Nigeria (1)" and "Nigeria (2)" respectively)

did not employ these two criteria, because of the potential assumption that rural areas in the country were considered poor.

Second, related to selecting roads for improvement, the following six items were employed: (i) population (densities) along the roads; (ii) locations of public services facilities such as markets, school and health service facilities; (iii) community preference; (iv) connectivity to trunk roads (national roads or provincial roads); (v) whether issues related to safeguards would be involved during civil works; and (vi) economic benefits. The (i), (ii), (iii) and (iv) are related to accessibility and poverty around people along candidate roads, while the other items would indicate the viability of implementing projects.

Table 3-3 Categorization of Criteria for Selecting Roads for Intervention

Project name	**Cambodia**	**Nigeria (1)**	**Nigeria (2)**	**Bangladesh**	**Nepal**
Population (densities) of areas along roads		x	x		
Location of public service facility		x	x	x	(x)
Community preference		x	x	x	x
Connectivity to major (trunk) roads	x				
No issue involving serious safeguards	x	x	x	x	
Socioeconomic benefits (Index employed was indicated)	x (EIRR)	x (Cost-effectiveness)	x (Cost-effectiveness)	x (EIRR)	

The (i), related to population or population densities of the selected areas, is to estimate how many people would benefit from the improvement of rural roads under the intended projects. If being employed at selecting areas for intervention, this criterion would not be taken into account. The (ii), locations of public service facilities such as markets, school, health service facilities, or local administration council were employed in the projects in Nigeria and Bangladesh, which might be intended to offer people more access to those facilities for maintaining their needs for subsistence. The (iii), community preference, would indicate immediate needs of local population which could be realized through improving rural roads in their areas. Those views would be collected in community meetings in the course. Such preference could be respected when employing the IRAP which involves participatory processes. The (iv), connectivity to trunk roads, was included as one selection criterion in the projects in Cambodia and Nigeria (only RAMP-2), probably as a response to the expectation that the rural road improvements boost individual mobility and such effects be diffused beyond the roadsides. The criterion was not employed in the first project in Nigeria (RAMP-1), which could be because it focused on heavily impassable and damaged roads for rehabilitation. The (v) and (vi), criteria related to safeguards issues and economic benefits, would be examined mainly for assuring projects' viabilities, which indicates that some roads involving negative results on those aspects would be eliminated.

3.5 Discussion on Formulation Processes of Rural Roads Projects in Developing Countries

First, it was found that there is no standardized approach with a set of criteria for selecting and prioritizing roads for IFI-financed rural roads projects aimed at poverty alleviation through

improving/providing accessibilities to local people. However, some common features were identified. One is that those projects often cover several areas of various socioeconomic contexts. Another is that the criteria for selecting roads for intervention are determined by the financiers and the government. Such a joint decision-making process could be intended to transfer the financiers' knowledge to the countries and their local stakeholders and to incorporate those stakeholders' needs.

Second, related to the entire project life, it was suggested that the process of prioritizing and selecting the roads for intervention was generally executed prior to project approval by the financiers. The fund for the preparatory works was commonly financed by the financier(s) in forms of grant or loan. This timeframe could be because the selection procedure may take longer than expected. Transportation projects are principally managed with balancing cost, time, and scope (Atkinson, 1999), but the outstanding difference between rural roads projects and other transportation projects was that their scopes (area, alignment, and technical specifications) were not clearly defined at the stage of proposing the project. From the project management perspective, such approaches would not always be cost/time-efficient. These contradictory characteristics of rural roads projects could be attributed to the projects' pro-poor characteristics.

Third, as rural roads projects take a pro-poor approach, it may be suggested that the executing agency/ies in the recipient countries involve other governmental stakeholders in relevant sectors, such as education, health, and other livelihood-related areas, in the consultation process to determine criteria for selecting roads for intervention. Such multi-sectoral approaches could enhance the achievement of one of rural roads projects' mandates: to improve accessibility to those basic services for ameliorating local people's livelihoods and helping them out of poverty.

Lastly, there is a conflictual issue between rural roads projects' characteristics and IFIs' institutional and operational requirements for their approval. One example is EIRR. If an EIRR of a candidate road is estimated below the threshold, the road would slip from the shortlist. However, such a road may often be in an area where poor people reside and cannot afford to own motorized modes. As a primary aim of rural roads projects in developing countries is to contribute to poverty reduction in their target areas, we could consider some room for relaxing such requirements and establishing alternative criteria for assuring accountability to the financiers' investors.

3.6 Conclusions

This chapter reviewed the theoretical knowledge in relation to rural roads projects and made comparative analysis of the five completed/ongoing rural road improvement projects.

As rural roads projects are different from projects concerning other transportation, it was assumed that there are certain differences in project formulation processes. Incorporating unique characteristics of rural roads and their development projects, various design approaches were invented and tested to ensure that rural roads to be constructed/rehabilitated under projects would be beneficial for the local population, boost socio-economic activities, and contribute to poverty reduction. With such knowledge, the five IFI-financed rural roads projects' design approaches were compared. Those projects

were selected because their ultimate objective was the common goal of reducing poverty in areas of their influence through improving the local population's individual accessibility. Their approaches were varied in terms of selecting areas and roads for intervention, possibly because of their attributions to local conditions and institutional concerns of the IFIs and the government on policies, knowledge, and experiences of rural roads projects. In terms of accessibility, which is an expected catalyst for achieving the objective, the projects in Nigeria and Bangladesh employed the relevant criteria; for example, locations of public service facilities that were critical for the population's daily survival. Under the project in Nepal, the issue related to accessibility required for daily subsistence were discussed as one agenda of public meetings held as part of the IRAP. However, this was not explicitly addressed in the project of Cambodia.

Where to remain poor in status would be influenced by accessibility, and if a rural roads project sets the eventual goal of alleviating poverty along the intervened areas, accessibility of the local populations should be addressed and incorporated in the process of formulating the project. This may be on the assumption that improving accessibility for basic needs would eventually enhance individual economic status and well-being.

The following could be the chapter's conclusive finding from the review of practices: accessibility for prospective beneficiaries of rural roads projects was not properly addressed when selecting areas and/or roads for intervention in recent projects though individual accessibility should be guaranteed for survival and escaping from poverty. What could be done in this respect will be examined further in Chapter 10.

Chapter 4. Data Collection

4.1 Introduction

To examine impacts of a rural road rehabilitation project on prospective beneficiaries' livelihoods and existing poverty in their localities, this research employs a completed rural road improvement project in Cambodia as its case project with results of the quantitative and qualitative surveys conducted at its post-completion stage. The quantitative survey was conducted by the case project's executing agency about one year after the civil works completion with using a paper-based face-to-face interview, while the two qualitative interview surveys were implemented to (i) leaders and council members of the communes along the studied roads; and (ii) residents and shop owners stationed along the roads. This chapter will explain the generals of the case project and detail the conducted surveys and their interviewees' profiles. The data presented are used for analyzing impacts of the case projects on travel behaviors and socio-economic activities of the local residents along the studied roads. Their details will be presented in Chapters 5-8 and be synthesized in Chapter 9.

For more details, see Idei and Kato (2018a).

4.2 Project Studied as a Case Project

The project studied in this research is Rural Roads Improvement Project (the project), implemented by the Ministry of Rural Development, the Kingdom of Cambodia (MRD), from 2010 to June 2016. The project aimed at improving 25 rural roads totaling 505.4 km to reduce poverty in the seven provinces around the Tonle Sap region, which is comparatively poorer than other regions, due to higher populations and overreliance on rice farming as their primary income source (Asian Development Bank, 2010). The aim is consistent with the fact that more than 70% of the country's citizens lives in rural areas (National Institute of Statistics [NIS], 2016). In Cambodia, MRD is responsible for the overall operation of feeder roads in rural areas, while the Ministry of Public Works is responsible for national and provincial roads.

The project rehabilitated feeder roads selected as explained in Chapter 3 through double bitumen surface treatment, instead of ordinary gravel paving, to make those roads tolerable for all-weather use. Before the project, the roads were depressed and worn out, which made them impassable during rainy seasons and obstructed people's travelling.

4.3 Data Collected at a Post-Completion Socio-Economic Survey

The MRD carried out a socio-economic survey at a post-completion stage of the project in February-March 2016, about one year after the civil works were completed (hereinafter called in the research "the survey"). The section details the survey, including the areas surveyed, the procedure taken for implementing the survey and the interviewees' profiles.

4.3.1 Study Areas

Three areas were selected for the survey (see Figure 4-1) based on the provincial-level poverty rates recorded by the Ministry of Planning (MOP) in 2012: the lowest poverty rate of 20.4% (the area along the road TK, hereinafter called "TK"), the mid-point of 27.2% (the area along the road KC, "KC"), and the highest of 32.5% (the area along the road BB, "BB") among the project areas (MOP, 2012). One of the major aims at conducting the survey in those multiple areas was an assumption that differences in regional economic conditions could generate heterogeneities among the areas regarding the impact materialization process, particularly in people's behaviors.

This survey examines how improving rural roads in Cambodia affects the local population's mobility and economic status in areas where single-season rice farming is a major economic activity (Cai, Ung, Setboonsarng, & Leung, 2008; Poulton, Dalgliesh, Vangn & Roth, 2016; Thath, 2014).

Figure 4-1 Study Areas of the Case Study

4.3.2 Data Collection

To carry out the survey, the MRD employed a survey team from the National University of Phnom Penh (MRD, 2016). Enumerators in the team conducted face-to-face structured interviews using a paper-based questionnaire sheet. The sheet was structured into the following categories: (i) socio-economic profiles, including family composition and their details, incomes, and expenditures in the wet and dry seasons; accessibility of social services (education and health) and their facilities; and assets or

properties owned; (ii) travel modes and behaviors; (iii) economic activities (type, location, travel mode used to commute, incomes gained, and types of employment contracts); (iv) access to markets; and (v) personal networks. To conduct before-and-after comparisons, the respondents were asked to report on the above items (ii), (iii), and (iv) as in 2011 (before the civil works commenced) and in 2015 (after their completion). This comprehensive questionnaire was designed to incorporate suggestions by Wondemu and Weiss (2012) that rural residents' perceptions are essential for comprehending the impacts of rural road improvements upon their circumstances, together with quantitative monetary and time data.

The enumerators were requested to attend a half-day training program on February 25, 2016 in advance of the survey to improve the likelihood of successful implementation (Photo 4-1). As the interviews were to be conducted in Khmer, the official language of Cambodia, translation of the questionnaire sheet into Khmer was finalized during the training program. The process helped to enhance the clarity of each question and ensure consistency with the original questionnaire prepared in English. Following the training program, the enumerators were given one day to prepare themselves and mobilized to the field where they were assigned (Photo 4-2). They also had opportunities to consult with and receive guidance from their supervisors during implementation.

Regarding the number of their interviewees, 400 potential households (HHs) were selected randomly from the three target areas, comprising 141 from Area TK, 130 from Area KC, and 129 from Area BB, after the enumerators obtained permissions from commune chiefs to approach their populations for conducting interviews and checked the communes' profiles. Subsequently, enumerators visited to ask a member of each HH to participate in the survey. In selecting the interviewees, they sought to select HH heads as the respondents, in order to comprehensively grasp the economic conditions of individual HHs. Finally, the individuals who agreed to participate were interviewed by the enumerators, upon their availability. The sample sizes allocated each area was computed by the survey team, based on the population statistics of the government's Commune Data Base as of 2014 (MRD, 2016).

Photo 4-1 During the Preparatory Workshop on February 25, 2016


Area BB (February 28, 2016)


Area KC (February 26, 2016)


Area TK (March 2, 2016)

Photo 4-2 Interview Conducted by Enumerators during the Survey

4.3.3 Socio-Economic Characteristics of Respondents

Table 4-1 displays the descriptive statistics of the sample dataset with the socio-economic profile of the study areas. First, the number of HHs, families, and population were marked the largest in Area TK, followed by Areas BB and KC. Second, 69.5% of the respondents were HH heads in the total dataset, while this figure ranges from 60.8% to 77.3% among the three areas. Third, the total dataset comprised 221 females (55.3%) and 179 males (44.7%); furthermore, the gender balances were similar among the three areas and correspond to each areas' gender ratio. Fourth, in the total dataset, the highest share of respondents was those in their 50s (25.3%), followed by those in their 40s (23.0%), and 60s (18.8%); the age distributions were quite similar across the study areas. Fifth, over 99% of the respondents were Buddhist and Khmer in all the areas. Sixth, most of the respondents (74.4%) were married. Seventh, 73.0% of the respondents in the total dataset were farmers, followed by vendors of goods/farm products (9.5%); the dominance of the job of farmer was commonly observed in all the areas. Finally, non-educated respondents accounted for 50.8% of the total dataset, followed by primary (30.5%), and secondary (14.8%) level education. While over half of the respondents were unschooled or did not complete primary education in Areas BB and TK, over one-quarter of the respondents in Area KC received a secondary school education.

Gaps between the country's demographic data and the established dataset were examined. According the demographic information of the country of 2015 (NIS, 2016), the women-men ratio is recorded 51.0%, the percentage of Khmer population is 96.1% against the total population, and the percentage of people who never attend/complete primary education is 47.1% against the total population over 15 years old. There is no significant difference on these two datasets. However, several gaps are noticed between the dataset. One of the gaps is related to civil status. The percentage of married people over 15 years old in the country is 58.0% and of non-married 31.8%, against 74.5% and 11.3% in the dataset respectively. This gap would not generate any significant bias on interviewees' responses, as most of the interviewees stayed with other members and experienced sharing living income/expenses and travel modes regardless of civil status, which was observed in the follow-up survey to be discussed later. Sato (2017) evidenced that HH's mixed composition are common in rural areas in the country. Another gap is observed on people's occupational composition, as 47.3 % of people aged 15-63 engages engage in self-employed farming at the national level, while 73.0% in the dataset. This could be because of the two characteristics related to local economic structures: heavy reliance on rice farming; and

distant location far from economic centers with active secondary and tertiary sectors. Those would limit opportunities to working in non-farming economic activities and increase the number of people engaged in farming.

Table 4-1 Descriptive Statistics of the Sample Dataset

Study Areas		Total		TK		KC		BB	
Number of Interviewees		400		141		130		129	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%
Household head	Yes	278	69.50%	109	77.30%	79	60.77%	90	69.77%
	No	122	30.50%	32	22.70%	51	39.23%	39	30.23%
Gender	Female	221	55.25%	78	55.32%	76	58.46%	67	51.94%
	Male	179	44.75%	63	44.68%	54	41.54%	62	48.06%
Ages	10-19	3	0.75%	2	1.42%	0	0.00%	1	0.78%
	20-29	34	8.50%	7	4.96%	19	14.62%	8	6.20%
	30-39	74	18.50%	23	16.31%	24	18.46%	27	20.93%
	40-49	92	23.00%	34	24.12%	29	22.31%	29	22.48%
	50-59	101	25.25%	36	25.53%	33	25.38%	32	24.81%
	60-69	75	18.75%	28	19.86%	20	15.38%	27	20.93%
	Above 70	20	5.25%	11	7.80%	5	3.85%	5	3.87%
Religion	Buddhist	396	99.00%	141	100.0%	126	96.92%	129	100.0%
	Muslim	3	0.75%	0	0.0%	3	2.31%	0	0.0%
	Christian	1	0.25%	0	0.0%	1	0.77%	0	0.0%
Ethnicity	Khmer	398	99.50%	141	100.0%	128	98.46%	129	100.0%
	Cham	1	0.25%	0	0.0%	1	0.77%	0	0.0%
	Other	1	0.25%	0	0.0%	1	0.77%	0	0.0%
Civil Status	Married	298	74.50%	113	80.14%	100	76.92%	85	65.90%
	Separated/ Divorced or Widowed (Female)	44	11.00%	15	10.64%	13	10.00%	16	12.40%
	Separated/ Divorced or Widowed (Male)	13	3.25%	0	0.00%	3	2.31%	10	7.75%
	Never married	45	11.25%	13	9.22%	14	10.77%	18	13.95%
Employment type or status	Farmer	292	73.00%	113	80.14%	96	73.84%	83	64.34%
	Fisherman/woman	1	0.25%	0	0.00%	0	0.00%	1	0.78%
	Vendor of goods or farm products	38	9.50%	8	5.67%	19	14.62%	11	8.53%
	Employed in non-farming role	25	6.25%	8	5.67%	9	6.92%	8	6.20%
	Student	8	2.00%	0	0.00%	1	0.77%	7	5.43%
	Unemployed	9	2.25%	6	4.26%	2	1.54%	1	0.78%
	Unknown	27	6.75%	6	4.26%	3	2.31%	18	13.95%
Education	Primary	122	30.50%	47	33.33%	37	28.46%	38	29.45%
	Secondary	59	14.75%	16	11.35%	34	26.15%	9	6.98%
	Tertiary	16	4.00%	2	1.42%	10	7.69%	4	3.10%
	No education	203	50.75%	76	53.90%	49	37.70%	78	60.47%
Total		**400**	**100.0%**	**141**	**100.0%**	**130**	**100.0%**	**129**	**100.0%**

4.3.4 Major Characteristics of Travel Behaviors of Respondents

Table 4-2 presents an overview of the respondents' travel behaviors before and after the road improvement. First, the ownerships of motorcycle(s) and bicycle(s) were commonly increased across the three areas. The increase rate was the most significant in Area BB for motorcycle(s) and in Area KC

for bicycle(s). The increase in the ownership of vehicle and truck was also found in Areas KC and TK, which was less significant than the other wheeled modes. Second, the most significant increase in the daily use of the rehabilitated roads was observed in Area TK (18.8%), while 9.6% in KC and 11.9% in Area BB. This result evidences that the road improvement motivated the respondents to travel more by using the roads. Third, changes in travel purposes vary across the three areas. In Area TK, "meeting family members/relatives" was the primary travel purpose both before and after the road improvement; its percentage in 2011 (49.6%) almost matches that in 2015 (53.3%). In Area KC, "purchasing daily commodities" was the primary travel purpose both before and after the road improvement; its percentage in 2011 (18.6%) nearly matches that in 2015 (18.7%). "Meeting friends" was selected as another primary travel purpose before the road improvement (18.6%), but the share slightly declined to 17.9%. In Area BB, the primary travel purpose in 2011 was to "meeting family members/relatives" (26.4%), whereas in 2015 this had changed to "receiving medical services" (22.6%), which revealed that local people were more likely to use the rehabilitated roads for non-economic purposes of satisfying immediate needs for survival. Fourth, the travel destination with the highest share was found to be the "market" in all the areas in 2011. In TK, however, it was replaced with "workplaces" in 2015, followed by "pagoda". Furthermore, the respondents' overall selections also changed: over 20% selected "markets," "outside the province," or "farming fields" as their main destinations in 2011, while less than 10% selected these destinations in 2015. Conversely, in KC and BB, the most frequently visited destinations remained unchanged before and after the roads were rehabilitated. This indicates that some of the respondents in TK found their workplaces for non-farming works after the road improvement, e.g., road improvement might cause changes in local employment markets more significantly in TK than in the other two. Finally, "self-owned motorbike" was most commonly used as a primary mode in all the areas and this was unchanged even after the road improvement. Shared modes, including shared personal vehicles and *tuk-tuk*s, were less used in Area TK, but the use of "tuk-tuks" increased in Areas BB and KC. Despite the increased use of wheeled or motorized options, the major travel mode recorded in 2015 was "on foot" for 16.5% in Area BB, 2.8% in Area TK, and 0.9% in Area KC, of which only the rate in Area BB increased after the road improvement. This may mean that the increase in modal ownerships did not necessarily change respondents' individual use of daily travel modes, rather newly purchased modes could be for their household members' use and might enhance the mobility at their household levels. Photo 4-3 shows major travel modes used in the study areas.

Table 4-2 Changes in Travel Behaviors from 2011 to 2015 in Study Areas

	Total (N=400)		TK (N=141)		KC (N=130)		BB (N=129)	
	2011	2015	2011	2015	2011	2015	2011	2015
Ownership rate of major travel modes								
Vehicle and Truck	6.50%	7.75%	2.84%	3.55%	14.62%	17.69%	2.33%	2.23%
Motorcycle	35.25%	67.75%	41.84%	74.47%	40.00%	80.00%	23.26%	48.06%
Bicycle	54.25%	72.25%	42.55%	53.90%	60.00%	82.31%	61.24%	82.17%

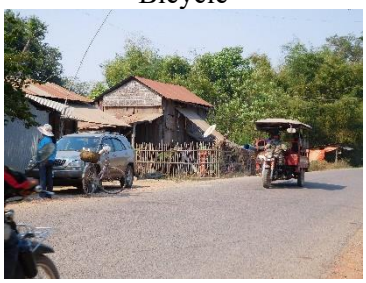
	Total (N=400)		TK (N=141)		KC (N=130)		BB (N=129)	
	2011	2015	2011	2015	2011	2015	2011	2015
Frequency of using the road								
Daily	**58.42%**	**71.76%**	**70.91%**	**89.72%**	**63.11%**	**72.73%**	42.74%	**54.62%**
3-4 times a week	33.99%	23.92%	25.45%	8.42%	29.51%	20.66%	**45.97%**	41.18%
Once a week	3.65%	1.15%	1.82%	0.00%	2.46%	1.65%	6.45%	1.68%
Once every two weeks	1.69%	1.44%	0.91%	0.00%	0.82%	2.48%	3.23%	1.68%
Once a month	1.69%	1.44%	0.91%	0.93%	2.46%	2.48%	1.61%	0.84%
Never	0.56%	0.29%	0.00%	0.93%	1.64%	0.00%	0.00%	0.00%
p-value	0.067		1.000		1.000		1.000	
Primary travel purpose								
Meeting family or relatives	**29.61%**	**28.39%**	**49.56%**	**53.34%**	13.57%	13.39%	**26.40%**	18.28%
Meeting friends	13.69%	10.97%	6.09%	6.67%	**18.64%**	17.86%	16.00%	7.53%
Selling own farm products	5.31%	6.77%	2.61%	1.90%	11.86%	14.29%	1.60%	3.23%
Selling own non-farm products	6.42%	6.45%	4.35%	3.81%	11.02%	10.71%	4.00%	4.30%
Purchasing daily commodities	16.48%	17.74%	19.12%	17.14%	**18.64%**	**18.75%**	12.00%	17.20%
Purchasing goods for business	3.35%	4.19%	1.74%	2.86%	6.78%	7.14%	1.60%	2.15%
School	1.96%	2.26%	0.87%	0.95%	2.54%	2.68%	2.40%	3.23%
Farming activities	8.10%	7.74%	5.22%	3.81%	2.54%	2.68%	16.00%	18.28%
Medical service	8.38%	9.03%	3.48%	2.86%	3.39%	3.57%	17.60%	**22.57%**
Non-farming activities	2.23%	1.94%	1.74%	1.90%	3.39%	1.79%	1.60%	2.15%
Other	4.47%	4.52%	5.22%	4.76%	7.63%	7.14%	0.80%	1.08%
p-value	1.000		1.000		0.106		0.209	
Primary travel destination								
Market	**33.73%**	**29.41%**	**29.70%**	7.79%	**44.55%**	**44.34%**	**27.27%**	**30.34%**
Workplace	5.12%	21.32%	4.95%	**62.34%**	8.18%	7.55%	2.48%	2.25%
Health center	11.45%	9.19%	10.89%	0.00%	3.64%	2.83%	19.01%	24.72%
School	2.41%	3.31%	0.99%	1.30%	2.73%	3.77%	3.31%	4.49%
Commune hall	0.90%	1.47%	0.00%	0.00%	2.73%	3.77%	0.00%	0.00%
Provincial hall	0.00%	0.37%	0.00%	0.00%	0.00%	0.94%	0.00%	0.00%
Pagoda	2.11%	5.88%	1.98%	16.88%	0.91%	1.89%	3.31%	1.12%
Outside the province	7.53%	1.10%	21.78%	1.30%	2.73%	1.89%	0.00%	0.00%
Farming fields	4.82%	1.84%	3.96%	1.30%	1.82%	1.89%	8.26%	2.25%
House of non-family persons	11.75%	8.46%	20.79%	9.09%	1.82%	1.89%	13.22%	15.73%
Other	20.18%	17.65%	4.95%	0.00%	30.90%	29.24%	23.14%	19.10%
p-value	1.000		1.000		0.049		1.000	
Primary travel mode								
Self-owned vehicle	12.40%	9.72%	16.38%	14.81%	10.83%	7.01%	10.23%	7.22%
Self-owned motorcycle	**50.41%**	**58.31%**	**56.90%**	**65.74%**	**60.83%**	**69.30%**	**34.65%**	**37.11%**
Self-owned bicycle	19.01%	16.30%	17.24%	13.89%	14.17%	13.16%	25.20%	22.68%
Sharing a vehicle	4.96%	1.88%	0.86%	0.00%	7.50%	3.51%	6.30%	2.06%
Tuk-tuk	5.78%	5.64%	2.59%	1.85%	1.68%	1.75%	12.60%	14.43%
Public bus	0.28%	0.31%	0.00%	0.00%	0.83%	0.88%	0.00%	0.00%
Other public transportation	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
On foot	5.78%	6.27%	5.17%	2.78%	0.83%	0.88%	11.02%	16.50%
Other	1.38%	1.57%	0.86%	0.93%	3.33%	3.51%	0.00%	0.00%
p-value	1.000		1.000		0.071		1.000	

Note: p-values were computed using the two-sided Fisher's exact test, representing a probability of rejecting the null hypothesis that travel behaviors before the road improvement would be the same as those after. If p-value is estimated above 5% (0.05), the null hypothesis is accepted.

Bicycle

Motorcycle

Motorcycle attached with a cart



Tuk-tuk

Koyone

Four-wheeled vehicle

Photo 4-3 Major Travel Modes in the Study Areas

4.4 Interview survey to local commune officials

In parallel to the above survey, from February 26 to March 3, 2016, the interviews were conducted to chiefs, council members and other public officers of the 14 communes along the three study roads, totaling 32 (Photo 4-4). Their breakdown is detailed in Table 4-3, indicating that 13 were commune chiefs, 12 commune council members and 7 other public service officers like policeperson attended the survey. One officer in Area TK was female, and the rest were male. The interview survey aimed at understanding their socio-economic overviews and information regarding the primary economic activities of their local population and changes observed after the road improvement in their population's travel and economic behaviors. Demographic data of the communities and villages were collected together. The data and information collected through the interviews were to be used as references for analyzing the data obtained in the survey. Interview notes and collected demographic data were presented in Appendix 2, and the summary is presented in Table 4-4.

Table 4-3 Profiles of the Interviewees

Study Areas	Total	TK	KC	BB
Communes	14	7	3	4
Commune chief	13	7	2	4
Commune council member	12	10	1	1
Other public service officer	7	6	1	0

Table 4-4 Demographic Information of each Area

Study Areas	Total	TK	KC	BB
Province's poverty rate (MOP, 2012)		20.4	27.2	32.5
Villages	55	29	12	14
Communes	14	7	3	4
Households	10,465	4,766	1,875	3,824
Families	12,138	5,543	2,201	4,394
Population	53,086	25,161	8,896	19,029

Area BB (February 29, 2016)

Area KC (February 26, 2016)

Area TK (March 1, 2016)

Photo 4-4 Interview Surveys to Commune Officials

4.5 Follow-up Survey

Following the above post-completion survey, another survey was executed from December 12 to 27, 2016 by a study group led by the author (hereinafter called in the research "the follow-up survey"), through which face-to-face semi-structured interviews were implemented with 45 individuals along/around the study roads and adjacent markets (Photo 4-5). The follow-up survey aimed at understanding how project beneficiaries and local stakeholders found changes in their living environments and in accessibility to public utilities. The following two were this survey's major goals: (i) to comprehend how project beneficiaries and local stakeholders perceived changes around their living environment and (ii) to verify our findings from the above survey on modal ownership; economic behaviors; and accessibility to social services, education and health.

Table 4-5 presents the profiles of the interviewees. Out of 45 interviewees, 34 were from HHs residing along the three roads and were asked about their members' economic and travel behavior and accessibility to social service facilities before and after the road improvements. The remaining 11 interviewees were shop owners—three rice mill firm staff, one operator of a family-run restaurant, and seven shop owners/staff—who were interviewed mainly on the changes in their business environments after the road improvements, including sales and types of customers. Five interviewees ran their businesses at markets but outside the road areas. To select the interviewees, the author first drove through the study areas to understand the environments and, second, randomly selected potential interviewees, taking into account their economic status such as their houses' exteriors, genders, ages, residential places, HH compositions, and ownership of travel modes. Then, the potential interviewees were asked to participate voluntarily and, if she or he agreed, the interview was carried out. The number of female interviewees was larger than the number of males, mainly because the survey was carried out

during the harvest season for rice farming, when most male HH members work in the field during the daytime. The minutes of the interviews were presented in Appendix 3.

Table 4-5 Descriptive Statistics of Follow-up Survey Respondent Characteristics

Study Areas		Total (N=45)	TK (N=19)	KC (N=13)	BB (N=13)
Gender	Female	33	16	9	8
	Male	12	3	4	5
Age	20–29	4	1	1	2
	30–39	12	4	4	4
	40–49	8	6	1	1
	50–59	15	6	4	5
	60–69	5	1	3	1
	Above 70	1	1	0	0
HH or not	Yes	20	8	6	6
	No	14	4	4	6
Shop operator/Staff		11	7	3	1

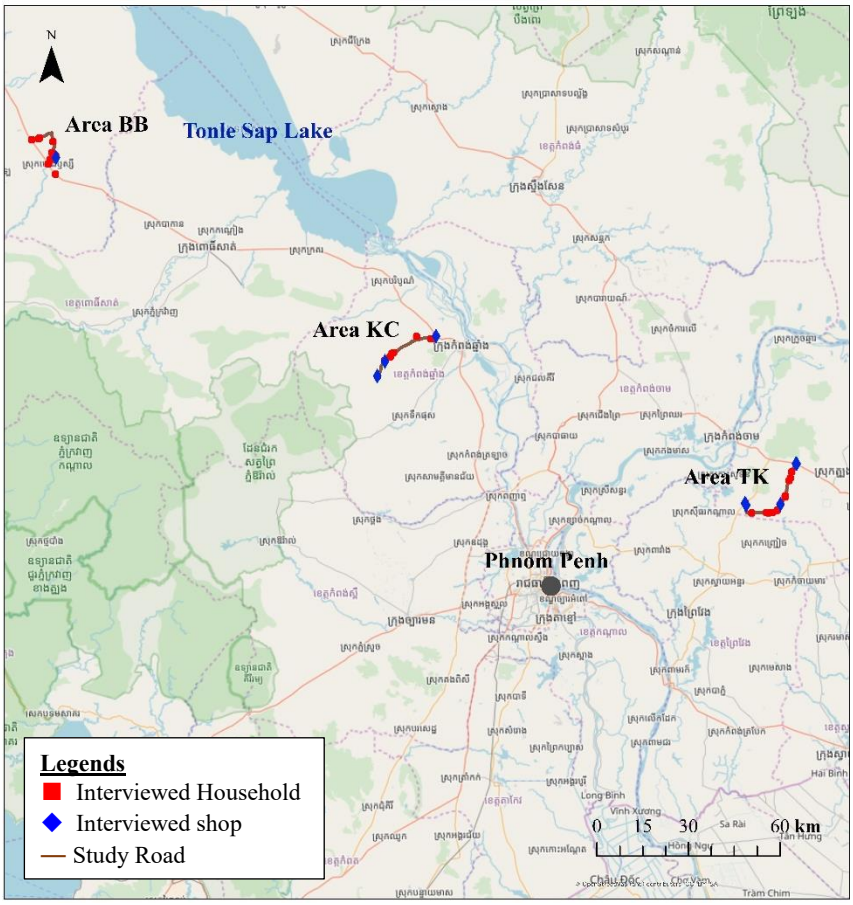


Figure 4-2 Location of Interviewed Shops and Households in the Study Areas

Area BB

December 14, 2016

December 15, 2016

December 16, 2016

Area KC

December 17, 2016

December 20, 2016

December 25, 2016

Area TK

December 20, 2016

December 21, 2016

December 23, 2016

Photo 4-5 Follow-up Survey

Chapter 5. Impact of Rural Road Improvements on Mobility and Economic Status

5.1 Introduction

Over 70% of the people who live below the international poverty line reside in rural areas in developing countries (International Fund for Agricultural Development, 2010). These circumstances are principally the result of an overreliance on agriculture that makes people vulnerable to seasonality and climate, and their isolation and/or remoteness from the economic and social mainstream (Bird & Shepherd, 2003; Njenga & Davis, 2003; Stifel & Minten, 2008; World Bank, 2007). To help these people out of poverty, international communities have provided various financial and technical aid, one of which is improving roads in these areas.

Rural road improvements are expected to facilitate better access to various opportunities and places, and thus to enhance people's economic status and mobility, which in turn may lead to more sustainable livelihoods (Faiz et al., 2012). Although this expectation is widely acknowledged by the international communities, it may not always be fulfilled, and the reported unexpected result is that some people benefit less than others and may even be affected adversely. For example, Windle and Cramb (1997) reported that the physical distance between individual houses and improved roads is a key determinant of the distribution of economic benefits in rural areas in Malaysia. Through their comparative analysis of individual mobility among the three selected Asian and African countries, Bryceson et al. (2008) confirmed that road improvements commonly contributed to changes in local people's behaviors and increased ownership of wheeled modes of transportation. Such contributions were more significant in wealthier individuals and regions than others. These findings may suggest that positive impacts of improving rural roads' contributions on individual mobility and economic status are more likely observed in populations with economic capacities and in wealthier areas than others, which indicates the possibility that improving roads may expand discrepancies among those populations.

This chapter aims to examine what to influence impacts of a completed rural road improvement on local population's mobility and economic status in the study areas. The areas' overreliance in single-season rice farming on is considered to make their population poor and vulnerable against fluctuations of rice prices, often affected by national markets and policies. Improving road conditions in the areas is expected to promote the transformation of existing mono-economic systems with boosting the connectivity with areas outside the improved roads, eventually reaching more to economic opportunities and stabilizing annual income of the roadside population.

The reminder of the chapter is organized as follows. Section 5.2 presents a review of previous findings on the effects of rural road improvements on beneficiaries' economic status and travel patterns. In Section 5.3, the dataset used in our empirical analysis is described, and in Section 5.4, our model's estimates of households' (HHs) mobility and economic status are presented. Finally, the findings are discussed in Section 5.5, followed by the conclusive remarks in Section 5.6.

5.2 Literature Review

5.2.1 Impacts of Rural Road Improvements on Travel Behaviors

There are several studies empirically analyzing the impact of rural road improvements on travel behaviors in developing countries, most of which focus on mobility or modal ownership. For example, Hettige (2006) reported no significant change in individuals' mobility following a road improvement project in Indonesia. This was due to the local population's preference for walking on daily short-distance trips, rather than using motorized transportation or bicycles, even after the road had been improved. Bryceson et al. (2008) also observed differences in the characteristics of the trips made by local populations in Vietnam, particularly in terms of distance, duration, and speed. They concluded that high-income individuals more often travelled longer distances at a faster speed than low-income individuals, and that such differences were more significant in remote areas.

As for the impacts on modal ownership, Iimi, Lancelot, Manelici, and Ogita (2015) found increases in modal ownership after road improvements, and concluded that these increases resulted from a combination of improved road conditions, better road access, and increases in income. Bryceson et al. (2008) compared the impacts of rural road improvements on people's modal ownership in three countries with different geological and socioeconomic characteristics, and found different impacts by subgroup. For example, low-income individuals did not change their HH's modal ownership as much as high to middle income individuals; and people in remote areas had fewer private motorized modes than those in well-connected areas.

These findings indicate that individuals' income levels and regional economic conditions may affect people's mobility and modal ownership in relation to road improvements. It is assumed that such well-resourced people who benefitted might be equipped with other factors related to those determinants, which may not be explicitly recognized. However, few studies have looked into those indirect factors influencing people's mobility.

5.2.2 Impacts of Rural Road Improvements on Economic Status

Various studies about direct and indirect effects of rural road improvements on individuals' economic status in developing countries focused mainly on income levels. Their approaches can be categorized into two types: changes in individuals' income sources and structural changes to the local economy.

Two processes related to road improvements have been identified as accounting for changes in individuals' income sources. One is alterations to a farm's agricultural practices, which may include moving from mono cropping, undertaken by small to medium-sized enterprises in addition to farming activities (Lokshin & Yemtsov, 2005; Njenga & Davis, 2003; Sieber & Allen, 2016); accessing extension services for farming activities provided by trained professionals from outside localities (Dercon et al., 2009); and diversifying the products available for sale, particularly cash crops or perishable items (Sieber & Allen, 2016). Such changes might subsequently transform local HHs' economic activities. The other process leading changes in income is the likelihood that road improvements will lead to an increase in employment opportunities in non-farm sectors, such as the

service sectors (Asher & Novosad, 2016; Iimi et al., 2015; Mu & van de Walle, 2011; Rand, 2011). These sectors typically emerge only after improvements have been completed, since their development responds to the needs of people who are accustomed to using the improved roads (Mu & van de Walle, 2011; Rand, 2011). Increased access to opportunities are observed not only within the roadside areas, but also outside, since some local people are able to access more job opportunities by using the improved roads (Iimi et al., 2015).

Changes to local economic structures are also influenced by two drivers: one is the means of exchange, particularly with regard to the transition from barter trade to cash-based trade (Lokshin & Yemtsov, 2005; Mu & van de Walle, 2011; Sieber & Allen, 2016). The other possible driver is an influx of people from outside the roadside area, mainly for trading farm products, although evidence supporting this claim for rural road projects is quite limited (Bell & van Dillen, 2012). These structural changes may be observed in the years following the road improvements.

Although the above studies investigated effects of the improvements on income levels in depth, few studies have analyzed their influence on income seasonal stability. Poor income stability has been identified as one of factors contributing to rural poverty and farmers' economic vulnerability, particularly in areas that are predominantly based on agriculture (Njenga & Davis, 2003; Parada, 2015; Porter, 2002). Hence, this chapter will examine effects of rural road improvements on individual income seasonal stability as well as income levels

5.3 Data Development

Table 5-1 summarizes measures of the characteristics and activities of participants, whose responses to the survey will be used for the empirical analysis of this chapter. Only 235 responses were selected out of the originally collected 400, which were detailed in Chapter 4, considering the robustness of their data for further analysis. Of the samples, the responses of eight landowners who had indicated that they had "no land ownership" were replaced by "owning/using rice lands" if they were a "self-employed farmer." This adjustment was made based on Yagura's (2008) findings in other rural areas in Cambodia, where people who described themselves as "self-employed farmers" tend to own or use rice fields by themselves. Further, answers from twenty of the 235 respondents were incomplete with regard to the primary travel mode used by respondents for their daily lives in 2015, and their answers in 2011 were assumed to substitute for these missing items, because 90.6 % of the sample selected was the same for 2015 as for 2011. For 24 respondents who did not answer the question about which market they visited most frequently, either before or after the road improvement, we assumed the closest markets for their choices, taking into account the others' responses.

The table shows that most of the respondents (98.3%) were Buddhist, while the rest were Muslim or Christian. Similarly, more than 99.0 % of them were Khmer. As for occupations, 95.3 % of the respondents were engaged in farming, while 3.0 % were fishermen/women, and 1.7 % were vendors. Most respondents (86.4%) had not completed primary education; 11.9 % had a primary education; 1.7 % had completed a lower secondary education. The respondents' average daily income per capita were

estimated, based on their households' monthly income. Area BB, the area with the highest poverty rate, had the highest average income, and also the largest standard deviation (S.D.), while Area TK, the wealthiest of the three areas, had the smallest average income and the lowest S.D. They indicate that economic discrepancies in poorer areas could be larger than those in the other areas.

Table 5-2 summarizes the respondents' and their HHs' travel related statistics. Following the road improvement, more than half of the populations in all three areas used the improved roads every day, though the vast majority in Area BB, the poorest area, had previously used the roads less frequently. This indicates that poor road conditions might affect local populations' mobility more severely in poorer areas. The share of people using motorcycles as their primary travel mode was larger than those who had owned motorcycles before the road improvement. As an instance, 53.6% of the total respondents answered that their primary travel mode in 2011 was a motorcycle, while only 38.3% said that they owned motorcycles at that time. It is likely that some people who used these modes might borrow them from their neighbors, including relatives and friends, as observed during the follow-up survey. Such gaps in the rates of "use" and "ownership" disappeared in all the areas after the road improvements, because of increases in the number of HHs owning motorcycles. For all three modes, the largest increase was marked in Area KC.

Table 5-3 shows changes which the respondents perceived in their economic status before and after the road improvements. The share of people not recognizing any change in their economic status was the largest, commonly in all the areas. Regarding economic seasonal stability, the respondents' perceptions were varied. Those recognizing that seasonal income fluctuations were reduced comprised the largest share in Area TK, while the largest share in Areas BB and KC was found in the group not recognizing any change.

Table 5-1 Descriptive Statistics of Data to be Used for the Empirical Analysis

Study Areas		Total (N=235)		TK (N=58)		KC (N=106)		BB (N=71)	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%
HH head	Yes	160	68.09%	47	81.03%	63	59.43%	50	70.42%
	No	75	31.91%	11	18.97%	43	40.57%	21	29.58%
Gender	Female	133	56.60%	30	51.72%	63	59.43%	40	56.34%
	Male	102	43.40%	28	48.28%	43	40.57%	31	43.66%
Ages	10-19	1	0.43%	1	1.72%	0	0.00%	0	0.00%
	20-29	18	7.66%	1	1.72%	17	16.04%	0	0.00%
	30-39	48	20.43%	12	20.69%	19	17.92%	17	23.94%
	40-49	55	23.40%	12	20.69%	25	23.58%	18	25.35%
	50-59	54	22.97%	12	20.69%	25	23.58%	17	23.94%
	60-69	45	19.15%	13	22.41%	15	14.15%	17	23.94%
	Over 70	14	5.96%	7	12.08%	5	4.73%	2	2.83%
Religion	Buddhist	231	98.29%	58	100.00%	102	96.23%	71	100.00%
	Muslim	3	1.28%	0	0.00%	3	2.83%	0	0.00%
	Christian	1	0.43%	0	0.00%	1	0.94%	0	0.00%
Ethnicity	Khmer	234	99.57%	58	100.00%	105	99.06%	71	100.00%
	Cham	1	0.43%	0	0.00%	1	0.94%	0	0.00%

Study Areas		Total (N=235)		TK (N=58)		KC (N=106)		BB (N=71)	
		Freq.	%	Freq.	%	Freq.	%	Freq.	%
Employment type or status	Farmer	224	95.32%	58	100.00%	103	97.17%	63	88.74%
	Fisherperson	7	2.98%	0	0.00%	3	2.83%	4	5.63%
	Vendor of goods /farm products	4	1.70%	0	0.00%	0	0.00%	4	5.63%
Education	Primary	28	11.92%	3	5.17%	12	11.32%	13	18.31%
	Secondary	4	1.70%	0	0.00%	0	0.00%	4	5.63%
	No education	203	86.38%	55	94.83%	94	88.68%	54	76.06%
Average daily income per capita (Cambodian riel '000)		Average 19.86	S.D. 25.11	Average 16.79	S.D. 17.07	Average 14.98	S.D. 22.07	Average 29.15	S.D. 30.96
Total		235	100.00%	58	100.00%	106	100.00%	71	100.00%

S.D. = standard deviation

Table 5-2 Changes in Travel Behaviors from 2011 to 2015 in the Study Areas

Study Areas	Total (N=235)		TK (N=58)		KC (N=106)		BB (N=71)	
Year	2011	2015	2011	2015	2011	2015	2011	2015
Ownership of travel mode(s)								
Vehicle and truck	3.83%	5.53%	13.79%	15.52%	0.94%	3.77%	0.00%	0.00%
Motorcycle	38.30%	73.62%	48.28%	82.76%	39.62%	82.08%	28.17%	53.52%
Bicycle	56.17%	77.87%	50.00%	62.07%	57.55%	84.91%	59.15%	80.28%
Primary travel mode								
Self-owned vehicle	12.34%	8.84%	15.52%	13.80%	11.32%	7.00%	11.27%	7.02%
Self-owned motorcycle	53.62%	61.39%	63.79%	70.69%	63.21%	70.00%	30.99%	36.84%
Self-owned bicycle	16.59%	14.42%	15.52%	12.07%	12.26%	13.00%	23.94%	19.30%
Share a vehicle	4.68%	2.33%	0.00%	0.00%	6.60%	4.00%	5.64%	1.75%
Tuk-tuk	5.53%	4.65%	1.72%	1.72%	1.89%	1.00%	14.08%	14.04%
Public transportation	0.43%	0.46%	0.00%	0.00%	0.94%	1.00%	0.00%	0.00%
On foot	5.11%	6.05%	3.45%	1.72%	0.00%	0.00%	14.08%	21.05%
Other	1.70%	1.86%	0.00%	0.00%	3.78%	4.00%	0.00%	0.00%
p-value	0.959		0.811		0.980		0.940	
Frequency of using the road								
Daily	60.85%	73.19%	82.76%	93.10%	63.21%	72.64%	39.44%	57.74%
3–4 times a week	32.76%	22.13%	15.52%	5.17%	28.30%	20.75%	53.52%	38.03%
Once a week	2.98%	1.70%	1.72%	0.00%	2.83%	1.89%	4.22%	2.82%
Once every two weeks	1.28%	1.70%	0.00%	0.00%	0.94%	2.83%	2.82%	1.41%
Once a month	1.28%	1.28%	0.00%	1.73%	2.83%	1.89%	0.00%	0.00%
Never	0.85%	0.00%	0.00%	0.00%	1.89%	0.00%	0.00%	0.00%
p-value	1.000		1.000		0.812		0.922	
Primary travel purpose								
Meeting family members/relatives	29.60%	28.29%	60.00%	60.38%	14.85%	15.31%	26.86%	20.37%
Meeting friends	13.45%	10.73%	3.63%	3.77%	18.81%	17.35%	13.43%	5.56%
Selling own farm products	8.52%	10.73%	1.82%	1.89%	16.84%	18.37%	1.49%	5.56%
Selling own other products	1.79%	1.95%	0.00%	0.00%	3.96%	4.08%	0.00%	0.00%
Purchasing daily commodities	17.04%	19.03%	14.55%	16.98%	18.81%	19.39%	16.42%	20.37%
Purchasing goods for business	3.59%	3.90%	0.00%	0.00%	5.94%	6.12%	2.99%	3.70%
School	1.79%	1.95%	0.00%	0.00%	1.98%	2.04%	2.99%	3.70%
Farming activities	9.42%	8.78%	10.91%	7.55%	2.97%	3.06%	17.91%	20.37%
Medical service	6.28%	5.86%	1.82%	0.00%	3.96%	4.08%	13.43%	14.82%
Non-farming activities	2.24%	1.95%	0.00%	0.00%	2.97%	2.04%	2.99%	3.70%
Other	6.28%	6.83%	7.27%	9.43%	8.91%	8.16%	1.49%	1.85%
p-value	0.885		0.986		0.834		0.487	

Note: p-values were computed using the Wilcoxon-Mann-Whitney test, representing the probability of rejecting the null hypothesis that travel behavior before road improvements are the same as after.

Table 5-3 Perception of Changes in Economic Status in Study Areas after the Rural Road Improvement

Study Areas	Total (N=235)	TK (N=58)	KC (N=106)	BB (N=71)
Change Recognized in Income Level				
Increased	25.96%	12.07%	28.30%	33.80%
Unchanged	65.11%	84.48%	59.44%	57.75%
Reduced	8.93%	3.45%	12.26%	8.45%
Change Recognized in Seasonal Income Stability				
Stabilised	27.66%	34.48%	20.76%	32.39%
Unchanged	39.57%	29.31%	48.11%	35.22%
Unstabilised	32.77%	36.21%	31.13%	32.39%

5.4 Empirical Analysis

5.4.1 Analytical Framework

As stated earlier, previous studies found that impacts of rural road improvements on local population's mobility and economic status were subject to individual/regional economic capacities. Hence, this chapter establishes the following four working hypotheses:

- First hypothesis (H1): A rural road improvement in areas with a higher poverty rate increases individual travel frequencies more than that in areas with a lower poverty rate;
- Second hypothesis (H2): A rural road improvement enhances modal ownerships of HHs of higher income levels more than the others;
- Third hypothesis (H3): A rural road improvement helps to raise HH income levels; and
- Fourth hypothesis (H4): A rural road improvement reduces disparities in HH income's seasonal stability over HH income level.

The first hypothesis (H1) is related to changes in individuals' travel frequencies, while the second hypothesis (H2) is related to changes in modal ownership. These examine in detail the two findings presented in Table 5-2. The first is that the travel frequency grew the most in the poorest area, and the second is that modal ownerships were increased regardless of commune poverty rates and income levels. They contradict previous studies' findings that those positive changes to individual mobility were likely observed in wealthier people or areas (for example, Bryceson et al. [2008]). Then, the third and fourth hypotheses (H3 and H4) come from the observations in Table 5-3, indicating that most local people along the improved roads did not perceive any significant improvement in their income levels while changes in incomes' seasonal stabilities were perceived variously regardless of regional poverty rates. Hence, referring to the previous findings (for example, Hettige [2006]), we hypothesize that economic impacts from road improvements would be more significant for higher-income HHs. Verifying H4 will help us understand whether the rural road improvements contribute to stabilizing local populations' income level throughout the year.

5.4.2 Model Formulation and Estimation Results

To test H1, the changes in individual travel frequency following the road improvement are formulated as a simple ordered logit model. This enables us to understand how individual travel frequencies changed after the road had been improved. The choice set is assumed to be: "3: frequency was increased," "2: frequency was unchanged," and "1: frequency was reduced." The model formulates the latent variable of the individual *i* as:

$$y_i = X_i\beta_k + \varepsilon_i \tag{5-1}$$

where X_i represents a vector of explanatory variables, while β_k represents a vector of the variables' coefficient and ε_i an error component respectively. The probability of choosing the choice *j* of the individual *i* is presented.as:

$$\begin{aligned}\pi_{ij} &= Pr(y_i = j|X_i) = Pr(y_i \le j|X_i) - Pr(y_i \le j-1|X_i) \\ &= \Lambda\left(\tau_j - X_i\beta_k\right) - \Lambda\left(\tau_{j-1} - X_i\beta_k\right)\end{aligned} \tag{5-2}$$

where π_{ij} represents a probability when the individual *i* chooses the choice of *j* from the three choices. $\Lambda(\cdot)$ represents the probability density function of the logistic distribution.

The potential explanatory variables are: "daily income per capita in 2015 ('00000 Cambodian riels);" "use of bicycle as the primary travel mode (dummy)," which is 1 if the respondent used a bicycle as the primary travel mode and 0 otherwise; "use of motorcycle as the primary travel mode (dummy)," which is 1 if the respondent used a motorcycle as the primary travel mode and 0 otherwise; "distance from house to market most frequently visited ('00000 meters);" "poverty rate of a commune after road improvement," which represents the poverty rate in a commune following road improvements (Ministry of Planning [MOP], 2016); and "percentage of road to market most frequently visited that is paved (pavement rate)," which is assumed to indicate an improvement in the rural road condition. Other than these individual variables, Model 1-2 employs a combination variable of the last two variables, being "pavement rate" and "poverty rate."

Table 5-4 summarizes the model's estimates with the compiled dataset for 2015 (after the civil works had been completed). First, they show that the estimated coefficient of "daily income per capita" was significantly negative, which can be interpreted as low-income individuals increasing their travel frequency more than high-income individuals. This may be unexpected, because high-income individuals are expected to travel on the improved road more frequently than low-income individuals, according to previous studies such as a study by Bryceson et al. (2008). Second, the estimated coefficient of "use of bicycle as the primary travel mode (dummy)" was not statistically significant, while "use of motorcycle as the primary travel mode (dummy)" has a significantly negative effect on travel frequency. This may be because the road improvements enable motorcycle users to travel more efficiently by shortening travel times and bringing/delivering items in bulk at one time, which might

eventually reduce the need to travel often. Third, the results show that the estimated coefficient of "distance from house to market most frequently visited ('00000 meters)" is significantly negative, indicating that people residing far from markets would not change their travel frequency. Fourth, the variable of "poverty rate of a commune" is estimated not to be statistically significant, indicating that the commune's poverty rate would not influence their local population's travel frequency. Lastly, the pavement rate may have significantly negative impacts when employing the combination variable together in Model 1-2, though not when being solely employed in Model 1-1. The estimation results of Model 1-2 imply that the pavement improvement would boost the frequency of local population's use of the roads in the areas with higher poverty rates more than those with lower poverty rates. The likelihood ratio test was carried out to check the null hypothesis that Model 1-2 is the same as Model 1-1; and this is statistically rejected at a significant level of 90%. Consequently, H1 is supported by our dataset.

Table 5-4 Model Estimates of Changes in Travel Frequency Following Road Improvements

	Model 1-1		Model 1-2	
Variable	Coefficient	t-statistics	Coefficient	t-statistics
Daily income per capita in 2015 ('00000 Cambodian riels)	-2.615	-2.856 **	-2.633	-3.842 **
Use of bicycle as the primary travel mode (dummy)	-0.339	-0.653	-0.312	-0.594
Use of motorcycle as the primary travel mode (dummy)	-1.616	-3.556 ***	-1.671	-3.656 ***
Distance from house to market most frequently visited ('00000 meters)	-8.728	-2.359 *	-8.347	-2.349 *
Poverty rate of a commune after road improvement	0.079	1.435	-0.139	-1.114
Percentage of road to market most frequently visited that is paved (Pavement rate)	0.570	0.900	-5.339	-1.721 .
(Pavement rate) x (Poverty rate in a commune)			0.271	1.888 .
Intercepts				
1|2	5.628	-3.580 ***	-10.499	-3.534 ***
2|3	2.110	1.589	-3.669	-0.994
Initial log-likelihood (L0)	-111.818		-111.818	
Final log-likelihood (LL)	-94.243		-92.521	
-2(L0-LL)	35.168		38.596	
Akaike Information Criterion	204.489		203.041	
Adjusted ρ^2	0.157		0.173	

N=235; ***:< 0.001; **:< 0.01; * <0.05; .<0.1

Next, to test H2, modal ownership is formulated as a simple multinomial logit model. The choice set contains four ownership statuses of bicycle and motorcycle as: "both bicycle(s) and motorcycle(s)," "bicycle(s) only," "owns motorcycle(s) only," and "neither." Note that vehicles and/or trucks are not included in the choice set, because, as shown in Table 5-2, the increase in the ownership of vehicles and trucks accounted for only 1.7 % in total, which is considered negligible. The model formulates the probability of choosing transportation mode *i* for individual *n* as:

$$P_n(i) = \frac{exp(V_{in})}{\sum_j \exp(V_{jn})} \quad (5\text{-}3)$$

where V_{in} represents the indirect utility function of individual *n* under the condition that the individual uses transportation mode *i* (privately-owned, shared or walk) and *j* represents one of options in the transportation mode set. This utility function of the individual is specified as

$$V_{in} = \sum_k \beta_k \cdot x_{ink} \tag{5-4}$$

where x_{ink} represents the kth explanatory variable of individual *i* under the condition that the individual uses transportation mode *i*, and β_k represents a coefficient. The potential explanatory variables are: "growth in the ownership rate of bicycle(s) in commune," which is defined as the rate of HHs owning bicycles in a commune after the improvements minus that before the improvements; "growth in the ownership rate of motorcycle(s) in commune," which is defined as the rate of HHs owning motorcycles in a commune after the improvements minus that before the improvements; "daily income per capita (dummy)," which is 1 if the daily income per capita is below the national poverty line of Cambodian Riel 3,871 (MOP, 2013) and 0 otherwise; "percentage of the total distance of road between the respondent's house and the nearest junction of the national road that is paved."

Table 5-5 summarizes the model's estimates, which are based on the dataset compiled for 2015 (after the civil work had been completed). The results show that "growth in the ownership rates of bicycle(s) in commune" positively influenced the local populations' ownership of bicycles as did "growth in the ownership rate of motorcycle(s) in commune." This may mean that the group behavior in the commune influences individuals' choices. This could be supported by participants' comments through our interviews in the follow-up survey that showed that some people who lived along the improved road were motivated to get new modes of transportation after their neighbors had acquired those modes. Second, "daily income per capita (dummy)" has significantly negative effects on the ownership of bicycles and motorcycles. This is reasonable, because HHs whose incomes are low, particularly below the national poverty line, cannot afford to purchase new transportation modes. The average price of motorcycles available in the study areas was US$ 1,264, equivalent to approximately 5.06 million Cambodian riels, and quite high relative to the average income levels as summarized in Table 5-1. Third, the "ownership of rice fields" was not found to significantly influence HHs' decisions of owning bi-wheeled modes, though those modes were often observed in the follow-up survey to be used for going to rice fields when their major income source was selling rice they produced in their fields. This indicates that bi-wheeled modes were not necessarily used for activities related to rice farming but rather for non-economic activities, and the purchase of these modes was not necessarily financed by income earned from rice farming activities. This requires further investigation. Fourth, the estimated coefficient of the "percentage of paved road needed to access the national road" is significantly positive. This can be interpreted as indicating that the improvement works positively influenced HHs' modal ownership. Hence, we concluded that H2 is supported by our dataset.

Table 5-5 Model Estimates of HH's Modal Ownership Choices Following Road Improvements

Variable	Option	Coefficient	t-statistics
Growth in the ownership rate of bicycle(s) in commune	B+MC, B	7.189	3.285 **
Growth in the ownership rate of motorcycle(s) in commune	B+MC, MC	6.534	3.334 ***
Daily income per capita (dummy)	B+MC, B, MC	-1.434	-2.410 *
Ownership of rice field (dummy)	B+MC, B, MC	0.704	1.120
Percentage of the total distance of road between the respondent's house and the nearest junction of the national road that is paved	B+MC, B, MC	2.390	2.724 **
Constant	B+MC	-4.871	-3.538 ***
Constant	B	-3.729	-3.405 ***
Constant	MC	-4.774	-3.763 ***
Initial log-likelihood (L0)		-325.779	
Final log-likelihood (LL)		-244.683	
-2(L0-LL)		162.192	
Akaike Information Criterion		505.366	
Adjusted ρ^2		0.224	

N=235; ***:< 0.001; **:< 0.01; * <0.05
Note: "B" denotes bicycle(s) and "MC" motorcycle(s).

The ordered logit model was used to test H3, which enables us to understand how the road improvements affected income levels. The ordered logit model explains the changes in HH income levels with an individual's choice set of "3: increased," "2: unchanged," or "1: reduced," all of which are based on respondents' answers to the survey with regard to their subjective perceptions of the change. The model principally follows the formulas of (5-1) and (5-2). The potential explanatory variables are "ownership of three-/four-wheeled vehicles (dummy);" "ownership of bicycles (dummy);" "ownership of motorcycles (dummy);" "experience improvements of social networks (dummy);" "ownership of rice fields (dummy);" "percentage of HH members over 18 years of age;" "distance to market most frequently visited ('00000 meters);" "poverty rate of a commune after road improvement;" "daily income per capita in 2015 (Ln) (daily income per capita);" and "percentage of road to market most frequently visited that is paved (pavement rate)." Other than these individual variables, Model 3-2 employed a combination variable of the last two, being "pavement rate" and "daily income per capita."

Table 5-6 shows that no coefficient estimated for the variables related to travel mode ownership was significantly influential, though only the coefficient of "ownership of three-/four-wheeled vehicle(s)" in Model 3-2 was estimated negative at a 10% statistical significance. This seems to be unexpected, as those travel modes could be utilized for enhancing the respondents' economic activities. Second, the estimated coefficient of "experience improvements of social networks (dummy)" was found positively significant for increases in income levels, which indicates that the improved social networks helped to increase household incomes. This is in line with the finding of Songsermsawas, Baylis, Chhatre, Michelson, and Prasanna (2015) in India that social networks helped farmers to search and obtain their products' price information efficiently and reduce transaction costs for determining prices. Third, the estimated coefficients of the variables related to HHs' productive capacities, "ownership of rice fields (dummy)" and "percentage of HH members over 18 years of age," were not statistically significant, which indicates that changes in HHs' income levels would not be influenced by their

productive capacity. Fourth, the estimated coefficient of "distance to market most frequently visited ('00000 meters)" was negative at a 10% significant level in Model 3-1, while not significant in Model 3-2. This result indicates the influence of the variable would not be certain with the dataset on individual income levels, though previous studies (for example, Jacoby [2000]) evidenced that people residing far from markets would participate in economies less actively than those living nearby and miss opportunities to trade with others. Fifth, "poverty rate of a commune after road improvement" would have positive influences on income improvements at a significant level, being consistent with the finding in Table 5-2 that improvements in income levels were more prevalent in Area BB than the other less poor areas. Sixth, the coefficients of "daily income per capita" and "pavement rate" were estimated differently between Models 3-1 and 3-2, including their statistical significance. The coefficient of "daily income per capita" was estimated positive at a significant level in Model 3-2, but insignificant in Model 3-1. The coefficient of "pavement rate" was estimated at a significant level, negative for Model 3-1 while positive in Model 3-2. Their combination variable in Model 3-2 was estimated significantly negative. These estimation results indicate that the improvement of the road pavements would not necessarily be recognized as a contributive factor to the improvement of income levels, particularly for those of higher income levels. Hence, H3 is not supported by our dataset. Note that the model's adjusted coefficient of determination was relatively low, and the likelihood ratio test was carried out to test the null hypothesis that Model 3-2 is the same as Model 3-1. The test rejected the null hypothesis at a statistically significant level of 95%.

Table 5-6 Model Estimates of Perceived Changes in HH Income Levels

	Model 3-1		Model 3-2	
Variable	Coefficient	t-statistics	Coefficient	t-statistics
Ownership of three-/four-wheeled vehicles (dummy)	0.689	0.966	-1.270	-1.753 .
Ownership of bicycles (dummy)	-0.423	-1.224	-0.378	-1.079
Ownership of motorcycles (dummy)	0.246	0.746	0.195	0.578
Experience improvements of social networks (dummy)	0.813	2.608 **	0.808	2.572 **
Ownership of rice fields (dummy)	0.323	0.887	0.295	0.794
Percentage of HH members over 18 years of age	0.463	0.819	0.206	0.358
Distance to market most frequently visited ('00000 meters)	-4.114	-1.803 .	-3.677	-1.579
Poverty rate of a commune after road improvement	0.096	2.239 *	0.733	1.668 .
Daily income per capita in 2015 (Ln)	0.069	0.611	0.922	3.210 **
Percentage of road to market most frequently visited that is paved (Pavement rate)	-0.865	-2.109 *	1.920	2.037 *
(Pavement rate) x (Daily income per capita in 2015)			-1.053	-3.244 **
Intercepts				
1|2	-0.673	-0.562	0.945	0.714
2|3	2.969	2.431 *	4.690	3.445 ***
Initial log-likelihood (L0)	-198.647		-198.647	
Final log-likelihood (LL)	-187.408		-182.012	
-2(L0-LL)	22.478		33.271	
Akaike Information Criterion	398.816		390.023	
Adjusted ρ2	0.057		0.084	

N=235; ***:<0.001; **:<0.01; *<0.05; .<0.1

Finally, to test H4, another ordered logit model was employed to examine the seasonal stability of the income levels of local populations along the improved roads. It assumed that an individual's choice set consisted of "3: stable," "2: almost stable," and "1: unstable," all of which were also drawn from the participants' responses to survey questions. The model principally follows the formulas of (5-1) and (5-2). Their potential explanatory variables were "ownership of three-/four-wheeled vehicle(s) (dummy)," which was 1 if the respondent or his/her household owned three-/four-wheeled vehicle(s) and 0 otherwise; "ownership of motorcycle(s) (dummy)," which was 1 if the respondent or his/her household owned motorcycle(s) and 0 otherwise; "ownership of bicycle(s) (dummy)," which was 1 if the respondent or his/her household owned bicycle(s) and 0 otherwise; "experience improvement of individual social networks (dummy)," which was 1 if the respondent recognized that his/her social network was improved and 0 otherwise; "experience an increase in daily income after the project (dummy)," which was 1 if it increased and 0 otherwise; "ownership of rice fields (dummy)," which was 1 if his/her household owned rice fields and 0 otherwise; "percentage of HH members over 18 years of age," which was the number of HH members over 18 years of age relative to the total number of people living in a HH; "distance from house to market most frequently visited ('00000 meters);" "poverty rate of a commune after road improvement;" "daily income per capita in 2015 (Ln) (daily income per capita);" and "percentage of road to market most frequently visited that is paved (pavement rate)." A combination variable of the last two variables is employed in Model 4-2.

Table 5-7 shows the estimation results of Models 4-1 and 4-2 for H4. First, incomes of households owning motorcycles were stabilized seasonally. This could be supported by the finding of the follow-up survey as, after the road improvements, some interviewed farmers started grocery shops in their empty spaces aside from rice farming and travelled regularly to their local markets with those modes to purchase goods for their new business. Hence, the modes helped those people to secure their new income sources. However, the statistical significance of ownerships of three-/four-wheeled modes was found for HHs' income seasonal stability only in Model 4-1 though only at a significant level of 5%. Considering that differences in the variable's estimated coefficients were not significantly big, the variable's overall significance to HHs' income seasonal stability may not be remarkable. The two models did not confirm the significant influence of owning bicycle(s) on the seasonal stability, probably because bicycles are not able to run fast and carry loads. Second, the results further show that the estimated coefficient of "improvement of individual social networks" is not significant in the both models, indicating that social networks improved after the road improvements would not be significantly influential. Third, owning rice fields does not significantly influence income stability. This could be explained by another finding in the follow-up survey that most of local rice farmers still continued single-season cropping due to the requirements of extra investments for starting double-cropping system. Hence, the ownership of rice fields would not necessarily enhance incomes' seasonal stabilities. Fourth, HHs that experienced increases in daily income after the road improvement significantly perceived that their HH income level was stable throughout the year. This may be explained by the finding in the follow-up survey that some of rice farmers started new roadside grocery

shops or double-cropping system during/after road improvements as a response to increases in opportunities to trade their products following increases in road users from outside the roadside areas. Fifth, “percentage of HH members over 18 years of age” affected the HH’s income stability positively at a significant level. This is probably because a HH with a larger labor force has more variety in income sources throughout the year. Sixth, the estimated coefficient of “distance from house to market most frequently visited” was insignificant. This is because negative effects of distances to markets on people’s earning activities might be cancelled by newly emerging changes in trading patterns. Before the road improvement, farmers had to transport their products to markets, where their travel distance negatively affected their sales. However, after the improvement, more traders from outside the roadside areas approached those farmers to purchase directly their products, which reduced the farmers’ burdens to travel to the markets for trades. Seventh, the estimated coefficient of “poverty rate of a commune after road improvement” was also insignificant. The reason could be that people’s economic status and activities were almost same across the studied communes, regardless of their poverty rates. Eighth, the coefficients of “daily income per capita” and “pavement rate” were estimated differently between Models 4-1 and 4-2, including their statistical significance. Individual income levels were found to reduce significantly seasonal fluctuations. This is because high-income HHs may have larger economic capacity to invest in new economic activities, such as starting small business or changing their farming style. The coefficient of the pavement rate was estimated positively significant in Model 4-2, while not in Model 4-1. Then, the coefficient of the combination variable of “daily income per capita in 2015” and “pavement rate” was estimated significantly negative on the respondents’ HH income seasonal stability. These could be interpreted as marginal contributions of the road improvement to HH income seasonal stability would be smaller as pavement rates become higher. This result shows that H4 is not supported by our dataset. Similar to the other models discussed above, the likelihood ratio test was carried out to test the null hypothesis that Model 4-1 is the same as Model 4-2. The test rejected the null hypothesis at a statistically significant level of 95%.

Table 5-7 Model Estimates of the Perceived Seasonal Stability of HH Income Levels

	Model 4-1		Model 4-2	
Variable	Coefficient	t-statistics	Coefficient	t-statistics
Ownership of three-/four-wheeled vehicles (dummy)	1.368	2.079 *	1.070	1.585
Ownership of motorcycle(s) (dummy)	0.589	1.936 .	0.639	2.047 *
Ownership of bicycle (s) (dummy)	-0.123	-0.370	-0.081	-0.241
Experience improvements of social networks (dummy)	-0.476	-1.628	-0.404	-1.361
Ownership of rice fields (dummy)	-0.370	-1.091	-0.486	-1.400
Experience an increase in daily income after the project (dummy)	1.794	5.509 ***	1.658	5.011 ***
Percentage of HH members over 18 years of age	1.333	2.527 *	1.235	2.306 *
Distance from house to market most frequently visited ('00000 meters)	-1.235	-0.596	-0.911	-0.432
Poverty rate of a commune after road improvement	0.019	0.454	0.016	0.389
Daily income per capita in 2015 (Ln)	0.281	2.728 **	1.195	3.407 ***
Percentage of road to market most frequently visited that is paved (Pavement rate)	-0.007	-0.019	2.867	2.587 **
(Pavement rate) x (Daily income per capita in 2015)			-1.061	-2.810 **
Intercepts				
1|2	1.379	1.209	3.746	2.532 **
2|3	3.430	2.959 **	5.840	3.880 ***
Initial log-likelihood (L0)	-255.663		-255.663	
Final log-likelihood (LL)	-225.496		-220.860	
-2(L0-LL)	60.333		69.606	
Akaike Information Criterion	476.993		469.719	
Adjusted ρ2	0.117		0.136	

N=235; ***:<0.001; **:<0.01; *<0.05; .<0.1

5.5 Discussion

Our results showed that H1, "a rural road improvement in areas with a higher poverty rate increases individual travel frequencies more than that in areas with a lower poverty rate," and H2, "a rural road improvement enhances modal ownerships of HHs of higher income levels more than the others," were supported, but H3, "a rural road improvement helps to improve income levels of HHs with higher income more significantly than the others," and H4, "a rural road improvement helps to stabilize seasonal fluctuations of incomes of HHs with higher income more significantly than the others" were not supported.

First, individuals' travel frequency increased more significantly in poorer areas after the road improvements, which could be explained by higher marginal impacts from the improvements in poorer areas. As shown in Table 5-2, marginal changes in modal ownerships were found to be more significant in poorer areas (Areas BB and KC) than a wealthier area (Area TK), implying that the marginal impact of rural road improvements on local populations' travel frequency decreases as the regional economic level is higher.

Second, more active influxes of business-purposed outsiders would reduce local people's travel frequency. The follow-up survey revealed that increases in such outsiders were the most evident in Area TK with geographical advantages, which is located nearby a junction of two national roads connecting the country's capital and the border of Vietnam. They approached local people to offer direct trades of rice and daily commodities; this could reduce the people's needs for business-purposed travels. Their

direct approaches reflect the fact that the road improvements physically enabled those outsiders to approach the farmers by trucks of large capacities. Additionally, tough competitions in rice markets could be another reason, in which traders are motivated to purchase products of better qualities from farmers.

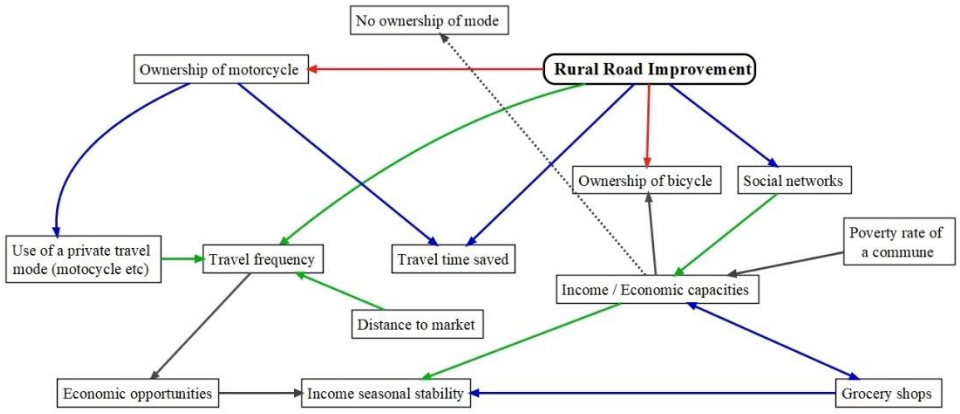
Third, the results showed that the road improvement increased people's ownership of bi-wheeled mode(s) regardless of regional economic levels. This can be explained by the finding in the follow-up survey that people tended to follow their neighbors' behaviors of purchasing and using these modes after the road surface had been improved. This could be rationalized by "mimetic desires" emerging in their minds after the road improvements. This is also a kind of positive feedback mechanism whereby the increase in individuals' ownership of bi-wheeled modes is accelerated by the aggregated ownership of these modes of transportation in society (Fukuda & Morichi, 2007). Another motivation of purchasing those modes was to help children's smooth commuting to school. Previous bad road conditions involved long commuting time and hampered their commuting particularly during rainy seasons, which resulted in their dropouts.

Fourth, as for impacts on individual economic status, the enhancement of income levels or seasonal stability was recognized not significantly, particularly by households of higher income levels. In the follow-up survey, it was found that people with robust economic capacities, like monetary savings and/or rice fields, started grocery shop business and established new arrangements for selling their rice, to improve their income level and stabilize through a year. However, that would expose them more to competitions with outsiders induced by the road improvement, which might made them economically vulnerable against shocks in the competitions, if any, due to their insufficient social and educational endowments and knowledge. On the other hand, low-income interviewees of the follow-up survey reported that they did not change or perceive outstanding changes in their income sources, inferring that their HHs would not perceive any change in their income levels and seasonal stability.

Lastly, as shown earlier, the models for testing H3 and H4 employed a variable related commonly to social networks where its estimated coefficients were significantly positive on income level, and negative on income seasonal stability. At the follow-up survey, increases in individual social interactions, such as chatting or watching television together in a coffee shop located along the roads, were reported in all the areas. Relationships generated on such interactive occasions might help local populations to survive particularly with regard to the needs of money or food, as some of the interviewees said that they sought contributions from their neighbors or relatives or were given opportunities of working in daily contracted jobs in other HHs' farming practices. This indicates that the road improvements might strengthen safety nets for sharing risks of daily survival. On the other hand, the potentially negative result was consistent with findings by Johny, Wichmann, and Swallow (2017) in rural India that social networks facilitate risk sharing systems among societies though they have little influence on income diversification unless people are well endowed. As most shops found along the roads were family-run, economic benefits stimulated from the road improvements would hardly be distributed to others, due to the structural limitation of social networks in the study areas.

Hence, the improvement of social networks would not influence much individual income seasonal stability.

An assumed mechanism of impact distribution related to people's economic activities and travel behaviors is displayed in Figure 5-1.



— : Identified from the model estimation and during the follow-up survey;

— : Identified from the model estimation; — : Confirmed during the follow-up survey:

— : Assumed based on the previous studies; - - : Identified from the model estimation (Adverse effects)

Figure 5-1 Impact Distribution Mechanism on Individual Travel Behaviors and Economic Status

5.6 Conclusions

This chapter examined how rural road improvements in Cambodia affected local people's mobility and economic status, in areas where single-season rice farming is the dominant economic activity. Mobility was analyzed in relation to changes in travel frequency and modal ownerships following the road improvements, while economic status was examined with looking into people's perceptions of changes in income levels and seasonal stability.

The empirical analysis found that (i) road improvements increased individual travel frequency more in poorer areas; (ii) they enhanced local HHs' ownership of bicycle(s) and motorcycle(s); but (iii) they did not improve income levels nor seasonal stability, particularly where road conditions were improved, and their discrepancies among local populations might be reduced. Those findings were different from earlier studies that the rural road improvements might benefit wealthier individuals to a greater extent than poorer individuals and economic discrepancies among those individuals be enlarged. The first finding could be attributed to influxes of business-purposed people from outside the roadside areas. The surging influxes are mainly because of high competitions among rice traders from inside/outside Cambodia. Thath (2016) indicates that traders from Vietnam and Thailand actively approach local rice farmers with better offers than domestic ones, due to their capacities to purchase larger amounts and offer lower processing costs. This suggests that rural road improvements in areas with high competitions of traders would induce the inflow of outsiders, which seems to reduce travel frequencies of local people along the improved roads, but this does not necessarily indicate to lower

their participation in markets. This implies that it is required to collect data on behavioral changes and characteristics of traders outside the roads in addition to those of local people at conducting impact evaluation studies on rural road improvements. The second finding could be explained by increasing motivations of local people to acquire bi-wheeled modes regardless of their income levels. The increases in modal ownerships, particularly motorcycles, might be because of the penetration of second-hand motorcycles whose price is often lower than new products. Those are originally imported from neighboring countries, like Vietnam (Ngo, 2017). This suggests that rural road improvements would increase people's ownerships of convenient modes in areas with developed markets of second-hand ones. This suggests that their availability and associated regulations should be studied around roads for improvements at planning projects of rural road improvements and carrying out their post-completion studies. The third is attributable to differences among local population in opportunities to expose themselves to new business environments. Bogale (2012) points out that people in rural areas are vulnerable to stress caused by environmental and social changes and lack capacities to cope with such stress. Though some people were found to start new business activities using their resources after the road improvement, they might not necessarily prepare themselves to manage such stresses. Their educational backgrounds are limited, which would impose constraints for their further growth in the long run. Without obtaining new technical and business knowledge for surviving in emerging competitive environments, they would eventually face difficulties at continuing their shop business. Others who did not change economic activities were likely poor even before and might remain vulnerable. This suggests that rural road improvements would not contribute to the improvement of people's economic status in a long run unless they were equipped with abilities to cope deal with changes induced by the improvement.

Chapter 6. Impact of Rural Road Improvements on Accessibility to Markets

6.1 Introduction

Many people in rural areas in developing countries are engaged in subsistence farming as their primary source of income, and markets are their economic centers for trading their products and engaging in social-/economic-purposed interactions (Smith, Gordon, Meadows, & Zwick, 2001; Chamberlin and Jayne, 2013). Assuring people's accessibility to markets is critical in these areas to improve their individual economic levels (Stifel, Minten, & Koro, 2012; van de Walle, 2009).

Various studies have analyzed the impact of rural road improvements on people's economic activities around markets, and particularly have highlighted farm product trading. When roads are of low quality, farmers are reluctant to transport their products to markets, and instead sell them to traders at their farmers' fields or residences. However, prices are often favorable to traders who are skilled at negotiations and familiar with price information, and less to farmers (Abebe, Bijman, & Royer, 2016). Rural road improvements are expected to fix such imperfect trading patterns by enabling farmers to transport their products efficiently and integrate themselves into market economies (Cai et al., 2008; Gibson & Rozelle, 2003; Lokshin & Yemtsov, 2005; Mu & van de Walle, 2011). Prior studies have not yet identified how the improvements cause such positive impacts on individual socioeconomic conditions and regional economic development status and whether such impacts occur equally or not. This chapter aims to empirically examine the impacts of rural road improvements in Cambodia on the behavior of the local population around their markets along the roads.

The remainder of the chapter is organized as follows. Section 6.2 reviews previous findings and discourses on the effects of rural road improvements on local population's economic activities and market environments. Then, the dataset used in the empirical analysis is described in Section 6.3, followed by model estimations of individual travel behavior around markets in Section 6.4. Observations of the changes in the local populations' livelihoods are detailed from the follow-up survey in Section 6.5. Finally, discussions and suggestions for future research are provided in Sections 6.6 and 6.7 respectively.

For more detail, see Idei and Kato (2018b).

6.2 Literature Review

Strategies for farmers to sell their farm products and for traders to purchase/sell those products are affected by road conditions in developing countries' rural areas because market prices are affected by the transportation time and costs for those products (Guo, Koo, & Wood, 2009; John Hine & Ellis, 2001; Khandker, Bakht, & Koolwal, 2009; World Bank, 2016a). Olsson (2009) observed in the rural Philippines that a major direct effect of rural road improvements could be the cost and time saved in transporting goods or products, and secondary effects could be lowering trade costs, easing information flows, and consequently reducing consumer prices. Khandker et al. (2009) found in Bangladesh that an improvement in surfaces of rural roads reduced transportation costs by approximately 25%, contributing

to increases in local farmers' receipt of profits. In Sierra Leone, Casaburi, Glennerster and Suri (2013) examined the impacts of rural road improvements on transportation costs and local staple crop prices in markets. They confirmed that the impacts recognized by traders are different from those recognized by producers (farmers) because these two parties' markets were separated and that traders respond more sensitively than farmers to transportation cost changes and that search costs using mobile phone(s) are another determinant of market prices. Those authors also showed that traders' markets became more competitive after the road improvements. Their findings could be supported by Wondemu and Weiss (2012), who found in rural Ethiopia that road improvements could positively influence households' (HHs) farm activities from increasing farm-gate prices, productivity improvements, and subsequent marketing strategy changes. They also identified potential factors generating such positive results by developing a farm HH model that required various explanatory variables, implying that the impacts of rural road improvements on farm products' prices and stakeholder behavior involve complexities. Note that Casaburi et al. (2013) added the findings that traders respond more sensitively than farmers to transportation cost changes and that search costs using mobile phone(s) are another determinant of market prices.

Rural road improvements often stimulate individuals' mobility and economic activities, thus transforming the market environment. Olsson (2009) mentioned that rural road improvements entail transforming social and economic structures and narrowing rural–urban economic gaps, eventually benefitting their societies in the long run. Regarding changes in markets adjacent to improved roads, Khandker et al. (2009) also indicated the possibility that markets could facilitate interactions among the local people. Using a time-series statistical dataset, Mu and van de Walle (2011) illustrated changes in markets after a rural road improvement project in rural Vietnam. Their findings are as follows: (i) an increase in individuals engaged in the service and trade sectors, most of whom were engaged in rice farming before the Project commenced; (ii) service sector diversification; and (iii) ethnic minority participation in cash-based market transactions, although they were accustomed to barter trades. Using Nicaragua as a case study, Rand (2011) presented another type of change in local economies around markets: job opportunity augmentation in the agriculture sector and extension of individual working hours, due to the improvement of economic productivities. For instance, the unemployed before the road improvements started working in farmlands after the improvements. The major reason was that the increase in farm product prices after the road improvements motivated farmers to increase their productivity and required workforce. They also noted that, after the road improvements, travel time reductions extended individual working hours, and labor demand in other sectors with larger economic potential increased.

As previously shown, evidence indicates that improving rural roads could fuel regional economic growth, enabling markets to play a catalytic role. However, past studies noted that such positive impacts could be generated only when specific conditions were satisfied, such as sociodemographic conditions including HH's composition, HHs' land ownership and income sources, and markets' institutional/policy conditions, particularly related to price determination systems (Bell &

van Dillen, 2012; Gibson & Rozelle, 2003; Wondemu & Weiss, 2012). For instance, Gachassin, Najman, Raballand (2010) found in Cameroon that the frequency of individuals' visits to markets were inversely proportional to distances from houses because people in remote areas tend to survive on their own instead of participating in trade economies, thus losing opportunities to receive cash. A case in Nepal by Jacoby (2000) indicated that people who own houses or farmland close to markets benefitted more significantly from agricultural productivity improvements and crop sale increases, whereas others far from markets did not benefit as much. In addition, John Hine and Ellis (2001) cautioned about the existence of imperfectness in market mechanisms and asymmetries in price information between buyers and farmers. Markelova, Meinzen-Dick, Hellin, and Dohrn (2009) explained that imperfect rural market structures constrain small-scale farmers' participation in markets in which they sell their products. Lyon (2000) found in Ghana that, in major markets, improving rural roads strengthens the bargaining power of traders from outside, whereas local farmers' knowledge of supply and price conditions remained limited.

6.3 Data Development

Tables 6-1 and 6-2 represent the consolidated datasets of local peoples' behavior around their markets. Out of the originally collected 400 sampled, 265 subsamples were employed in the dataset for empirical analysis in this chapter considering their robustness and validity regarding individual behaviors around markets. The average commune-level poverty rate for each area was 15.5% in Area TK, 20.3% in Area KC, and 24.6% in Area BB, respectively, all of which were improvements from the 2011 values: 22.2%, 28.0%, and 27.8%, respectively.

As shown in Table 6-1, most respondents (74.2%) were engaged in either self-employed or employed farming, whereas the second largest job category (10.3%) was vendors of goods or farm products. Regarding respondents' educational backgrounds, 52.2% had never attended school or had failed to complete a primary education, followed by those who had completed only a primary education (27.2%). Of the respondents, 99.6% were Khmer and 0.4% were Cham (Khmer-Muslim). The majority (98.5%) were Buddhist and the remaining were Muslim (1.1%) and Christian (0.4%). Area BB had the highest average income and largest standard deviation (S.D.) despite having the highest poverty rate among the three areas. Area TK had the lowest average income and the smallest S.D. despite having the lowest poverty rate among the three areas. The average distance from respondents' houses to their most frequently visited market was shortest in Area TK and longest in Area KC. This finding corresponds to the geographical distributions of the markets visited by the respondents, which were located along the study roads in Areas BB and TK, whereas three markets were scattered, and one was located 17.9 km from the endpoint of the road KC. A correlation was 0.4, between distances from individuals' houses to their most frequently visited markets and the commune-level poverty rate. This finding implies that lower-income people reside in areas with poorer market accessibility.

Table 6-2 compares respondents' behavior related to visiting a market before and after the road improvements. First, the table shows that mobile phone ownership significantly increased across all

areas. It should be noted that all respondents had one or more mobile phones in their HHs, which reflects the recent nationwide penetration following the enhancement of competitiveness in the telecommunication markets with the active participations of private firms in 2014 (Carter, 2016). According to time-series surveys by Phong, Srou, and Javier (2015, 2016), mobile phones, including smartphones, evolved by accommodating the needs of the local population and primarily enabling them to send and read short message services in Khmer without having to physically move—giving this population better and more efficient access to information. Second, the results revealed that respondents' daily market visits increased in all areas. All respondents went to markets after the road improvements, although a few had not previously visited. Third, in all areas in both 2011 and 2015, the highest percentages of respondents' purpose for visiting the markets are buying food and commodities, followed by selling their own products. The percentage of respondents buying food and commodities increased from 2011 to 2015. Fourth, more than 65% of the respondents used motorcycles in Areas TK and KC before and after the road improvements, and more than half the respondents used a *tuk-tuk* to visit their markets in Area BB. Note that no respondent in Area BB privately owned a *tuk-tuk*, indicating that the *tuk-tuk* in Area BB was generally used as shared transportation which are often privately operated. Following the motorcycle, the travel mode used by respondents was walk in Area TK and bicycle in Area KC, and was motorcycle in Area BB, following the *tuk-tuk*. Walking is preferred in Area TK because the market density was the highest along the road TK, where the average distance from houses was the shortest among the three areas, as shown in Table 6-1.

Figure 6-1 shows primary markets where people residing along the roads visited for daily purposes, including shopping goods for their own business, and Photo 6-1 presents environments of those markets taken at the follow-up survey.

Table 6-1 Descriptive Statistics of Data to be used for the Empirical Analysis

Study Areas		Total (N=265)	TK (N=89)	KC (N=104)	BB (N=72)
Number of markets answered		13	8	3	2
Gender	Female	56.98%	55.06%	59.62%	55.56%
	Male	43.02%	44.94%	40.38%	44.44%
Age	10–19	0.38%	1.12%	0.00%	0.00%
	20–29	7.92%	3.37%	15.38%	2.78%
	30–39	21.51%	23.60%	19.23%	22.22%
	40–49	23.40%	20.22%	24.04%	26.39%
	50–59	23.40%	22.47%	23.08%	25.00%
	60–69	17.74%	20.22%	14.42%	19.44%
	Over 70	5.65%	9.00%	3.85%	4.17%
Employment type	Farmer	74.20%	74.70%	69.23%	80.65%
	Daily labor	3.97%	6.90%	2.88%	1.61%
	Vendors of goods or farm products	10.32%	3.45%	16.35%	11.29%
	Employed in manufacturing /service	2.78%	3.45%	3.85%	0.00%
	Government officer	1.98%	0.00%	4.81%	0.00%
	Teacher	0.40%	1.15%	0.00%	0.00%
	Student	1.19%	3.45%	0.00%	0.00%
	No job	1.59%	0.00%	0.96%	4.84%
	Others	3.57%	6.90%	1.92%	1.61%
Ethnicity	Khmer	99.62%	100.00%	99.04%	100.00%
	Cham	0.38%	0.00%	0.96%	0.00%
Education	No education	52.45%	61.80%	36.54%	63.89%
	Primary	27.17%	28.09%	27.88%	25.00%
	Lower secondary	15.86%	7.87%	28.85%	6.94%
	Higher secondary	3.77%	1.12%	5.77%	4.17%
	College or above	0.75%	1.12%	0.96%	0.00%
Religion	Buddhist	98.49%	100.00%	96.16%	100.00%
	Muslim	1.13%	0.00%	2.88%	0.00%
	Christian	0.38%	0.00%	0.96%	0.00%

HH income	Average	S.D.	Average	S.D.	Average	S.D.	Average	S.D.
(Cambodian riel '000)	18.06	22.98	14.52	15.08	14.60	22.30	27.45	28.68
Distance	Average	S.D.	Average	S.D.	Average	S.D.	Average	S.D.
('000 meters)	6.60	6.67	4.09	5.39	9.49	7.97	5.52	3.48

S.D. = standard deviation

Table 6-2 Changes in Travel Behavior from 2011 to 2015 in the Study Areas

Study Areas	Total (N=265)		TK (N=89)		KC (N=104)		BB (N=72)	
	2011	2015	2011	2015	2011	2015	2011	2015
Ownership of mobile phones	42.54%	100.00%	51.11%	100.00%	33.02%	100.00%	45.83%	100.00%
Ownership of transportation modes								
Vehicle and truck	1.94%	2.64%	5.62%	5.62%	0.00%	1.92%	0.00%	0.00%
Motorcycle	40.31%	74.72%	47.19%	78.65%	41.35%	85.58%	26.39%	55.56%
Bicycle	40.31%	71.32%	40.45%	49.44%	57.69%	84.62%	58.33%	79.17%
Tuk-tuk	1.94%	2.26%	3.37%	4.49%	0.96%	1.92%	0.00%	0.00%
Frequency of using the road								
Daily	60.38%	76.23%	71.91%	91.01%	62.50%	73.08%	43.06%	62.50%
3–4 times a week	33.21%	20.37%	24.72%	7.87%	29.81%	21.15%	48.61%	34.72%
Less	5.66%	3.40%	3.37%	1.12%	5.77%	5.77%	8.33%	2.78%
Never	0.75%	0.00%	0.00%	0.00%	1.92%	0.00%	0.00%	0.00%
p-value	0.886		0.971		1.000		0.971	

Study Areas	Total (N=265)		TK (N=89)		KC (N=104)		BB (N=72)	
	2011	2015	2011	2015	2011	2015	2011	2015
Purpose of visiting markets								
To sell your products	13.58%	12.45%	13.49%	12.36%	14.42%	11.54%	12.50%	13.89%
To buy food and commodities	77.74%	79.62%	82.02%	83.15%	76.93%	79.81%	73.61%	75.00%
To purchase commodities for business	7.17%	6.42%	4.49%	4.49%	7.69%	7.69%	9.72%	6.94%
To meet with others	1.13%	1.13%	0.00%	0.00%	0.96%	0.96%	2.78%	2.78%
Other	0.38%	0.38%	0.00%	0.00%	0.00%	0.00%	1.39%	1.39%
p-value	0.984		1.000		1.000		1.000	
Primary travel mode								
Vehicle (truck and van)	3.02%	3.77%	1.12%	2.25%	5.77%	6.73%	1.39%	1.39%
Motorcycle	62.26%	66.04%	67.42%	77.53%	75.00%	73.08%	37.50%	41.66%
Tuk-tuk	15.85%	14.72%	2.25%	1.12%	0.00%	0.96%	55.55%	51.39%
Walk	9.81%	7.92%	21.34%	14.61%	5.77%	6.73%	1.39%	1.39%
Bicycle	9.06%	7.55%	7.87%	4.49%	13.46%	12.50%	4.17%	4.17%
p-value	0.841		0.984		0.818		1.000	

Note: p-values were computed using the Wilcoxon-Mann-Whitney test, representing the probability of rejecting the null hypothesis that travel behavior before road improvements are the same as after.

Figure 6-1 Location of Markets along/adjacent to the Study Roads

Area BB

Area KC

Area TK

Photo 6-1 Environments around Major Markets adjacent to the Study Roads

6.4 Empirical Analyses

6.4.1 Model Formulation

Two models are employed for analyzing the impacts of rural road improvements on travel frequency to markets and on travel mode choices for their market visits. The first analysis is intended to examine whether HH income influences travel frequency when controlling for road improvements. The second analysis is motivated by the fact that more than 20% of the respondents used a shared mode despite increases in their HHs owning a private-travel mode. Several reasons could be behind the fact, one of which was that privately-owned modes were used for their HH members' commuting to workplace or school and not always available for their market visit, and another that shared modes could be more spacious to accommodate their potential bulk shopping. Note that the potential available shared modes of travel in the study areas are motorcycle taxis or *tuk-tuks*, both of which are privately operated. Both analyses are carried out using the dataset compiled for 2015 (after the civil works were completed).

First, an individual's frequency of market visits after the road improvements is analyzed with formulating the two simple ordered logit models with differentiating the set of the explanatory variables, namely Models 1 and 2. In the both model, the choice set is assumed to be: "3: traveling every day," "2: traveling three or four days a week," and "1: traveling less than three days." The model formulates the latent variable of the individual *i* as:

$$y_i = X_i\beta_k + \varepsilon_i \tag{6-1}$$

where X_i represents a vector of explanatory variables, while β_k represents a vector of the variables' coefficient and ε_i an error component respectively. The probability of choosing the choice *j* of the individual *i* is presented.as:

$$\begin{aligned}\pi_{ij} &= Pr(y_i = j|X_i) = Pr(y_i \le j|X_i) - Pr(y_i \le j-1|X_i) \\ &= \Lambda(\tau_j - X_i\beta_k) - \Lambda(\tau_{j-1} - X_i\beta_k)\end{aligned} \tag{6-2}$$

where π_{ij} represents a probability when the individual *i* chooses the choice of *j* from the three choices. $\Lambda(\cdot)$ represents the probability density function of the logistic distribution. The common potential explanatory variables of the two models are: "Distance to market most frequently visited ('000 meters)," "Visit using a private mode (dummy)," which takes the value of 1 if an individual visits using a privately-owned wheeled mode—bicycle, motorcycles, or automobile—and 0 otherwise, "Visit using a shared mode (dummy)," which takes the value of 1 if an individual visits using a shared wheeled mode—motorcycle, automobile, or *tuk-tuk*—and 0 otherwise; "Percentage of paved road access to market most frequently visited;" and "Low income (dummy)," which takes the value of 1 if the daily per capita income is below the average income in Cambodia of 2015 (US$ 1,093.46 per capita per annum, equivalent to 12,168.86 Cambodian riels per capita per day [CEIC Data, n.d.]) and 0 otherwise. Model 1 employs a combination variable of "Percentage of paved road access to market most frequently visited" and "Low income (dummy)."

Next, a multinomial logit model is used to formulate the travel model choice. The choice set is assumed to consist of three options: privately-owned mode, shared mode, and walk. The shared mode includes motorcycle, taxi, and *tuk-tuk*, whereas the privately-owned mode includes motorcycle and bicycle. The model formulates the probability of choosing transportation mode *i* for individual *n* as:

$$P_n(i) = \frac{exp(V_{in})}{\sum_j \exp(V_{jn})} \tag{6-3}$$

where V_{in} represents the indirect utility function of individual *n* under the condition that the individual uses transportation mode *i* (privately-owned, shared or walk) and *j* represents one of options in the transportation mode set. This utility function of the individual is specified as

$$V_{in} = \sum_k \beta_k \cdot x_{ink} \tag{6-4}$$

where x_{ink} represents the *k*th explanatory variable of individual *i* under the condition that the individual uses transportation mode *i*, and β_k represents a coefficient. Potential explanatory variables are "Distance to market most frequently visited ('000 meters);" "Daily income per capita in 2015

('00000 Cambodian riels);" "Number of members in a household;" "Ownership of rice fields by HH (dummy)", which takes the value of 1 if a HH owns rice fields and 0 otherwise; "Ownership of motorcycle(s) by HH (dummy)", which takes the value of 1 if a HH owns motorcycle(s) and 0 otherwise; and "Percentage of paved road from improvement in access to market most frequently visited."

6.4.2 Estimation Results

Table 6-3 shows the models' estimation results, whose coefficients and their statistical significances are almost same. First, the estimated coefficient of "Distance to market most frequently visited" is significantly negative, indicating that people residing far from market(s) visit less frequently. Second, "Visit using a private mode (dummy)" and "Visit using a shared mode (dummy)" are not statistically significant in terms of the frequency of market visits. Third, the pavement rate improvement significantly impacted the frequency, indicating that the smoothened road conditions promoted people's visit to markets. Fourth, people whose income was below the national average more frequently visited markets than the others. This explanation is in line with previous findings that lower-income people's purchasing power was not sufficient to buy more groceries than their immediate needs and had to visit markets frequently for their HH's daily needs (Prahalad, 2004; Singh, Ang, & Sy-Changco, 2009). Finally, the combined pavement rate with low-income variable, which is unique to Model 1-2, was estimated to be insignificant, indicating that the road improvement would not necessarily enhance the frequency only for low-income people to visit markets. The likelihood ratio of the two models was conducted to check their performance and the null hypothesis that all the coefficients are zero is statistically rejected in both models.

Table 6-3 Estimation Results of Ordered Logit Model for Frequency of Market Visits after Road Improvements

	Model 1-1		Model 1-2	
Variable	Coefficient	t-statistics	Coefficient	t-statistics
Distance to market most frequently visited ('000 meters)	-0.070	-3.091 ***	-0.071	-3.134 **
Visit using a private wheeled mode (dummy)	-0.785	0.973	-0.736	-0.912
Visit using a shared wheeled mode (dummy)	-1.158	-1.405	-1.090	-1.324
Percentage of paved road access to market most frequently visited (Pavement rate)	0.911	2.243 *	1.171	2.178 *
Low income (dummy)	1.163	3.680 ***	1.596	2.389 **
(Pavement rate) x (Low income (dummy))			-0.589	-0.741
Intercepts				
1|2	-3.648	-4.037 ***	-3.431	-3.644 ***
2|3	-1.249	-1.471	-1.014	-1.127
Initial log-likelihood (L0)	-171.178		-171.178	
Final log-likelihood (LL)	-152.820		-152.543	
-2(L0-LL)	36.715		37.269	
Akaike Information Criterion	319.641		321.087	
Adjusted ρ2	0.107		0.109	

N=265; ***:<0.001; **:<0.01; *<0.05

Table 6-4 shows the model estimation results. First, “Distances to a market most frequently visited” and “Daily income per capita” are estimated to be significantly positive, and both are mode-specific variables for the privately-owned mode and the shared mode. They indicate that those who reside far from markets or who earn higher incomes tend to choose a wheeled mode rather than walk. Such a choice is reasonable because a motorcycle or bicycle enables individuals to travel more efficiently when accessing a faraway market, whereas wealthier individuals can afford to purchase private vehicles and pay for using a shared mode. Second, the statistical significance of “Number of members in a HH” was confirmed, indicating that people of large-sized households are likely to use wheeled modes probably for economic efficiencies and/or to allow them to be accompanied on their visits. Third, “Ownership of rice fields by HH” positively affected the use of both the privately-owned and shared wheeled mode to visit a market, which could be interpreted as follows: using these modes enabled people to bring their rice to a market to sell or to transport purchased fertilizers or chemicals such as pesticides to maintain product quality (Cai et al., 2008). Fourth, “Ownership of motorcycle(s) by HH” also positively and significantly influenced the choice of a motorcycle as a private mode to travel to markets, which is a very reasonable choice. Lastly, the estimated coefficient of “Percentage of pavement improvement,” a mode-specific variable for the privately-owned mode and the shared mode, was significantly positive. Therefore, the local population is more likely to choose the wheeled mode for visiting markets on an improved road because the smooth surface enables greater comfort and higher speeds. Note that the attempt was made to employ other variables related to bicycle and automobile ownership in the utility functions of each mode, but statistical significance was not found. The insignificance of bicycle ownership is probably the result of travelers not being able to carry goods given limited loading capacities, whereas that of automobiles may be because roads near the market being congested from newly induced traffic demand after the completion of the civil works. The model’s adjusted $\rho 2$ indicates that it explains people’s modal use at visiting their market. This is verified by the likelihood ratio test as the null hypothesis that all the coefficients are zero is statistically rejected.

Table 6-4 Estimated Results of Travel Mode Choice Model when Visiting Markets after Road Improvements

Variable	Option	Coefficient	t-statistics
Distance to market most frequently visited ('000 meters)	S, P	0.135	2.144 *
Daily income per capita in 2015 ('00000 Cambodian riels)	S, P	4.666	2.397 *
Number of members in a HH	S, P	0.253	1.761 .
Ownership of rice fields by HH (dummy)	S, P	1.362	2.516 *
Ownership of motorcycle(s) by HH (dummy)	P	3.395	8.371 ***
Percentage of paved road access to market most frequently visited	S, P	1.409	1.761 .
Constant	S	-3.305	-2.924 **
Constant	P	-4.926	-4.176 ***
Initial log-likelihood (L0)	-291.132		
Final log-likelihood (LL)	-157.725		
-2(L0-LL)	266.814		
Akaike Information Criterion	331.450		
Adjusted ρ^2	0.431		

N=265; ***:< 0.001; * <0.01; * <0.05; .<0.1
Note: "P" denotes privately-owned mode and "S" denotes shared mode.

6.5 Findings from the Follow-up Survey

6.5.1 Changes in Behavior of Local Population around Markets

First, the follow-up survey revealed that seven individuals and their households commenced new business activities in their residence during/after the civil works, out of which five changed their primary income source from rice farming to shop operation. This is because they found growth in the number of road users who could be potential customers for a profitable business. All of them owned rice fields and continued producing rice for sale or self-consumption to secure their livelihoods. Furthermore, their business variety was noted to be limited to selling vegetables, snacks, bottled drinks/water, animal meat, fish, and cooked foods, probably because starting such a business might require only small initial investments and may not require sophisticated technical skills and education. In fact, four shop owner respondents completed only a primary education and one had never attended school, but they generated satisfactory profits. Our interviews found that successful entrepreneurships with a limited educational background might have discouraged their children from studying at higher education institutes. The children had interests in helping their HH's business and/or starting new businesses on their own. This contrasts with the belief of interviewees who had grand-/children that higher education attainments could help their grand-/children to get employed in better-paid jobs than rice farming or contracted labor work. In the research, rural road improvements may have unexpected side effects on the capabilities of the next generation.

The follow-up survey further found that 15 HHs obtained bicycles and 19 HHs obtained motorcycles during/after the road improvements, regardless of their income. 33 HHs purchased these modes using their personal savings, and one HH received financial support from relatives residing outside the area. The motivation to obtain private wheeled modes was found not always related to HHs' economic activities, but for enhancing their HH members' travel efficiencies and easing their grand-/children's schooling. Therefore, these modes were purchased as HH assets. Four HHs purchased

automobiles by borrowing money from a nearby microfinance institute (one HH) and by using their own savings (three HHs). Consequently, those who own the new motorized mode(s) traveled to large markets and purchased a larger variety of items.

Finally, the follow-up survey found that three HHs reported no change in their economic status. None of them owned their land for rice farming and completed the primary education, and they earned income by engaging in daily labor or selling fish or animals. This finding reveals that the road improvements could lead to increases in income, particularly for owners of rice fields, the local dominant economic activity.

6.5.2 Changes in Economic Environments

First, interviews during the follow-up survey showed that shop owners in small markets regularly purchase items in bulk at larger markets on behalf of their customers, such as once a week, using their privately-owned or shared modes, such as *tuk-tuks* and motorcycle taxis.

Second, 13 HHs remained engaged in rice farming as their primary income source, and all of them saw a growth in their 2015 incomes from selling rice. Ten HHs recognized increases in unit prices, two HHs increased the amount of rice they sell, and one HH found positive changes in both. Out of those HHs, five used to bring their products directly to markets or nearby and one HH used to bring them to customers' houses before the road improvements. However, they stopped this practice after the road improvements because their customers came to them, releasing them from financial and time burdens related to transporting their rice. These may be signs that the road improvements transformed the local market structure. Additionally, they were able to determine the prices of their rice by referring to the market price information rather than through individual negotiations, because owning mobile phones enabled them to obtain such information more easily from their business partners and relevant government institutions.

Third, after the road improvements, new rice mill operators emerged in all the study areas, particularly mobile operators. One reason was that the improved road surfaces enabled people to physically drive trucks or vans loaded with rice mill machines. Another reason was the increase in needs of rice farmers for polishing rice by themselves before selling. The self-polishing might allow them to sell their rice at a better price. However, one of the HHs was concerned about inflation of other products' prices. In fact, the government's public market statistics on rice prices indicated no significant increases during 2014 and 2015 (Food and Agriculture Organization of the United Nations, 2017; World Food Programme, 2015). This implies that the positive changes reported in the follow-up survey might be limited to their areas and their continuities.

Fourth, the interviewees selling vegetable, fruits, and rice at large markets commonly confirmed significant increases in customers residing along the roads and the gradual emergence of competitive business environments after the road improvement. Further, it was noticed during the follow-up survey that some in markets at road junctions with other national roads started direct transactions with traders from larger cities, such as Phnom Penh and provincial/district capitals. Therefore, the road

improvements affected economic structures not only along improved roads themselves but also beyond their immediate areas.

Fifth, increases in motorcycle taxis and *tuk-tuk* operators were observed along the roads, which was supported by another finding from two male interviewees who started motorcycle taxi businesses during and after the civil works and offered their services at more reasonable prices and with shortened travel times.

Sixth, the interviews also found a clear contrast in the significance of impacts on local socioeconomic environments between Area TK, the wealthiest area with 13 markets, and the other two areas with fewer markets. This implies that the positive economic effects that emerged in individual markets are bolstered and extended over networks among markets along the roads, and these interactive effects could be observed in areas of high market densities.

Lastly, it was further found that many similar-style grocery shops had emerged along all the study areas, and they expected to face tough competition among themselves in the near future. To survive such eventualities, they should make immediate efforts to diversify their income sources, as reported by Yamauchi, Muto, Chowdhury, Dewina, and Sumaryanto (2011).

6.6 Discussion

The follow-up survey revealed that the HHs' reasons for visiting markets after the rural road improvements were varied and mixed. For instance, some individuals who had recently opened shops visited markets mainly to purchase items to sell in their own businesses, whereas others visited for networking. Another possible reason is that mobile shops selling daily food were found along all the roads, reducing people's need to visit markets to satisfy their daily needs, although the shops sometimes offered higher prices than those at the markets. Because the rural road improvements involved changes in people's decision making, regarding their daily economic activities and use of time, local market functions could be continuously transformed beyond those of a trading activity platform.

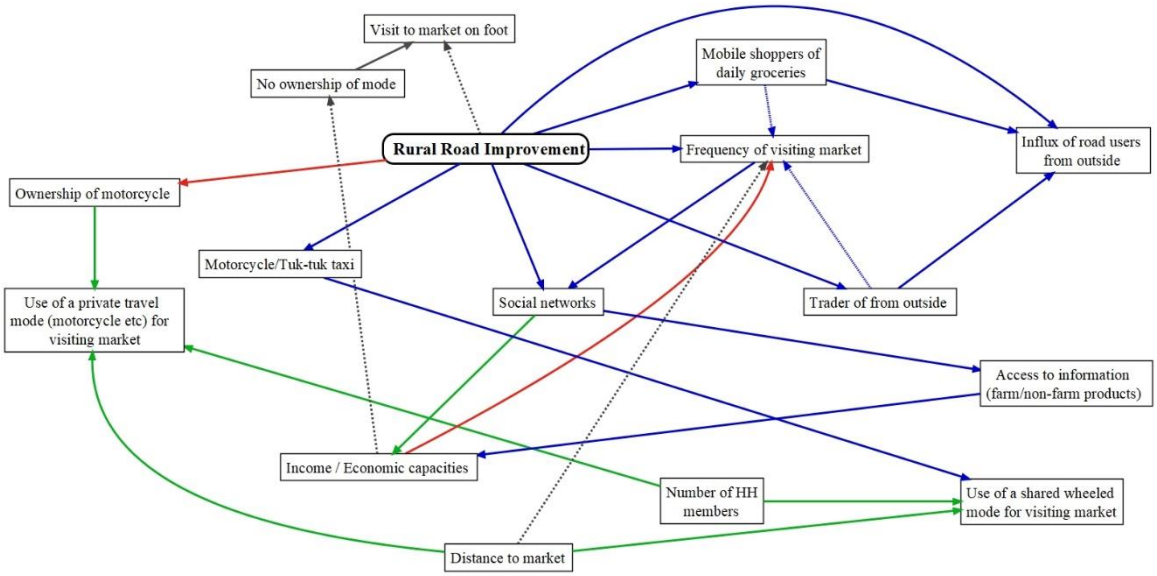
Second, the survey suggested that the use of wheeled modes for visiting markets was not significantly changed, as shown in Tables 6-3 and 6-4, despite the increased ownership of private modes during/after the roads' condition was improved. The road improvements led an increase in the number of businesses operating shared travel services, since the follow-up survey found such services to be easy to start and flexible in responding to local people's needs for growing multi-purposed trips around markets, as previously discussed (Lee, Hickman, & Washington, 2007). Considering that such a business is demand-responsive, the recent growth is likely to lead to reductions in user fees and enhance the local people's mobility and participation in interactions in markets.

Third, as for imbalances between farmers and traders in rural markets that we were originally aware of, findings from this examination suggest that the rural road improvements made farmers more powerful as price setters than before, because those farmers could be approached by more traders and, using a newly owned mode or shared modes, could participate in larger markets and expand their

business networks by getting more direct contacts with potential partners within or outside their localities.

Lastly, the follow-up survey showed that economic situations of households of low-income or with poor economic resources might worsen because of recent increases in product prices around their areas, resulting in increases in their daily expenditures though their incomes remained low after rural road improvements. Table 6-3 indicates that low-income people frequently visit markets and that they have the potential to become integrated into market-based economies by establishing personal networks. However, its sustainability is questionable if they continue to participate in the markets only as consumer. We now appreciate that the rural road improvements could involve a setback of making poor people more vulnerable than others.

An assumed mechanism of impact distribution related to people's accessibility to and environments of markets along the studied roads is displayed in Figure 6-2.



— : Identified from the model estimation and during the follow-up survey;

— : Identified from the model estimation; — : Confirmed during the follow-up survey;

- - : Confirmed during the follow-up survey (Adverse effects); — : Assumed based on the previous studies;

- - : Identified from the model estimation (Adverse effects)

Figure 6-2 Impact Distribution Mechanism on Individual Accessibility to Markets and Regional Economic Systems

6.7 Conclusions

This chapter examined how rural road improvements impacted local people's economic activities around local markets using a case study on rural areas of Cambodia. The model estimation results indicated that the improvements more significantly enhanced the people's frequency to visit markets and their uses of bi-wheeled modes, like bicycles or motorcycles. The follow-up survey revealed that the improvements enhanced individuals' incomes, particularly for owners of rice fields, promoted

economic activities along the roads, and expanded such activities around markets even beyond the roadside areas by fostering business relationships and stimulating entrepreneurship in people and potentially their next generations. These findings imply that rural road improvements are a contributive factor in regional development—one of the strategic aims of international aid communities in providing developing countries with continuous help to improve rural roads.

The envisaged transformation of regional economic platforms by the rural roads improvement could be worth to be studied further. Other factors, such as transportation services, financial services (for example, microcredit), and non-farming economic activities, could be a part of the study's scope, considering potential linkages among those. Such comprehensive approaches would help planners identify what instruments should be installed for enhancing roadside people's accessibility to the new economic/social structure.

Chapter 7. Impact of Rural Road Improvements on Accessibility to Public Health Service Facilities

7.1 Introduction

Access to health services is widely acknowledged as a basic human right. The concept of Universal Health Coverage (UHC) holds that "all individuals and communities receive the health services they need without suffering financial hardship (World Health Organization [WHO], 2017)." Those lacking access to needed health services are likely to be living in socioeconomically poor and vulnerable conditions, particularly in rural areas in developing countries (Murawski & Church, 2009; Peters et al., 2008; Scheil-Adlung, 2015). Such severely limited accessibility lowers individual well-being and economic productivity, leading to adverse influences on the social and economic development of a society. There are a number of underlying issues on both the provider side and the patient side of the problem.

Accessibility to health services is determined by multiple factors, one of which is the inadequate transportation infrastructure in developing countries, where budgets are chronically limited and insufficient for infrastructure maintenance and rehabilitation. Roads in impassable conditions can seriously disrupt communications between the authorities and individual health care facilities. McCall (2014) reports a case in rural East Timor in which the long delivery time for letters from the government caused time lags in information distribution that led to miscommunication with staff in the area, resulting in a lowering of the quality and efficiency of health services for local patients. Poor physical accessibility, another serious issue, may be more complicated. The causes tend to be a mix of poor road conditions, the travel distances and time required to reach facilities, and the lack of availability of suitable and affordable modes of travel (De Silva & Kato, 2011; Oppong, 1996; Peters et al., 2008).

Individual travel patterns are determined primarily by income levels, modal ownership, and/or household composition or regional economic characteristics (Bryceson et al., 2008; Iimi et al., 2015). On the patient side, the causes for the difficulties encountered by patients seeking treatment at health facilities are essentially twofold: a limited economic capacity to pay for necessary preventive and curative treatment, and poor physical accessibility to facilities. The economic limitations of patients have received global attention following the general embrace of the UHC concept, as out-of-pocket expenditures associated with health care services are considered one of the principal causes of inequality in people's ability to access and utilize needed services (Vega, 2013). Health financing policies have been discussed as one of the major instruments for providing public financial support to the poor and ensure equality in their access to proper health services (McIntyre & Borghi, 2012).

This chapter focuses on the selection of public health service facilities and the mode of travel used to visit the selected facilities in rural Cambodia, where feeder roads were recently improved. The discussion has several important implications regarding the improvement of physical accessibility to health facilities in rural areas in developing countries. Some scholars (for example, Tromp & Baltussen [2012] and Younkong, Baltussen, Tantivess, Mohara, & Teewattananon [2012]) address the need to

determine priorities in health interventions for the efficient allocation of limited resources; the implications of this chapter should provide useful input to this priority-setting process.

The reminder of the chapter is organized as follows: Section 7.2 presents relevant prior research on the relationship between transportation infrastructure and accessibility to health services, mainly in rural areas in developing countries; Section 7.3 provides an overview of the existing health care system in Cambodia and the challenges it faces; Section 7.4 offers a descriptive analysis of the dataset for empirical analysis, and profiles the public health service facilities along/adjacent to the study roads; Section 7.5 gives an empirical analysis of how people select a public health facility and the travel mode they use to visit the selected facility; Section 7.6 discusses results and implications of the chapter; and Section 7.7 offers concluding remarks.

7.2 Literature Review

The potential barriers to an individual's access to health service facilities have been examined in a number of studies. Many have included the issue of geographic accessibility, e.g., location of health service facilities, available transportation means, costs and time involved in a visit to a facility, travel distances, and road conditions (Bigdeli & Annear, 2009; Downing & Sethi, 2001; Jacobs, Ir, Bigedeli, Annear, & Van Damme 2012; Peters et al., 2008). In a study of older people in Tanzania, Porter et al. (2013) discuss accessibility to health service facilities and report that approximately half of the respondents to their survey raised transport-related issues as a critical constraint to their making facility visits, particularly those who could not afford to use public transportation, which was dominant in the local areas. Müller, Smith, Mellor, Rare, and Genton (1998) look at the effects of distances to travel from home to a health service facility in rural areas of Papua New Guinea. They confirm lower attendance rates for those living farther from the facilities, with differences according to age, gender, and types of illness. They found that distance most adversely affected the rate of female infants. In a case study in the western part of Rwanda, Munoz and Källestål (2012) found inequalities in people's access to primary health care due to limited transportation infrastructure and the inadequate capacities of the existing health service facilities. The limited provision of transportation was attributed to local contexts, as walking was the predominant travel mode in the areas studied, and traveling to the facilities would involve substantial time and cost, as they were located only along provincial/national roads. Services available at the facilities were found to be below expected levels, mainly due to the government's limited budget for operating the facilities, including staff costs.

How then do the improvements in rural roads in developing countries affect people's access to health services? Molesworth (2005) conducted extensive reviews of the health-related benefits of rural road improvements, identifying benefits that included easing the transportation of medical equipment to health service facilities which subsequently led to an increase in the immunization of children; helping medical staff reach their facilities; and reducing the time and cost burdens on individuals travelling to the facilities. In Morocco, Levy (1996) confirmed other benefits, such as the improvement of staffing in the facilities, extending access of the local population to medical advice and information,

including family planning, and increasing the ability of ambulances to transport emergency patients, including pregnant women, to referral hospitals with the capacity to provide advanced treatment. Banerjee and Sachdeva (2015) found an evidence in India that road improvements enhanced people's use of preventive health care services, enabling them to receive information related to infectious and hygienic diseases, obtain health guidance and consultation by accredited staff, including midwives, and attend group activities to gather related information from others. Downing and Sethi (2001), however, indicate that road improvements may be effective only for the better-off who can afford to bear the costs, but not for poorer people who often perceive health care costs as a heavy financial burden, which is made even more burdensome with the addition of transportation-related costs.

The literature described here explains some of the influences of transportation infrastructure on the accessibility of health service facilities for people living in rural areas in developing countries. However, none of the studies appears to deal with the issue of whether improving the condition of rural roads influences an individual's selection of a health service facility or the mode of travel that he/she would use to visit the selected facility. This chapter looks at this neglected issue in areas where feeder roads have been recently improved. It is expected that the results will clarify the influence of such improvements in these two important aspects of health-purposed travel, identify other influencing factors, if any, and give rise to suggestions for planning measures that would enhance physical accessibility to facilities in parallel with the ongoing development of effective health financing systems.

7.3 Overview of the Health Service Operation in Cambodia and Challenges for Rural Populations to Reach Medical Services[1]

The people of Cambodia, particularly those living in poor conditions, have suffered extensively from inadequate access to public health facilities following the conclusion of a very tense political period. With support from international donors and non-governmental organizations (NGOs), the Cambodian government has been making substantial efforts to promote reform in the health sector and establish operational health service systems in accordance with the Health Strategic Plans for 2003-2007 and 2008-2015. These two milestone plans prioritized health service delivery, behavioral change, quality improvement, human resource development, health financing, and institutional development (WHO, 2015). The latest plan, for 2016-2020, includes an additional goal: "Increase access to and utilization of affordable quality health services with reduced financial burden (WHO, 2016)."

In 2000, the Cambodian government established a nationwide pro-poor social protection scheme, the Health Equity Fund (HEF). The fund provides financial support to people who are identified as poor through an assessment conducted by the Ministry of Planning (MOP). Those who qualify are issued an "ID Poor" and are exempted from the payment of fees for consultations, treatments or prescriptions at health service facilities operating under the Ministry of Health (MOH). They are also exempted, when applicable, from paying the cost of transportation to the facility. Details of this financial

[1] This section was developed based on the references presented and the interview with an officer of the Japan International Cooperation Agency, who was responsible for its operation in Cambodia, in October 2017 (Appendix 5).

support system appear in government decree entitled “Standard Benefit Package and Provider Payment Mechanisms for Health Equity Funds (MOH, 2014).” The documentation process, including the collection of vouchers from those who have been certified, is administered by local NGOs contracted by the MOH (Ensor, 2004; Ensor, Chhun, Kimsun, McPake, & Edoka, 2017; Flores, Ir, Men, O’Donnell, & van Doorslaer, 2013; Sokhavuth, 2016; WHO, 2015).

In 2015, the HEF covered approximately 20% of the population. The scheme has been found to be generally effective, as the number of the users has increased (Annear et al., 2016; Annear, Veasnakiry, & Takeuchi, 2016). With help from the international community, the HEF has continued to expand service coverage to accommodate people of poor economic status or with special needs. Monetary support for the HEF has been pooled from loans and grants from various donors under the Second Health Sector Support Project, whose donor organizations include the World Bank (leading agency), the Asian Development Bank (ADB), the United Nations Children's Fund, the United Nations Population Fund, and bilateral donor agencies including Agence Française de Développement, the Belgian Technical Cooperation, the Department for International Development, United Kingdom, and Australian Aid (WHO, 2015). However, the sustainability of the current overreliance on external financial sources is a concern (Flores et al., 2013).

Three types of MOH-regulated public facilities offering medical services are available: health post; health centers and referral hospitals. Health posts is located only in remote areas which are located more than 15 kilometers from the nearest health center. The number of staff stationed in a health post is no more than two, nurse or midwife, limiting the available services. Health centers are required to provide a Minimum Package of Activities (MPA), including basic curative and preventive care services. Referral hospitals provide a Complementary Package of Activities (CPA) in three service categories: CPA-1, CPA-2, and CPA-3. CPA-1 services include basic obstetric services and surgery without general anesthesia. CPA-2 services offer emergency care, surgery with general anesthesia, intensive care and other specialized services in addition to the more basic CPA-1 services. CPA-3 services are more extensive, varied and specialized than those offered under CPA-2 (WHO, 2015). Fees are determined by the MOH and vary among the health centers and the CPA-1, CPA-2 and CPA-3 referral hospitals. The referral hospitals are primarily designated to provide ambulatory care services and receive inpatients when necessary. In 2014, there were 1,105 health centers, 51 referral hospitals providing CPA-1 services, 29 hospitals providing CPA-2 services, and 18 hospitals providing CPA-3 services (MOH, 2015).

According to the referral system, potential patients are expected to proceed first to a health center for initial consultation, where they can, if appropriate, request a referral from the center’s medical staff for further consultation and treatment at one of the referral hospitals. However, the referral system has proven to be ineffective, as patients tend to proceed immediately to a referral hospital without first visiting a health center. One likely reason for this short-cutting is that the health centers are often not adequately staffed by trained and accredited professionals such as medical practitioners, an especially critical issue in rural areas. Another possible reason is that the centers typically put their focus on

preventive care services rather than curative ones. Regardless of the reason, this sort of short-cutting behavior has caused serious hospital overcrowding, as the number of patients often exceeds designed hospital capacities.

A major issue in rural areas is the burden of transportation costs as a significant component of total expenditures related to health, a problem that appears less serious in urban areas (ADB, 2014b). The reasons for this include greater travel distances to the health service facilities; lack of a means of transportation to reach the facilities; and the questionable quality of many of the facilities due to a shortage of qualified staff and suitable equipment (WHO, 2015). The 2014 Demographic and Health Survey found that only 12.4% of men and 16.7% of women in rural areas had visited health service facilities within the 30-day period of the survey period, although these percentages were higher than those in urban areas (10.3% and 13.8% respectively) (National Institute of Statistics, 2016; Wiseman et al., 2017). The higher rural percentages indicated here might be attributed to the availability of alternative health services in urban areas. Treatment informally provided by unqualified medical practitioners often substitutes for services provided at public health facilities, particularly for the poor in Cambodia due to their reasonable prices (ADB, 2014b). Such alternative services may be more readily available in urban areas given their significantly larger populations.

7.4 Dataset Development

A dataset of 258 respondents was developed for empirical analysis in this chapter, out of the originally collected 400, explained in Chapter 4. Details for these respondents' profiles are presented in Table 7-1. Most respondents indicated where they typically go for health services when needed; however, 27 interviewees did not specify the location. For those who failed to provide an answer, the nearest facility, either a health center or a referral hospital, was assigned to them based on their answer to visit the most often, health center or referral hospital, in another question. Responses regarding the modes of transportation used by interviewees to visit a health service facility, as well as modal ownership, are summarized in Table 7-2. In developing the dataset, some of the information related to travel mode was corrected as needed. For example, in 2011, 84 respondents indicated a self-owned mode such as an automobile, bicycle or motorcycle, for their visit, even though the household did not own such a vehicle. In such cases, the answers were corrected to "sharing transportation." 26 such responses of 2015 were corrected. Details of the public health facilities located along/adjacent to the study roads are presented in Table 7-3. Some of the public health service facilities were presented in Photo 7-1, and a map showing the locations of these facilities is provided in Figure 7-1. In 2015, there were roadside health centers in all of the communities studied, except for one located in the middle of Road KC. There was also a referral hospital in Areas BB and TK located either just before the beginning of the improved road or just beyond its end, while the referral hospital nearest to Road KC was approximately ten kilometers from its starting point.

Of the 258 respondents in the dataset, 19.4% was given a government priority card exempting them and their household members from paying fees for services at public health facilities. The rate in

Area KC (23.4%) was the largest among the three areas. With respect to gender, 58.1% of the 258 respondents were female; and 41.9% were male. The largest age category was 40-49 years (25.2%), followed by the category of 50-59 (23.3%). As for religion, 98.8% were Buddhist; the rest were Muslim and Christian, who were found only in Area KC. The largest share of the respondents (67.1%) engaged in farming, which was common across the three areas. The second largest employment category in all three areas was "other" which include worker in private firms and officers in public offices. The share was the largest in Area KC (16.0%), while the smallest in Area BB (1.6%). The share of "vendor of goods or farm products" and "daily contract worker" was same in the total, but their breakdowns were different among the three study areas. For the "vendor of goods or farm products," the share in Area KC was the largest (14.9%), while the largest share for the "daily contract worker" was marked in Area TK (16.3%). In Area BB, "No job" was reported by 9.5% of respondents, the largest percentage among the three areas. As the primary purpose for visiting a public health service facility, "treatment" was cited by more than half of the respondents (52.7%), followed by "check-up" (28.7%). In Areas BB and KC, more than 25% of the respondents indicated that the primary reason for their visits is to receive medicine, which was less observed in Area TK. This is likely due to the availability of free medicines at public health facilities (WHO, 2015). When asked about companions accompanying them on their visit, the largest share of respondents in Area TK (56.3%) indicated that they went alone. In Area KC, more than half were accompanied by one or more HH members or relatives, which is similarly observed in Area BB though the rest was different: 50.7% visited with one or more HH members or relatives, while 45.2% went alone. Across all three areas, fewer than 5.0% visited the facilities with one or more non-HH members or relatives. Asked which kind of facility they visit when a health service is required, 93.0% answered "health center," while the rest replied, "referral hospital." The share of respondents visiting a referral hospital is the smallest in Area KC, probably due to two factors: the nearest referral hospital for people living near the improved road was more than 10 km from its starting point, and the hospital offered CPA-3 services which means it generally charges patients the highest basic user fees among the public facilities (MOH, 2014). Average HH size was largest (and standard deviation [S.D.] was smallest) in Area KC, while the smallest average HH size was found in Area TK. As for the distance travelled to the most-often-visited facility, the longest average distance was in Area TK (which also showed the largest S.D.), while the shortest average was in Area KC. The relatively large average distance in Area TK can probably be explained by the fact that the largest share of respondents in this area visited the referral hospital, which requires travel along national roads that likely involves longer travel distances than the ones required for those visiting health centers. Finally, average HH income level was highest in Area BB with the largest S.D.; the lowest income average with the smallest S.D. was in Area TK. This result runs counter to the poverty rates reported for the two areas in 2015, when Area TK was reported to have the lowest poverty rate, while Area BB had the highest. This contrast is likely attributable to the definition of the country's poverty line of 3,871 Cambodian riels. To determine the line, three items were considered: monetary value required for consuming 2,200 kilocalories of food for daily life at minimum level; nonmonetary value of consumables, including cost to purchase cloths

and travel costs to public service facilities such as school and health service facilities; and costs for accessing clean and safe water sources (MOP, 2013). The high poverty rate in Area BB can be interpreted as an indicator that the provision of goods and public services, including health services, may be behind the other two areas.

Table 7-1 Descriptive Statistics of Data to be used for the Empirical Analysis

Study Area		Total (N=258)		TK (N=89)		KC (N=94)		BB (N=75)	
Average poverty rate among the roadside communes (MOP, 2016)				15.54%		20.29%		24.57%	
Ownership of Priority Cards		19.38%		19.10%		23.40%		14.67%	
Gender	Female	58.14%		56.18%		61.70%		56.00%	
	Male	41.86%		43.82%		38.30%		44.00%	
Age	10-19	0.39%		1.12%		0.00%		0.00%	
	20-29	8.53%		5.62%		17.02%		1.33%	
	30-39	16.67%		13.48%		17.02%		20.00%	
	40-49	25.19%		23.60%		25.53%		26.67%	
	50-59	23.26%		25.84%		21.28%		22.67%	
	60-69	20.16%		21.35%		14.89%		25.33%	
	Over 70	5.80%		8.99%		4.26%		4.00%	
Religion	Buddhist	98.83%		100.00%		96.81%		100.00%	
	Muslim	0.78%		0.00%		2.13%		0.00%	
	Christian	0.39%		0.00%		1.06%		0.00%	
Employment type	Farmer	67.08%		67.44%		68.09%		65.08%	
	Vendor of goods or farm products	9.47%		3.49%		14.89%		9.52%	
	Daily contract worker	9.47%		16.27%		0.00%		14.29%	
	Other	10.28%		10.47%		15.96%		1.59%	
	No job	3.70%		2.33%		1.06%		9.52%	
Primary purpose for visit	Check-up	28.68%		29.22%		26.60%		30.67%	
	Treatment	52.71%		64.04%		52.12%		40.00%	
	Receipt of medicine	18.22%		6.74%		21.28%		28.00%	
	Other	0.39%		0.00%		0.00%		1.33%	
Companion	Alone	46.88%		56.32%		39.36%		45.33%	
	HH member(s) or relative(s)	49.61%		39.08%		58.51%		50.67%	
	Friend(s)/Others	3.52%		4.60%		2.13%		4.00%	
Facility for visit	Health center	93.02%		88.76%		98.94%		90.67%	
	Referral hospital	6.98%		11.24%		1.06%		9.33%	
Number of members in a HH		Average	S.D.	Average	S.D.	Average	S.D.	Average	S.D.
		4.49	1.97	3.91	1.90	4.98	1.73	4.56	2.16
Distance to facility visited the most often (kilometers)		Average	S.D.	Average	S.D.	Average	S.D.	Average	S.D.
		4.24	4.96	4.71	5.74	3.81	5.20	4.18	3.31
Average HH income ('000 Cambodian Riel)		Average	S.D.	Average	S.D.	Average	S.D.	Average	S.D.
		18.74	24.27	13.74	15.16	15.55	23.22	28.66	30.61

S.D. = standard deviation

Table 7-2 compares modal ownership rates and use of travel modes before and after the rural road improvements, e.g., 2011 and 2015. Ownership of motorcycles increased the most in Area KC, making its ownership rate the highest in 2015. On the other hand, Area TK recorded the highest motorcycle ownership rate before the improvements, with the smallest increases of the three areas

between 2011 and 2015. The balance in the ownership of bicycles and motorcycles varied across the three areas. In Areas BB and KC, the bicycle ownership rate remained higher than the motorcycle ownership rate even after the completion of the civil works projects, which is in contrast to the situation in Area TK. As for the various travel modes used to visit health care facilities, an increase in the share of people using privately-owned motorcycles was observed in Areas KC and TK, while the use of shared modes decreased. On the other hand, in Area BB, the highest share continued to be the use of shared modes, even after the road improvements; next was the use of self-owned motorcycles. A relatively small percentage of respondents continued to walk for their health-purposed travel even after the road improvements, although this percentage decreased in all three areas.

Table 7-2 Changes in Travel Behaviors from 2011 to 2015 in the Study Areas

Study area		Total (N=258)		TK (N=89)		KC (N=94)		BB (N=75)	
		2011	2015	2011	2015	2011	2015	2011	2015
Ownership	Car	1.94%	3.10%	5.62%	6.74%	0.00%	2.13%	0.00%	0.00%
	Motorcycle	36.82%	69.38%	42.70%	75.28%	40.43%	80.85%	25.33%	48.00%
	Bicycle	52.71%	72.87%	43.82%	53.93%	57.45%	86.17%	57.33%	78.67%
Travel mode to use at visit a health service facility	4-wheeled vehicle	0.78%	0.78%	2.25%	2.25%	0.00%	0.00%	0.00%	0.00%
	Motorcycle	20.93%	48.06%	19.10%	53.93%	28.72%	57.44%	13.33%	29.33%
	Bicycle	14.34%	16.28%	15.73%	14.61%	15.96%	21.28%	10.67%	12.00%
	Sharing transportation	52.32%	26.74%	49.44%	22.47%	40.43%	8.51%	70.67%	54.67%
	On foot	11.63%	8.14%	13.48%	6.74%	14.89%	12.77%	5.33%	4.00%
p-value		1.000		1.000		0.746		1.000	

Note: p-values were computed using the Wilcoxon-Mann-Whitney test, representing the probability of rejecting the null hypothesis that travel behavior before road improvements are the same as after.

Table 7-3 provides details regarding the staff and equipment at public health facilities along/adjacent to the study roads. We found the two referral hospitals along the national roads adjacent to Area TK, but it was not possible to obtain the service-related information for one of them, about 1.5 km far from the end point. Hence, only one referral hospital was counted for Area TK. It was found that the 13 health centers were open five days a week, though their weekly schedules are flexible, and the three referral hospitals were generally open 24 hours a day, seven days a week, with regular office hours for accepting outpatients fixed from 8 am to 5 pm. Of the 13 health centers, only three had a resident medical practitioner. According to the staffing standards prescribed for health centers (MOH, 2007), there is no requirement for assigning resident medical practitioners or assistants. Qualified nurses and midwives are stationed at all the centers, although their numbers vary from two to eight. The three referral hospitals have larger staff than the centers due to the differences in their functional requirements. The major differences between the two types of public facilities are related to their service coverage and the number of beds available for inpatients, as indicated earlier. Among the answered facilities, the most common conditions for which patients seek consultation or treatment are, in order of frequency, cold/cough, childbirth, diarrhea and hypertension.

Table 7-3 Summary of Public Health Service Facilities along the Roads

Study Area	Total	TK	KC	BB
Health centers				
Number of health centers studied	13	7	2	4
Average number of medical assistants				
Average number of nurses	4.77	3.86	5.00	6.25
Average number of midwives	3.38	3.29	3.50	3.50
Average number of toilets: Male	0.69	0.75	0.50	0.50
Female	0.54	0.50	0.50	0.50
Unisex	1.00	0.75	0.50	1.25
Use of well water for treatment (Yes=1/No=0)	0.38	0.86	0.50	0.50
Use of piped water for treatment (Yes=1/No=0)	0.69	0.29	0.50	0.50
Referral hospitals				
Number of referral hospitals studied		1	1	1
Service package offered		CPA1	CPA3	CPA2
Number of medical practitioners		11	23	13
Number of medical assistants		0	0	5
Number of nurses		18	58	45
Number of midwives		8	30	14
Number of administrative officers		0	6	3
Number of toilets: Male		2	1	4
Female		2	1	4
Unisex		0	1	1
No. of beds for inpatients		60	125	84
Use of piped water for treatment (Yes=1/No=0)		1	1	1
Use of piped water for drinking (Yes=1/No=0)		0	1	1

CPA = Complementary Package of Activities

Referral Hospital near Area BB

Health Center in Area KC

Referral Hospital near Area TK

Photo 7-1 Public Health Service Facilities along/adjacent to the Study Roads

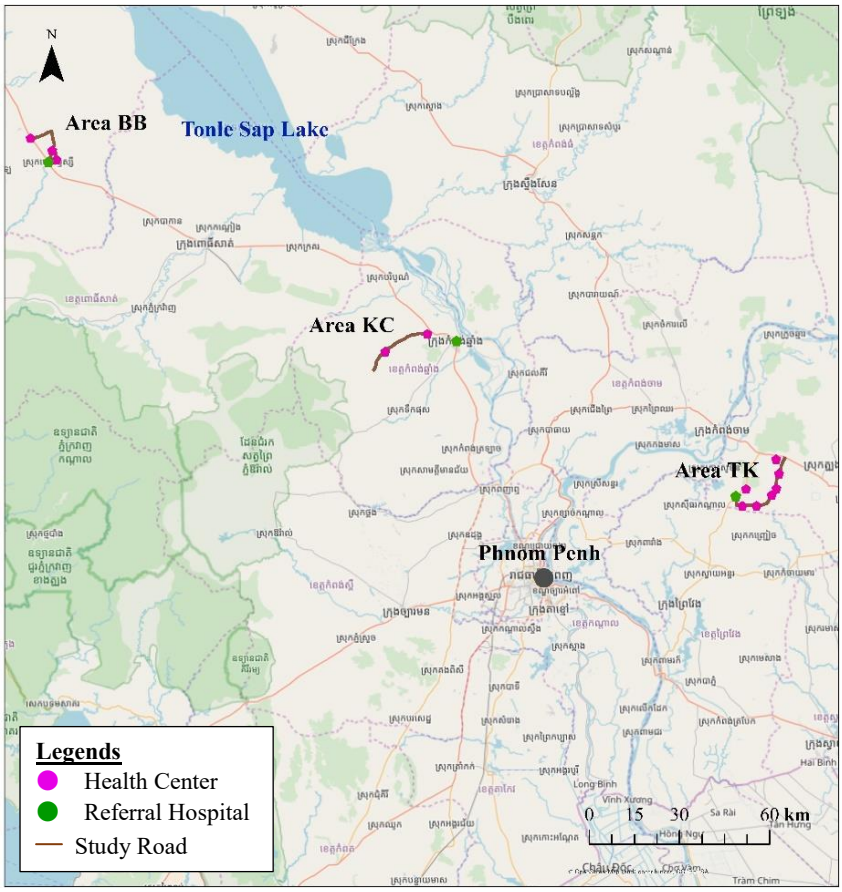


Figure 7-1 Location of Public Health Service Facilities along/adjacent to the Study Roads

7.5 Empirical Analysis with Questionnaire Survey Data for Accessibility to Health Service Facilities

Effects of rural road conditions are now examined on people's accessibility to public health service facilities, with focusing on selection of a public health service facility and travel mode to visit the selected facility. For this, a nested logit model was empirically estimated using the above dataset with a two-level choice structure: higher level is the modal choice and lower level is the choice of a public health facility for visiting the most often.

The choice of facility assumes that an individual chooses one of two options, health center or referral hospital, by maximizing his/her utility function. The conditional indirect utility function of each mode is formulated as:

$$V_{i,m} = \tilde{V}_{i,m} + \varepsilon_i = \alpha_i x_{i,m} + \beta_i D_{i,m} + \gamma_i \tag{7-1}$$

where $V_{i,m}$ the indirect utility function under a condition that the individual chooses a public health service facility i, health center or referral hospital, $\tilde{V}_{i,m}$ represents the systematic component of utility function, ε_i represents an error component, x_i represents the level or service of facility ("the number of nurse" for referral hospital) or the purpose to visit facility ("treatment" for health center), $D_{i,m}$ represents travel distance from home to facility i ('000 meters), γ_i represents a constant which is

specific to facility i, and α_i and β_i represent coefficients of $x_{i,m}$ and $D_{i,m}$ respectively. The error component is assumed to follow the identical and independent distribution of Gumbel (Ben-Akiva & Lerman, 1985).

Second, the modal choice assumes that an individual chooses one of three options, walk, shared transportation (*tuk-tuk*, motorcycle taxi, motorcycle/bicycle borrowed from his/her neighbor), or private transportation by maximizing his/her utility function. The conditional indirect utility function of each mode is formulated as:

$$V_{i,m} = \tilde{V}_{i,m} + \varepsilon'_m = \varphi E_{i,m} + \delta_m y_m + \varepsilon'_m \quad (7\text{-}2)$$

where $V_{i,m}$ represents the indirect utility function under a condition that the individual chooses travel mode m to a public health facility i, $\tilde{V}_{i,m}$ represents the systematic component of utility function, ε'_m represents an error component, $E_{i,m}$ represents a logsum variable related mode m is expressed as:

$$E_{i,m} = \ln \sum_m exp(\tilde{V}_{i,m}) \quad (7\text{-}3)$$

y_m represents a dummy variable of "ownership of motorcycle(s) at a household," which is 1 if a respondent has motorcycle(s) in his/her household and 0 otherwise, when he or she answered "using a public transportation mode for his/her visiting facility i", while representing a dummy variable of "daily income per capita," which is 1 if the daily income per capita is below the national poverty line of Cambodian Riel 3,871 (MOP, 2013) and 0 otherwise, when he or she answered "using a shared transportation mode for his/her visiting facility i", and φ and δ_m are unknown coefficients (note: δ_m is a specific constant to mode m). The unknown coefficients in the nested-logit model are estimated with the full information maximum likelihood method (Louviere, Hensher & Swait, 2000).

Table 7-4 shows estimation results of the nested logit model incorporating modal choice and destination choice. First, the estimated coefficient of "purpose to visit a health center (treatment)" is significantly negative. This indicates that people in the study areas would visit a health center for other purposes, probably checkup or consultation including prenatal care and medicine, and some would visit a referral hospital for treatment which often follows initial checkup at health centers. Second, the estimated coefficient of "number of nurses" is insignificant. To understand the situations that the number of nurses would not contribute to the attractiveness of referral hospitals, two possible situations could be considered: (i) limitations to their functions or responsibilities to care outpatients; and (ii) recent overcrowding in referral hospitals beyond capacities of medical staff stationed, including nurses. The reason (i) can be explained as all referral hospitals are equipped with beds for inpatients due to their responsibilities as determined by the MOH. This could be supported by the fact that coefficients of the other relevant variables like the numbers of doctors or midwives were estimated not significant as well. Third, the estimates of coefficients related to distances to a health center and a referral hospital

were found to be varied: insignificant for the variable related to a health center while negatively significant for the one related to referral hospital. This can be interpreted as the individual choice to visit a health center would not be influenced by the distance from his/her house to the center while he/she determines to visit a referral hospital if the hospital is not distant from his/her house. Fourth, the dummy variable of "ownership of motorcycle(s)" is estimated significantly positive for using a private transportation mode. As presented in Table 7-2, the increase in the ownership of motorcycles(s) was observed significantly. Considering those, the road rehabilitation might enable people to have more travel options for visiting a public health facility, which would enhance the convenience of their visit. Fifth, as for the dummy variable related to people's income, "household income level below the national poverty line," the coefficient was estimated significantly negative. This implies that low-income individuals were not able to avail of shared transportation modes, which often involves costs. During the follow-up survey, the increases in available transportation services like motorcycle taxi, *tuk-tuk* or share-ride lorry/koyon were reported in all the three areas. However, such increases were found not to reduce charges very much. As discussed in Chapter 5, the ownership of private wheeled modes, particularly motorized ones, were not well observed in households who were not equipped well with economic capacities and stayed poor. These indicate that low-income people might continue to walk to a public health facility. Lastly, the estimated coefficient of logsum is significant and estimated between 0 and 1, as theoretically required. Note that the variables related to the roads' conditions were employed, but the valid results were not obtained.

Table 7-4 Estimate Results of Model for Mode Choice at Visiting Health Service Facilities

Variable		Coefficient	t-statistics
Purpose to visit health center (Dummy: Treatment)	α_{HC}	-1.953	-2.784**
Number of Nurses	α_{RH}	-0.025	-1.385
Distance to health center ('000 meters)	β_{HC}	0.117	1.054
Distance to referral hospital ('000 meters)	β_{RH}	-0.164	-3.111**
Ownership of motorcycle(s) (Dummy)	δ_P	1.444	4.969***
Income level below poverty line (Dummy)	δ_S	-1.012	-2.055*
Logsum	φ	0.806	2.804**
Constant (Private mode specific for visiting health center)		0.879	2.272*
Constant (Shared mode specific for visiting health center)		0.718	2.413*
Constant (Private mode specific for visiting referral hospital)		-0.426	-0.396
Constant (Shared mode specific for visiting referral hospital)		0.108	0.101
Initial log-likelihood (L0)		-422.528	
Final log-likelihood (LL)		-240.142	
-2(L0-LL)		364.772	
Adjusted ρ^2		0.408	

N=258; ***:<0.001; **:<0.01; *<0.05

Note: "HC" denotes health center, "RH" referral hospital, "P" private transportation mode, and "S" shared transportation mode respectively.

7.6 Discussion

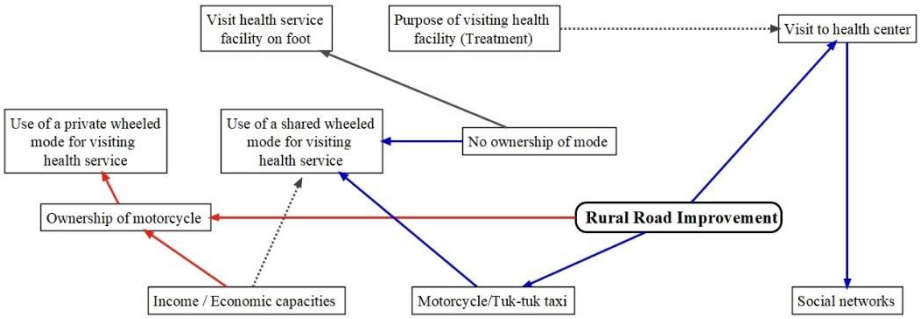
The above model estimation results revealed that the road conditions would not enhance local population's visit to a public health service facility. However, indirect effects could be observed by the statistically significant coefficient of the variable, "ownership of motorcycle(s)." As discussed in

Chapter 5, the improvement works enhanced households' ownership of motorcycle(s), indicating that the improvement would enable the HHs to travel to a facility at their convenience. Further, the results show that shared travel modes were found to be used by people whose income levels were above the national poverty line of 3,871 Cambodia riels (MOP, 2013). That is probably because the variety of available shared transportation services along the study roads were enhanced after the roads were improved, leading competitions among the service providers and eventually reductions in the service fares. However, these results indicate a possibility that low-income people's accessibility to a health service facility would not be changed much, except for potential reductions in their travel time.

Second, locations of the facilities might be influential to people's choice to visit, particularly for referral hospitals as the relevant variable's coefficient was significantly negative. This could be interpreted as people would go to a health center regardless to travel distance, while not visiting a referral hospital if being located far, which is in line with findings of the interviewees of the follow-up survey that increases in visitors in health centers nearby their house and found that those visitors were mainly from their localities. Possible reasons for the interpretation are considered: (i) higher costs of consultation or treatment in referral hospitals than the ones in health centers; and (ii) overcrowding problems in those hospitals due to ineffective referral systems, which might be caused by people who could afford to pay medical costs and/or travel or would live nearby the hospitals. The current HEF would be useful for people who are counted as "poor" at the MOP's assessment, but not be applicable for people whose income levels are low but not acknowledged as "poor" at the assessment. Those people might be discouraged to visit a referral hospital due to the (i) and (ii), who might visit a health center or approach private practitioner(s) if they need treatments which are beyond the center's coverage.

Third, during the follow-up survey in Area BB, some village officers mentioned that the government offered supports to people in their localities of installing a toilet inside their residence for improving hygienic environments after the study road was rehabilitated. One reason for the new initiative was that the road improvement enabled contractors to bring efficiently materials for installation works and carry out their works smoothly. Another reason may be that infectious diseases, such as diarrhea, were reported as major reasons for their visit to health centers in the study areas as indicated in Section 7.4 and discussed in previous studies (for example, Yishay et al. (2011)). Maintaining living environments hygienically clean is one immediate critical challenge in rural Cambodia. This government's initiative could be one of the by-products of the roads improvement in the study areas and the effect on local people's health conditions and visit to public health service facilities could be worth to be assessed over years.

An assumed mechanism of impact distribution related to people's accessibility to a public health service facility is displayed in Figure 7-2.



— : Identified from the model estimation and during the follow-up survey;

— : Confirmed during the follow-up survey: — : Assumed based on the previous studies;

- - : Identified from the model estimation (Adverse effects)

Figure 7-2 Impact Distribution Mechanism on Individual Accessibility to a Public Health Service Facility

7.7 Conclusions

The chapter examined effects of the improvement of feeder roads' conditions in rural areas on people's accessibility to a public health service facility, which has been one critical issue in rural Cambodia. The model estimation using a nested logit model evidenced that the improvement contributed to the convenience of those who owned motorcycle(s) in their household or those would afford to visit by a shared transportation mode like motorcycle taxi, *tuk-tuk*, or koyon/lorry. However, the improvement of accessibility of people without much economic capacities to the facility would not be significantly observed. Further, the road improvement would not motivate people to a referral hospital if being located far from their house, though their travel became easier. As the result also indicates that people would not visit a health center for treatment, people would not visit a referral hospital although they need treatments which were beyond health centers' responsibilities. This is in line with previous studies' findings that some people in the country would prefer to consult private practitioners who are often unqualified.

These findings draw the following three implications: that people still would prefer shorter medical-purposed travel regardless of the road conditions; and that low-income people's medical travel behaviors would not be changed. Further, it could be pointed out that the choice of medical services would be influenced by their individual preferences. Those three are related to people's decision-making to allocate their resources, particularly time and money, and could be verified through further assessments to local population, officers of the facilities and the relevant agencies, and private practitioners.

Chapter 8. Impact of Rural Road Improvements on Children's Accessibility to Schools

8.1 Introduction

International communities have been shifting the focus of their aid policies from economic growth to inclusive development, reconfirming the needs for empowering people in developing countries and involving them in decision-making processes for their countries' growth (Kanbur & Rauniyar, 2010). Focal areas are widely spread, in particular when related to human capital, and one of these areas is education. This trend is supported by a global commitment for "Education for All" (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2000), the Incheon Declaration on "Education 2030" (UNESCO, 2015), and the Sustainable Development Goals (SDGs) (United Nations, 2015). However, criticisms remain that resources have not been sufficiently mobilized to the education sector in developing counties. The situation has been found to be more critical in rural areas, where more than half of the population remains poor and suffers from inadequate access to service facilities as compared to urban areas (Alkire, 2011; Gannon & Liu, 1997). Agrawal (2014) directs our attention to inequalities between urban and rural areas in terms of the number of school facilities and the quality of education provided. While referring to findings by Thomas, Wang, Fan (2001), he cautions that such inequalities in children's access to education could cause long-lasting disparities in incomes and access to services necessary for maintaining people's daily lives. In this case, what can we do to fix such situations?

To respond to this question, it is essential to identify and examine the reasons that restrict children's accessibility to school education in rural areas in developing countries; this will allow for the invention of operational policy instruments to enhance accessibility. Three potential causes are as follows: poor governmental budgets for building relevant facilities and maintaining service qualities, socio-cultural and economic barriers on individual accessibility, and insufficient physical infrastructure for reaching the facilities. Out of those, the poorly resourced governmental budgets and socio-cultural barriers are of an institutional and structural nature, and difficult to overcome. Further, there have been criticisms that financial resources were not properly allocated despite the sector's significance to people's lives, mainly due to an unclear government decision-making process or to external constraints (Fosu, 2007; Judson, 1998). Lifting economic barriers at individual levels often requires external pushes that are subject to various institutional and political factors. On the other hand, the issue of insufficient physical infrastructure for reaching school facilities could be approached in a different way—for instance, through the implementation of projects that improve road conditions. Such projects are often expected to perform more general functions and bring a variety of benefits for the area, including the enhancement of local people's physical accessibility to services that satisfy their needs (Howe & Richards, 1984; Kanbur & Rauniyar, 2010; Mazlumolhosseini, 1990)

This chapter empirically examines the accessibility of school-aged children to basic education and related behaviors in three selected rural areas in Cambodia, where feeder roads have recently been

rehabilitated. This rehabilitation is in line with a government strategy that promotes children's access to education, which could be a driver of economic growth (Asian Development Bank [ADB], 2014b; Ministry of Education, Youth and Sport [MoEYS], 2014b). Further, by focusing on children's physical accessibility to school, the research is expected to provide a unique perspective to the discussions related to the SDG 4 to ensure all children's completion of primary and secondary education by 2030 (United Nations, 2015).

The remaining of the chapter is organized as follows. Section 8.2 reviews previous findings and debates regarding the effects of rural road improvements on local population's accessibility to schools, and the following section (Section 8.3) presents the overview of the education system in Cambodia. Then, the dataset used in the empirical analysis is described (Section 8.4), followed by a model estimation pertaining to children's accessibility to school in the areas (Section 8.5). Finally, discussion is provided in Section 8.6 and conclusive remarks in Section 8.7, respectively.

8.2 Literature Review

As per findings by van de Walle (2002) in Vietnam, the major constraints to schooling encountered by children in rural areas in developing countries are unmaintained road conditions, economic conditions, cultural or religious backgrounds, and contributions to household work. In addition, students' traveling time to a school and safety during their travels were addressed by empirical studies in rural areas in Mali (Education Development Center, 2013). These studies indicate that physical accessibility, such as transportation infrastructure, are one of the determinants for children in rural areas in developing countries to attend school.

Improving rural roads has been expected to contribute to children's school attendance. For example, Levy (1996) provides evidence from Morocco that satellite classrooms were built by governments after the improvement of rural roads, which reduced travel burdens; the quality of school education programs was improved because of the increase in the number of teachers willing to reside in rural areas or commute from adjacent towns; and materials necessary for teaching and maintaining daily operations of school facilities were more regularly transported.

Extended effects of rural road improvements, related to accessibility to education, have also been discussed. In the context of Indonesia, Yamauchi et al. (2011) highlight that the improvements could contribute to income growth more significantly in households (HHs) whose heads completed their education beyond high school, mainly because more highly educated individuals are able to benefit more than others from the improvements and allocate the benefits more effectively among household members. This is further supported by Yang and An (2002) and Yu and Fan (2011), suggesting that HHs with members who have attained a high school degree earn more than others and enjoy a more robust economic position, as such attainments enabled the inclusion of non-farming activities in HH income sources.

Previous studies in developed countries have shown that children's school travel patterns are different from adults' travel patterns, because they are often influenced by factors like HHs' socio-

economic characteristics, the daily activities of parents or other caregivers, and the distance between their house and school facilities, rather than by their own capacities (Ewing, Schroeer, & Greene, 2004; Mitra, 2013). Similar observations have been also reported for developing countries, particularly in urban areas. For instance, Adom-Asamoah, Okyere, and Senayah (2015) show that, in urban areas in Ghana, parents' educational records, socio-economic conditions, and distance to school could influence children's use of motorized modes of transportation. Similar findings are reported by Irawan and Sumi (2011) for Yogyakarta, a major city in Indonesia. In the rural context, several studies have revealed that rural road improvements influence adults' transportation ownerships and use. For example, Bryceson et al. (2008) show that such improvements contribute to the enhancement of transportation ownership at a HH level, particularly bi-wheeled modes such as bicycles and motorcycles.

Although rural road conditions have been recognized as one influential factor for children's schooling, few studies have been conducted on how the conditions' improvement relates to schooling. As stated above, children may not always decide on their own whether they go to school, rather they are to some extent influenced by their household. This chapter will analyze children's schooling behaviors in conjunction with the effects of road conditions and other potentially associated factors.

8.3 Education System in Cambodia and Challenges in Rural Areas

Tense and unstable political periods in 1970s made drastic changes in educational systems in Cambodia, which had great influences on children of school age as most of them were deprived of opportunities to learn general basic education and skills. After the end of the periods, the country faced serious problems related to their people's capacities, because the average literacy rates were dropped to less than 20% and very few people remained alive who had been professionally trained with abilities to provide basic educations. In 1979, the government established a comprehensive education system of the 4-3-3 school education program (4 years for primary education, 3 years for lower secondary education and 3 years for higher secondary education) to build people's capacities and promote their growth. The system was changed in 1986 to the 5-3-3 after reviewing the system's effects, and then in 1996 to the 6-3-3, the current program (Bray, Kobakhidze, Liu, & Zhang, 2016; Kitamura, Edwards, Williams, & Sitha, 2016; Yamaguchi, 2012). In 2014, the government developed the Education Strategic Plan, 2014-2018, with placing an emphasis on the improvement of access to and quality of lower secondary education among the others. This is consistent of the latest national development plan, the Rectangular Strategy Phase III, which prioritizes capacity building and human resource development in the country's development (World Bank, 2017d).

The current basic education in Cambodia consists of two levels: primary education (grades one to six) and lower secondary education (grades seven to nine), which was stipulated in the Education Law promulgated in 2007 (Ogisu & Williams, 2016). In the school year 2015/2016, gross enrollment rates in primary education were 109.7% in the country and 113.5% in rural areas, while those in lower secondary education were 53.8% and 53.3%, respectively (MoEYS, 2016). The enrollment rates of the primary education are above 100% because they include students who could not pass examinations for

promotion and repeated grade one. Net enrollment rates in primary education were 93.9% in the country and 96.5% in rural areas. Primary education completion rates in the country and in rural areas accounted for 80.6% and 82.5%, respectively; while those of lower secondary education accounted for 39.2% and 37.9%, respectively (MoEYS, 2016).

In rural areas, completion rates are lower than gross enrollment rates by 31.0% in the primary education and by 15.4% in the lower secondary. Major reasons for the lower completion rate in primary education are constraints imposed by HHs' economic conditions and their thoughts on their children's schooling (Zimmermann & Williams, 2016), and long-distance travel and poor availability of transportation means for commuting like bicycles (Edwards, Zimmermann, Sitha, Williams, & Kitamura., 2016; No, Sam, & Hirakawa, 2012; Velasco, 2001). As for lower secondary education, Kitamura et al. (2016) indicate that the low completion rates mainly owe to poorly accessible school facilities and high transportation costs incurred in daily commuting. Teachers' absenteeism is also caused by hardships on their commuting routes (Kitamura et al., 2016). If some of their travel routes to their schools are not passable or they cannot afford to purchase any convenient travel mode, their daily commuting becomes difficult and can be hampered. Additionally, school facilities in rural areas are not built enough to accommodate local needs particularly for lower secondary or upper-level education, and existing facilities are often inadequately equipped to assure students' regular attendance in a healthy environment in terms of building materials, sanitation facilities, available desks/chairs for students and teachers, and performance and quality of teachers (Benceniste, Marshall, & Caridad, 2008; Ogisu & Williams, 2016). Such situations could partly relate to the government's plan of allocating national budgets to the education sector. The further challenge is that poor HHs tend to regard education as a loss of earning opportunities, because children are expected to contribute to HH incomes and chores (ADB, 2014b; Kim, 2009; World Bank, 2005).

Classes are provided in a daily double-shifting system though not in all schools, with a morning session (from 7 to 11 am) and an afternoon session (from 1 to 5 pm), where children and their parents would choose either of them. This double-shifting system has been introduced to accommodate as many students as possible in the limited building capacities. However, it has been argued that four hours per day are not sufficient for students to complete the government's curriculum and pass examination for promotion, which eventually requires additional self-study through, for example, private tutoring by school teachers (Bray et al., 2016; Brehm & Silova, 2014) or supports of elder HH members at home (Sato, 2009). In Cambodia, private tutoring plays a great role to smoothen and promote children's education in all levels as well as to contribute to incomes of school teachers because their salary from the government is not sufficient for maintaining their HH's livelihoods (Bray et al., 2016; Brehm & Silova, 2014; Nguon, 2012). Hence, children's attendances are largely affected by their HH's economic capacities and understandings to their schooling.

8.4 Data Development

The chapter empirically analyzes the accessibility of children to public schools for basic education in rural areas in Cambodia. The dataset included children who attended primary and lower secondary education. In Cambodia, basic education is principally guaranteed for free to all children in grades one to six for primary school, covering six- to eleven-year-old students, and in grades seven to nine for lower secondary school, covering 12-to-14-year-olds (Ogisu & Williams, 2016; Sothy, Madhur, & Rethy, 2015). The dataset only covers children aged seven to 14, because some six-year-old children attend pre-school education (grade zero, not compulsory); Miwa (2008) highlights the delays in enrollments of six-year-old children due to potential repetitions. Table 1 shows the descriptive statistics of the sampled children, along with information on economic status and transportation ownership of their HH. In developing the dataset, if the children were enrolled in school, the schools' information along with the interviewees' responses was considered and employed, but a nearest school was assigned to nine children whose school information was not provided though their grades were reported. It was assumed that the children whose grade and/or school information was not reported by the respondents did not attend any school.

Table 8-1 shows that 77.4% of the children in the dataset attended basic education: 55.4% in TK, 84.8% in KC, and 89.1% in BB. The lowest attendance rate is found in TK, probably because the proportion of children older than 11 is higher than that in other areas and, according to the MoEYS's statistics, the transition rate from primary to lower secondary education is also relatively lower in the province of TK than those in the provinces of BB and KC (MoEYS, 2016). Note that children are expected to move from primary to lower secondary education at 11 years of age. The shortest average distance from an individual's house to primary school was in TK, while the longest was in KC, which could be attributed to the number of primary schools along the roads. The distances to lower secondary schools were longer than those to primary schools, because the number of primary schools is much higher than that of lower secondary schools. Such differences have been regarded as one of the issues in the education sector nationwide, as the budget has mainly been allocated to primary education in order to achieve the Millennium Development Goal No. 2, "Achieve universal primary education" (United Nations, 2017), which resulted in the poor development of school facilities and associated equipment, and inadequate assignments of teachers to higher education (ADB, 2014b).

The table also includes information on children's HHs and their heads. First, approximately 80% of the respondents' HH heads were engaged in farming, whereas the remaining occupations vary (vendor, governmental staff, shop owners, and so on), aside from 6.5% who were unemployed. Second, 8.8% of the HH heads in TK and 17.3% in KC had not completed primary education, which was less than the one in BB (57.1%). This is in line with evidence from provincial statistics in the last five years (from 2010/2011 to 2015/2016), where net enrollment rates for primary school are similar across the three provinces, while drop-out rates from grade one is the highest in the provinces of BB (MoEYS, 2011, 2012, 2013, 2014a, 2015, 2016). Third, all the interviewed HHs in BB and TK were Buddhist, whereas 98.1% in KC were Buddhist and the rest were Muslim (1.9%). Fourth, the ownership of

motorcycles increased from 2011 to 2015 more significantly than that of bicycles in all areas. The most significant ownership rate growth for both modes of transportation is in KC, and the least in TK. The ownership rate of motorcycles was higher than that of bicycles in TK, which is different from the other two areas. Fifth, the average income and its standard deviation are the highest in BB, despite its highest poverty rate. These unexpected results could be attributed to Cambodia's definitions of the poverty line. This line was computed by taking into account the monetary values of three items: "food," "non-food," and "clean water" (Ministry of Planning [MOP], 2013); the monetary values of "food" items are computed based on the cost of taking in 2,200 kilocalories per day; "non-food" items include costs for accessing or utilizing public infrastructure and services, such as education and medical services, and purchasing daily commodities; and "clean water" accounts for necessary expenses to access water safe for drinking. In 2013, the country set the national poverty line at 3,871 Cambodian riels, equivalent to US$0.95, per capita per day as an amount required for gaining the three items at a minimum level, and the poverty rate was computed as the share of people whose total income was below the poverty line (MOP, 2013). From this, we could infer that BB might not be poorer than the other two areas in terms of daily income, as the average values for KC and TK were lower; however, the BB's highest poverty rate indicates that the area's accessibility to the resources required for maintaining local livelihood, such as "non-food" and "clean water," could be worse than in the others.

Figures 8-1 and 8-2 illustrate the locations of the primary and lower secondary schools along/adjacent to the improved roads in the three areas.

Table 8-1 Descriptive Statistics of the Dataset for Empirical Analysis

Study Areas		Total	TK	KC	BB
Average poverty rate among the communes along the road (MOP, 2016)			15.54%	20.29%	24.57%
Children's information (N=218)					
Total children		218	62	92	64
Number of children of grade 1-6		129	29	54	46
Number of children of grade 7-9		42	7	24	11
Number of public primary schools along/adjacent to the roads		34	16	9	9
Number of public lower secondary schools along/adjacent to the roads		24	11	6	7
Attendance rate to basic education		77.38%	55.38%	84.78%	89.06%
Age	7	9.17%	14.52%	8.70%	4.69%
	8	15.60%	9.68%	15.22%	21.88%
	9	11.47%	11.29%	14.13%	7.81%
	10	12.84%	8.06%	11.96%	18.75%
	11	12.39%	16.13%	5.43%	18.75%
	12	16.51%	22.58%	16.30%	10.94%
	13	10.55%	12.90%	11.96%	6.25%
	14	11.47%	4.84%	16.30%	10.94%

Study Areas		Total		TK		KC		BB	
Distance from house to primary school (kilometers)		Average	S.D.	Average	S.D.	Average	S.D.	Average	S.D.
		1.69	1.74	1.29	0.75	1.86	2.31	1.74	1.31
Distance from house to lower secondary school (km)		Average	S.D.	Average	S.D.	Average	S.D.	Average	S.D.
		2.38	2.22	1.74	1.59	2.27	2.38	3.04	2.05
Interviewee's information (N=114)									
Total interviewees			114		34		52		28
Employment type	Farmer		80.37%		82.36%		81.25%		76.00%
	Vendors of goods/ farm products		5.61%		5.88%		8.33%		0.00%
	Others		7.48%		5.88%		10.42%		4.00%
	Unemployed		6.54%		5.88%		0.00%		20.00%
Education	Primary		49.12%		58.82%		51.92%		32.14%
	Lower secondary		21.93%		29.41%		25.00%		7.14%
	Higher secondary or above		4.39%		2.95%		5.77%		3.58%
	No education		24.56%		8.82%		17.31%		57.14%
Religion	Buddhist		99.12%		100.00%		98.08%		100.00%
	Muslim		0.88%		0.00%		1.92%		0.00%
Modal ownership rate in 2015 (2011)	Bicycle(s)		80.70% (55.26%)		58.82% (52.94%)		92.31% (53.85%)		85.71% (60.71%)
	Motorcycle(s)		74.56% (37.72%)		73.53% (52.94%)		86.54% (36.54%)		53.57% (21.43%)
Daily income per capita ('000 Cambodian riels)		Average	S.D.	Average	S.D.	Average	S.D.	Average	S.D.
		13.31	16.43	14.39	18.25	10.31	10.23	17.56	21.53

S.D. = standard deviation

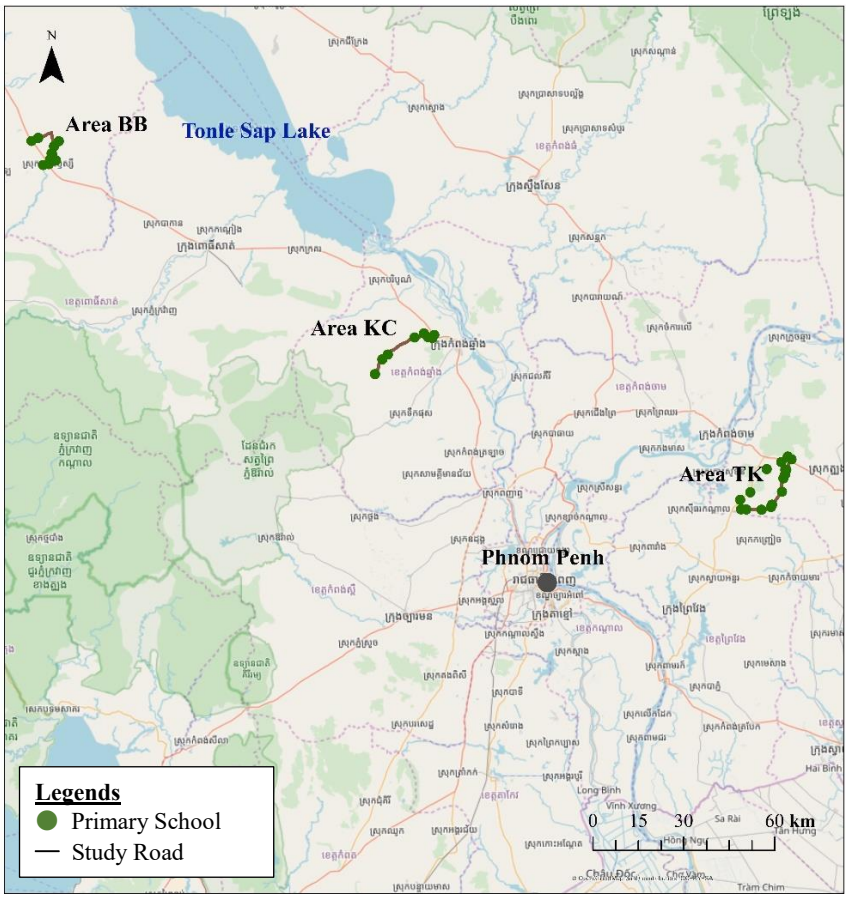


Figure 8-1 Location of Primary and Schools along/adjacent to the Study Roads

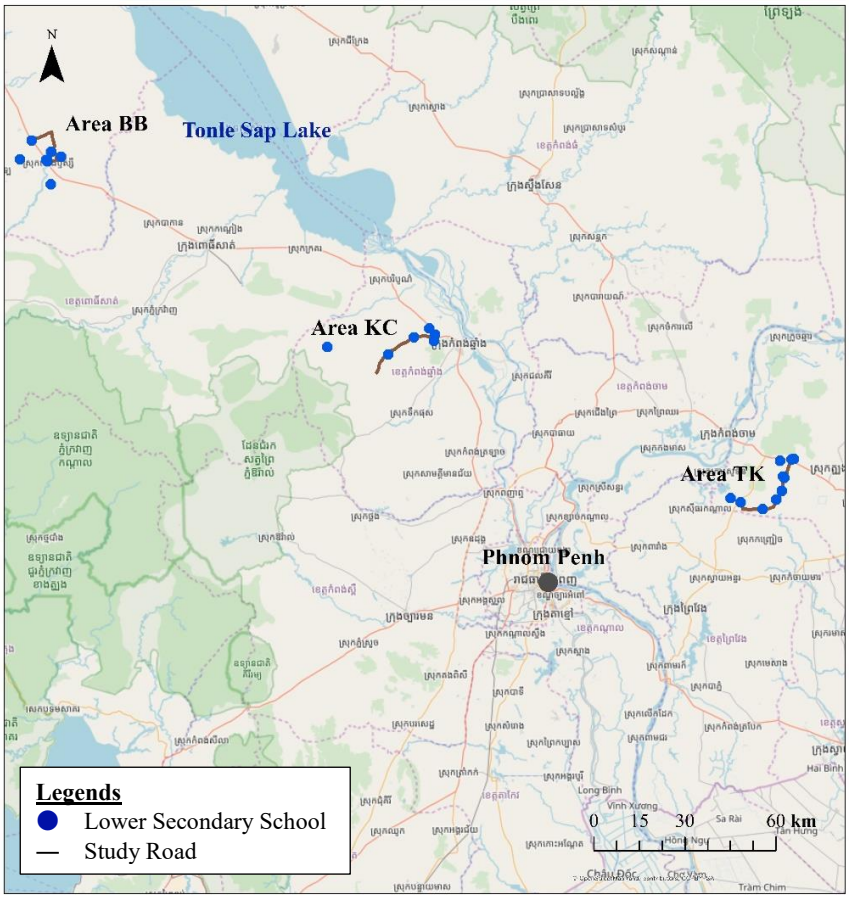


Figure 8-2 Location of Lower Secondary Schools along/adjacent to the Study Roads

Area BB

Primary School

Secondary School

Parking Area (Secondary School)

Area KC

Primary School

Secondary School

Class Room in a Primary School

Area TK

Primary School

Secondary School

Motorcycles Parked and Snack Shops in Schoolyard

Photo 8-1 Primary and Secondary School Facilities along the Three Study Roads

8.5 Empirical Study

8.5.1 Data Analysis

First, the correlation was checked between school attendance rates in the area and the two factors related to accessibility: distance from their homes to school and the proportion of the improved section to the total distance from their houses to the schools. Those two factors have been recognized as influential for children's schooling (van de Walle, 2002). The information about the schools' locations was principally referred to the dataset discussed in Section 8.4. For children who were not reported as attending school, the nearest school from those children's houses was assigned, based on regional findings in the follow-up survey that children principally went to the nearest public school.

Figures 8-3 and 8-4 present the relationships between children's school attendance rates and distance from their house to school facilities, as well as the conditions of roads that they used to get to school, respectively. Figure 8-3 shows that the highest attendance rate was marked in the category of the distance of 6-8,000 meters (100.0%), while the lowest attendance rate was in the category of the

distance of 4-6,000 meters (60.0%). Figure 8-4 presents that the highest attendance rate was found with a pavement rate of 0-20 percent (85.2%), while the lowest attendance rate was recorded in areas with a pavement rate of 40-60 percent (56.5%). Figures 8-5 and 8-6 compare the rates between children residing immediately along the roads and those not residing along the roads. These four figures explain that there is no explicit correlation between children's attendance and their residential location or physical accessibility to school, and indicates that children's schooling is influenced by something unrelated to road conditions.

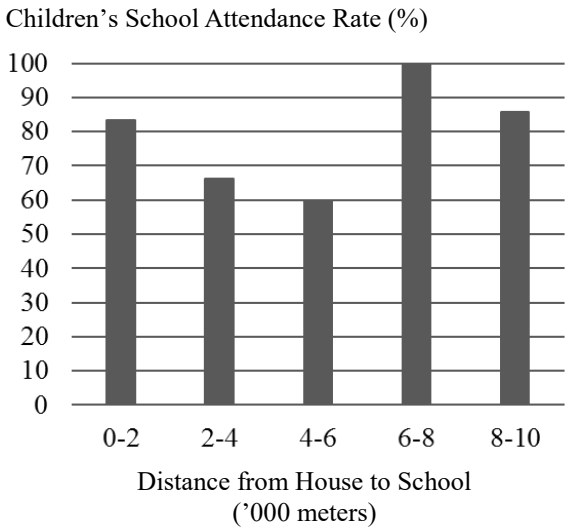


Figure 8-3 Relationship between Children's School Attendance Rate and Distance from House to School

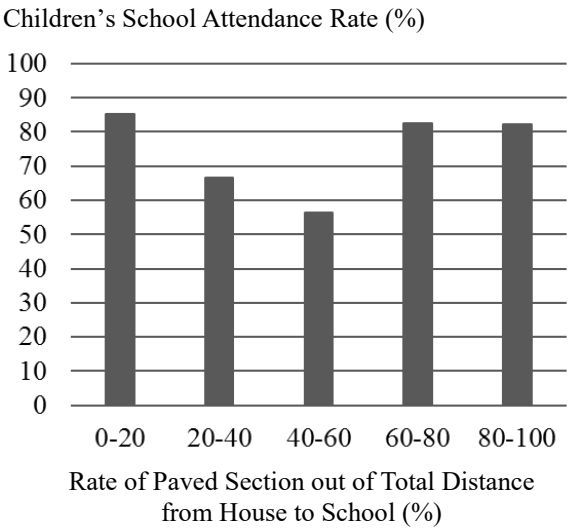


Figure 8-4 Relationship between Children's School Attendance Rate and Pavement Rate

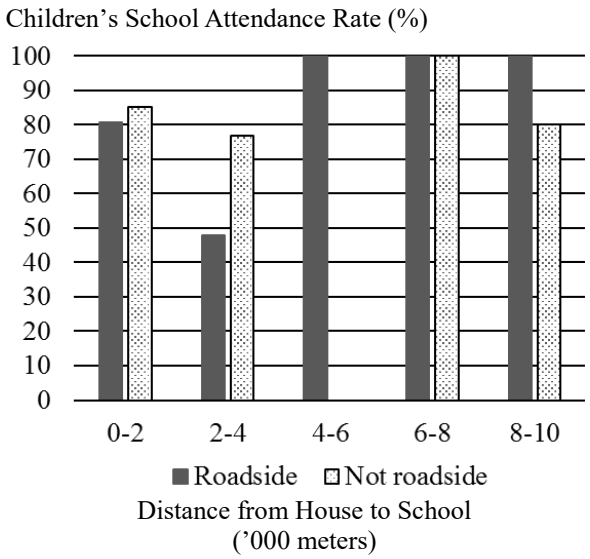


Figure 8-5 Relationship between Children's School Attendance Rate and Distance from House to School (Difference among Children residing Roadside or not)

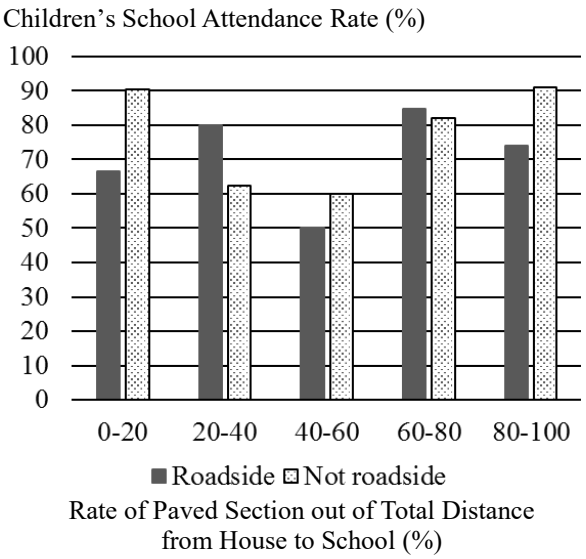


Figure 8-6 Relationship between Children's School Attendance Rate and Pavement Rate (Difference among Children residing Roadside or not)

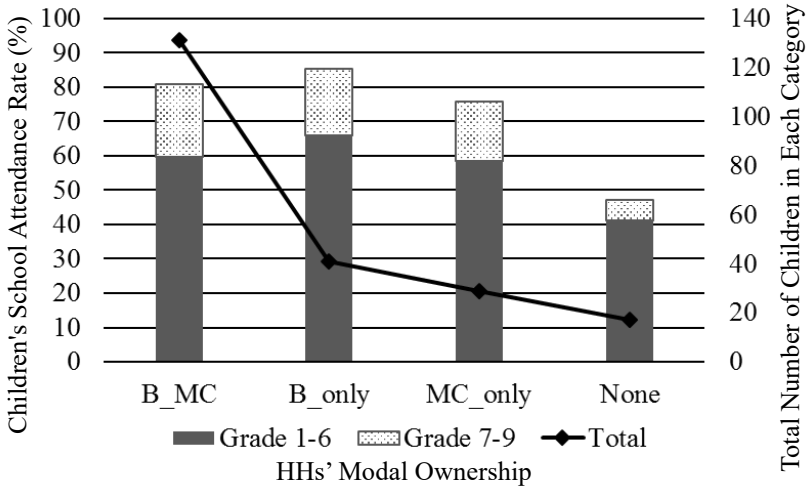
Figures 8-7 and 8-8 show the relationships between children's school attendance rates and their HH characteristics. Figure 8-7 exhibits the relationships between the attendance rates and the HH ownership of bi-wheeled modes of transportation, bicycles and motorcycles. The rate for primary education was the highest in the category of HHs owning only bicycles (65.8 %), while that for lower secondary was the highest in the category of HHs owning both bicycles and motorcycles (21.3%). The lowest rates for both education programs were marked in the category of HHs not owning any bi-wheeled mode, 41.2% and 5.9% respectively. As for relationships with the HH heads' educational attainment, displayed in Figure 8-8, all the HHs whose heads completed higher secondary education programs or above sent their children to school. However, other HHs show different results. The lowest rate for primary education was found in HHs with heads who had completed only primary education (52.4%), and that for lower secondary education in HHs whose heads had never attended school or did not complete primary education (15.9%).

Figures 8-9 and 8-10 present the relationships between children's school attendance rates and economic levels of HHs and communes. Figure 8-9 presents the relationships between the attendance rates and HH income levels (daily income per capita). A remarkable observation is that attendance rates in primary education were the lowest in the category of the lowest income level (0-5,000 Cambodian riels) (50.7%). The lowest rate in lower secondary education was marked in the category of the highest income level (more than 30,000 Cambodian riels) (14.3%). This is against previous findings that HHs of larger economic capacities would send their children to schools more likely than HHs of smaller capacities. Figure 8-10 compares the school attendance rates among the communes whose poverty rates varied. The rate of the poorest commune was the lowest, zero in fact, though the other communes'

school attendance rates were varied. Interestingly, the rates in the relatively wealthier communes were lower than in the others, though those communes had both of primary and lower secondary education facilities. This observation indicates that the children's school attendance would not be determined simply by the HH-level/regional economic conditions or the location of their school facilities.

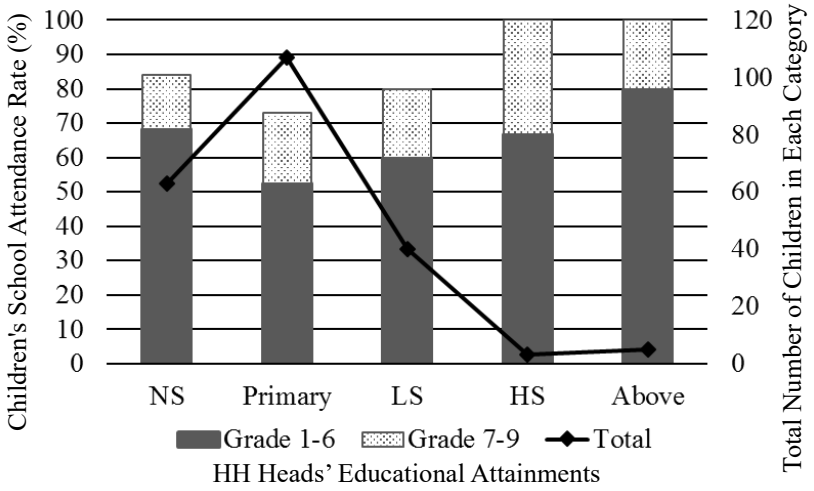
Finally, Figure 8-11 illustrates the relationship between children's school attendance rates and their age. The highest rate was marked at the age of 10 (85.7%), while the lowest was at the age of 13 (65.2%). This indicates that the conventional observation that enrollment rates are lower for older children may not be applicable to the dataset.

These nine figures present the initial picture of the dataset on children's school attendance. It is noted, however, that the dataset requires further examinations to identify influential factors on attendance.



Note: B_MC: HH owning bicycle(s) and motorcycle(s); B_only: HH owning bicycle(s); MC_only: HH owning motorcycle(s); None: HH without any bi-wheeled transportation

Figure 8-7 Relationship between Children's School Attendance Rate and their HHs' Transportation Ownerships



Note: NS: Never schooled/completed primary education; Primary: Completed only primary education; LS: Completed only lower secondary education; HS: Completed only higher secondary education; Above: Completed programs above higher secondary education

Figure 8-8 Relationship between Children's School Attendance Rate and their HH Heads' Education Attainments

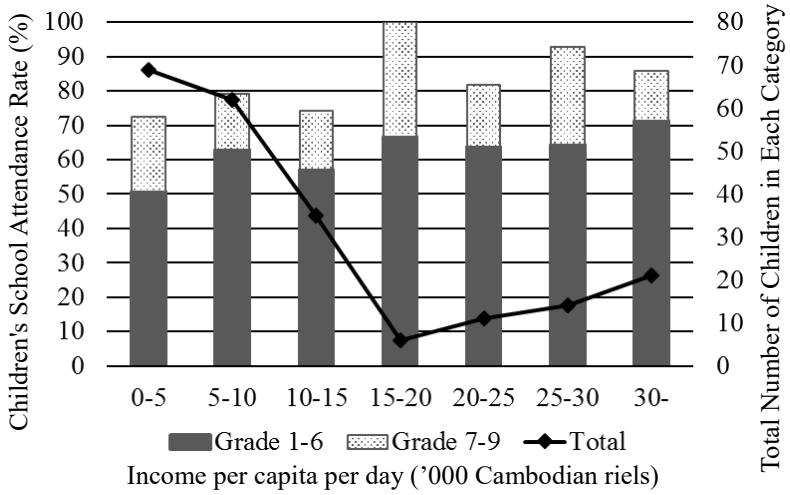


Figure 8-9 Relationship between Children's School Attendance Rate and their Income Level

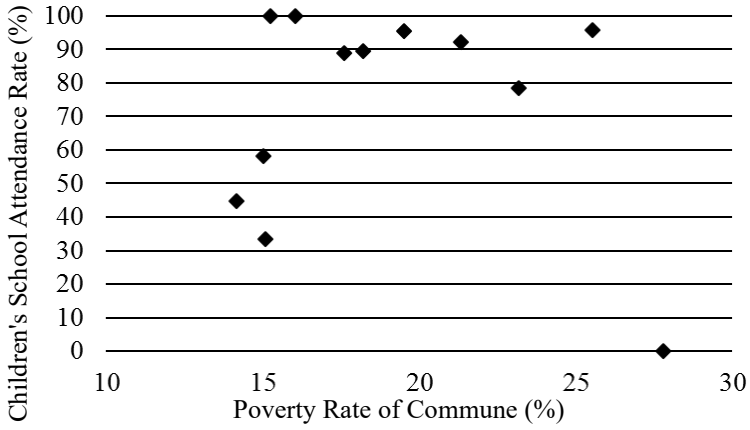


Figure 8-10 Relationship between Children's School Attendance Rate and Poverty Rate

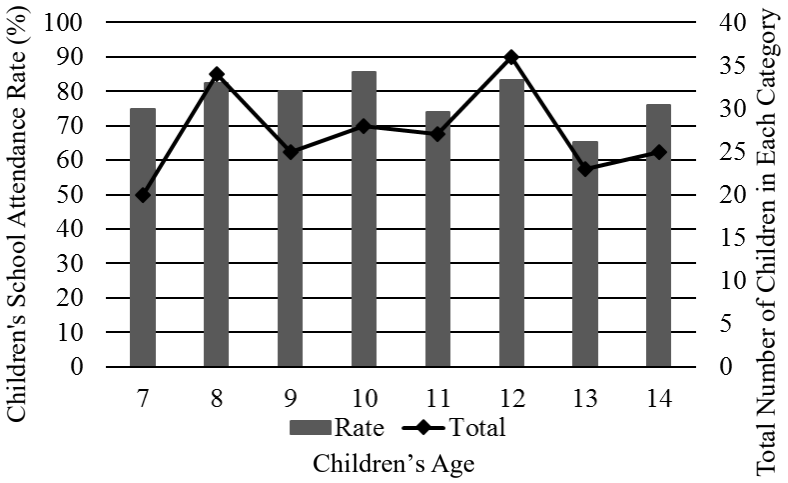


Figure 8-11 Relationship between Children's School Attendance Rate and their Age

8.5.2 Model Formulation

A simple binary logit model is formulated to estimate children's attendance to basic education in public schools, taking value 1 if a child attends and 0 otherwise. The utility function is assumed to be:

$$\Delta U_n = \sum_j \theta_j X_{jn} + \theta_0 \tag{8-1}$$

where ΔU_n represents the utility when child n attends school minus the net utility when she/he does not attend it; X_{jn} is the jth explanatory variable regarding child n; and θ_j and θ_0 are coefficients. Then, the probability of attendance for child n is derived as:

$$P_n = \frac{1}{1+e^{-\Delta U_n}} \tag{8-2}$$

The potential explanatory variables are: "0/1 Change in ownership of bicycle(s)," which takes value 1 if a household owned newly bicycle(s) during/after the road improvement and 0 otherwise; "0/1 Change in ownership of motorcycle(s)," which takes value 1 if a household owned newly motorcycle(s) during/after the road improvement and 0 otherwise; "0/1 Ownership of motorcycle(s) and bicycle(s)," which takes value 1 if a household owned both motorcycle(s) and bicycle(s) after the road improvement and 0 otherwise; "0/1 Ownership of motorcycle(s)," which takes value 1 if a household owned motorcycle(s) after the road improvement and 0 otherwise; "0/1 Ownership of bicycle(s)," which takes value 1 if a household owned bicycle(s) after the road improvement and 0 otherwise; "Number of members in a household;" "Poverty rate of a commune," which represents the poverty rate in the commune to which a household belonged at the time of the survey (MOP, 2016); "0/1 Education record of household head," which takes value 1 if a household head completed lower secondary education or above and 0 otherwise; "0/1 Residing along the study road," which takes value 1 if a household resides immediately along the study road and 0 otherwise; "Distance to school from house ('000 meters);" and

a combination of “Rate of paved road to access the nearest school” with “Daily income per capita (Cambodian riel ’00000).”

8.5.3 Estimation Results

Table 8-2 summarizes the estimation results of the five models. First, the dummy variables of “Change in ownership of motorcycle(s)” is significantly positive, while “Change in ownership of bicycle(s)” is negative. They mean that a child in the HH owning motorcycle(s) newly during/after the road improvement is likely to go to school, while not the case for the HH owning newly bicycle(s). Though it was found in the follow-up survey that many students, particularly in primary education, used a bicycle for going to their school, owning newly bicycle(s) would not promote local children’s attendances, probably because its speed is low, and/or it is not appropriate for parent(s) to give a ride to their children on their back.

Second, the dummy variables of “Ownership of bicycle(s) and motorcycle(s),” “Ownership of bicycle(s),” and “Ownership of motorcycle(s)” are significantly positive across the models. This indicates that ownerships of bi-wheeled mode(s) in HHs contributed to children’s school attendance. This is in line with our findings and interviews with teachers that those bi-wheeled mode were used for students’ schooling as well as for their HH members’ escorting. The teachers also acknowledged the increases in students using those modes at their schooling after the roads were improved.

Third, the “Number of members in a HH” is estimated to positively affect children’s attendance at a significant level. This is likely because the economic capacities of larger HHs might be bigger, allowing those HHs to send their children to school. As shown in Table 8-1, most of the sampled HHs were engaged in rice farming whose yields may often be in proportion to available manpower. This is in line with the finding by Yang and An (2002) that the number of HH members is one of determinants of its economic capacities. Ogisu and Williams (2016) recognize the size and composition of a HH as a determinant for making a decision among the HH members on whether or not to letting their children go to school. Sato (2009) observes in rural Cambodia that some HH heads live with their relatives’ children in their house and help the children to go to school. The number of those HH members must be large.

Fourth, the estimated coefficient of “Poverty rate of a commune” is also significantly positive. This suggests that people in poorer areas are more likely willing to send their children to school. In the follow-up survey, the respondents’ strong beliefs were found that educational attainments could help their children to reach opportunities for better-paid and more stable job than rice farming, the dominant economic activity in the areas.

Fifth, the results also show that “Education record of HH head (dummy)” is significantly positive. This could infer that children’s schooling is strongly influenced by their HH head’s educational backgrounds. Strauss and Thomas (1995) evidence the strong influence of parents’ educational backgrounds onto their children’s school attainments. Taking into account the above results related to the number of members in a HH together, it could be said that children may follow their HH members’

behaviors, including educational attainments. Related to this, Nguon (2012) evidenced from the case in other rural Cambodia that qualities of relationships among members in a HH, particularly parents, could be one of the essential influential factors of children's performances at school.

Sixth, "Age" indicates its significantly negative impact only in Models 2 and 3. This is reasonable, as the drop-out rates for senior students are normally higher because of various reasons, such as attending household works and farming activities, failing to follow the classes, or being demotivated to continue studying in school for their own interests. Models 2 and 3 employ the variable of "Age" combined with "Residing along the road" and "Pavement rate," respectively, and their estimated coefficients are significantly positive. This indicates a possibility that if elder children reside immediately along the improved roads or experience better conditions of the road to school, they are likely to attend school.

Seventh, the estimated coefficient of "Residing along the road" is significantly negative in Models 2, 4, and 5, being interpreted as children residing far from the road are not likely to go to school. One of possible reasons for this is that their HH may live nearby their rice fields, often located far from the roads, and may request them to work in the field with their HH members in the daytime. Those fields were often located far from the roads, according to observation in the follow-up survey.

Eighth, "Distance to school from house ('000 meters)" is found not to be influential at a significance level, probably because a recent increase in ownerships of bi-wheeled modes at a HH level, as shown in Table 1, enables children to go to school on their own or with their HH member's escort(s) more efficiently than before the road improvement regardless of the distance to schools. This could be one of the results of the government's efforts for promoting children's enrollments in primary education, as they allocated budgets to build school facilities nationwide (Kim & Rouse, 2011; Ogisu & Williams, 2016). In Model 4, the combination variable of "Age" and "Distance to school" is significantly negative, implying that if elder children reside far from school, they are unlikely to attend school. Further, this may be partly because the number of lower secondary school was fewer than that of primary school. The situation may involve children's long-distance traveling to schools and discourage their continuous schooling, which has been recognized one of critical issues in the country's education sector as discussed in Section 8.3.

Lastly, "Daily income per capita (Cambodian riel '00000)," is also found not to be significantly influential to children's school attendance, which is consistent to findings related to Figure 8-9. Further, it was originally hypothesized that this income-related variable would influence negatively to the attendance of elder children who are more likely dropped out than younger, but this hypothesis was rejected as the combination variable in Model 5 is not statistically significant.

Table 8-2 Estimation Results of a Binary Logit Model for Schooling of Children Aged from 7 to 14

Variables	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value
Change in ownership of bicycle(s) (dummy)	-1.297	-2.591 **	-1.399	-2.714 **	-1.493	-2.855 **	-1.385	-2.729 **	-1.305	-2.612 **	-1.291	-2.571 **
Change in ownership of motorbike(s) (dummy)	0.999	2.070 *	0.984	2.025 *	1.129	2.278 *	1.015	2.099 *	0.971	2.010 *	0.998	2.069 *
Ownership of bicycle(s) and motorbike(s) (dummy)	2.519	3.266 **	2.644	3.290 **	2.657	3.306 **	2.675	3.351 ***	2.566	3.299 ***	2.521	3.264 **
Ownership of bicycle(s) (dummy)	2.908	3.376 ***	3.204	3.521 ***	3.054	3.448 ***	3.193	3.518 ***	2.920	3.366 ***	2.925	3.364 ***
Ownership of motorbike(s) (dummy)	2.037	2.360 *	2.174	2.450 *	1.986	2.232 *	2.164	2.438 *	2.104	2.414 *	2.051	2.360 *
Number of members in a HH	0.375	3.475 ***	0.396	3.514 ***	0.370	3.399 ***	0.403	3.621 ***	0.381	3.488 ***	0.372	3.432 ***
Poverty rate of a commune in 2015	0.154	2.537 *	0.153	2.487 *	0.166	2.664 **	0.161	2.603 **	0.156	2.564 *	0.155	2.536 **
Education record of HH head (dummy)	1.156	2.050 *	1.252	2.183 *	1.208	2.105 *	1.293	2.206 *	1.183	2.089 *	1.158	2.048 *
Age	-0.108	-1.218	-0.242	-2.008 *	-0.431	-2.014 *	0.061	0.478	-0.158	0.151	-0.108	-1.213
Residing along the road (dummy)	-0.674	-1.628	-4.168	-2.015 *	-0.669	-1.594	-0.715	-1.711 .	-0.687	-1.652 .	-0.683	-1.634
Distance to school from house ('000 meters)	-0.118	-1.020	-0.134	-1.136	-0.135	-1.144	0.947	1.637	-0.118	-0.306	-0.117	-1.011
Pavement rate	0.817	1.240	1.008	1.468	-4.611	-1.397	0.877	1.304	0.849	1.285	0.748	0.950
Daily income per capita (Cambodian riels '00000)	1.476	1.177	1.451	1.146	1.549	1.194	1.501	1.202	-2.820	-0.513	1.072	0.391
(Age) x (Residing along the road)			0.316	1.734 .								
(Age) x (Pavement rate)					0.494	1.689 .						
(Age) x (Distance to school from house)							-0.089	-1.880 .				
(Age) x (Daily income per capita)									0.420	0.777		
(Pavement rate) x (Daily income per capita)											0.559	0.163
Constant	-5.375	-3.075 **	-4.200	-2.211 *	-2.099	-0.796	-7.804	-3.416 ***	-4.984	2.741 **	-5.351	-3.046 **
Initial log-likelihood (L0)		-113.639		-113.639		-113.639		-113.639		-113.639		-113.639
Final log-likelihood (LL)		-87.802		-86.260		-86.329		-86.079		-87.508		-87.789
-2(L0-LL)		51.574		54.758		54.620		55.120		52.262		51.700
Adjusted ρ^2		0.227		0.241		0.240		0.243		0.230		0.227

N=218; ***:<0.01; **:<0.01; *<0.05; .<0.1

8.6 Discussion

First, the results revealed that the improvement of rural roads' surfaces did not significantly enhance school attendance by children, though they do contribute to increases in ownerships of bi-wheeled modes of transportation. This implies that one critical determinant of their attendance is whether their HH has bicycle(s) and/or motorcycle(s), rather than the road condition itself. In the follow-up survey, it was found that, out of the 45 interviewed HHs, 11 HHs purchased bicycle(s) and 16 HHs purchased motorcycle(s) during/after the road improvement works by getting financial help from outside relatives (one HH) or using their in-house savings (the rest). A major motivation was helping children's self-schooling or HH members' escorts, particularly for children in grade one or two, with a strong belief that educational attainments would be a tool to acquire better-paid jobs than rice farming or unstable daily employment. Interviewed school teachers also confirmed that parents recognize the importance of their children's education more than they did before the road improvements. This indicates that road improvements indirectly enhance local children's attendance in basic education programs if their HH owns at least one bi-wheeled mode of transportation, bicycle or motorcycle, and they are allowed to use it to commute to school. However, it is not explicitly clear from this research whether their HH income level impacts their attendance, in consideration of hidden monetary assets which may not be counted as part of their daily livelihoods. It could be worth further studying how a HH makes decisions to invest their (non-/monetary) assets following changes in their living environments, such as improvement of nearby roads.

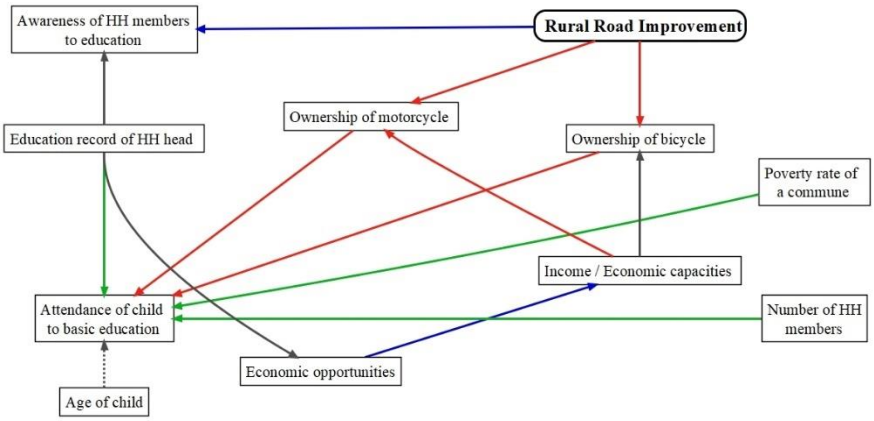
Second, if we consider transportation ownership as an indicator of HH economic capacity, we could say that HHs without the economic means to purchase any motorized mode cannot easily send their children to school. The difference in the estimated results of the variables related to changes in transportation ownership during/after the road improvements could have some implications: owning new motorcycle(s) significantly and positively influenced school attendance, but owning new bicycle(s) did so negatively. This could be attributed to the difference in price of motorcycles from that of bicycles: the follow-up survey highlighted that the average prices of new motorcycles and bicycles are US$1,263 and US$67, respectively. Motorcycles are approximately 20 times more expensive than bicycles; low-income HHs may not be able to afford motorcycles. This interpretation supports findings from previous studies (Edwards et al., 2016; No et al., 2012) showing that low-income HHs may not be able to make their children complete basic education in rural areas in Cambodia. Regularly sending children to school involves extra expenditures, mainly on uniforms, textbooks, and other necessary supplies like pens and notebooks. According to the interviewed teachers, these expenditures reach about 3-4,000 Cambodia riels per day. Moreover, some HHs spend their money on private tutoring that school teachers offer after regular school programs, with the aim of enhancing their children's educational performance to catch up with class progress and achieve a smooth promotion (Brehm, 2016; Brehm & Silova, 2014). The interviews with school teachers revealed that hourly tutoring fees ranged from 500 to 1,250 Cambodian riels, subject to children's grades and performance, representing a significant financial burden, particularly for low-income HHs. It was reported that some teachers who live near their students offer

tutoring to children in low-income HHs for free, as the teachers might feel reluctant to receive fees from such HHs (Brehm, 2016; Brehm & Silova, 2014). However, such a free tutoring would not be always provided, which is subject to teachers' empathies to the HHs. These mixed interpretations imply that vicious circles into which low-income households have fallen can continue for generations, as children and grandchildren continue to lack basic education for their household's poor-resourced economic capacities, and have difficulty finding well-paying jobs. Disparities between children based on abilities can widen, becoming more deeply rooted in the future. This may suggest a need to institute special instruments to secure opportunities for children to continue studying while avoiding drop-out or repetitions.

Photo 8-2 Private Tutoring before the Start of Classes in High School (Area TK)

Finally, the follow-up survey also revealed that some of the interviewees in Area TK, the wealthiest area, respected their children's willingness to stop schooling before completing basic education and work at roadside shops trading businesses or assembling cars. The children acknowledged the increase in the number of users of the improved roads and the improvement of their parents' roadside business. Such initial signs of entrepreneurship in young generations were naturally boosted by road improvements. However, it should be noted that one reason to stop studying was that the students did not consider high education attainment essential for starting trade businesses, as they know that their parents had completed only primary education or had dropped out. Given the emerging competition in local economies, those young generations would be required to diversify their trade practices beyond their parents' current simple ones. This may suggest that the curriculum in public schools, particularly for lower secondary education, should be flexible in accommodating changes in socio-economic situations and students' interests or needs, even though the standard curriculum for basic education is designed by the central government to help children develop basic knowledge, mainly literacy, numeracy, and life skills (Ogisu & Williams, 2016). Such flexibility could motivate children hoping to learn more practical skills to continue attending school to gain the knowledge necessary for surviving business environments in the future, along with basic knowledge for their life-long survival. To that end, policy-makers in their communities could collaborate with school teachers and their parents to identify needs and potentials for the development of their area, and develop learning programs.

An assumed mechanism of impact distribution related to children's accessibility to basic education school facilities is displayed in Figure 8-12.



— : Identified from the model estimation and during the follow-up survey;

— : Identified from the model estimation; — : Confirmed during the follow-up survey:

— : Assumed based on the previous studies

Figure 8-12 Impact Distribution Mechanism on Children's Accessibility to Basic Education School

8.7 Conclusions

This chapter examined the impacts of rural road improvements on children's accessibility to primary/lower secondary school facilities, using the dataset based on the surveys' results. HHs in the areas had faced difficulties in sending their children to school before the improvements, as the roads were not always passable. The empirical analysis in this chapter revealed that road improvements would not necessarily contribute to regular school attendance. However, indirect effects are implied through the increase in motorcycle ownership. Follow-up interviews also revealed that the improved road conditions encouraged local populations to send their children to school, thanks to the recognition of the importance of educational attainment for future survival and the ownership of convenient travel modes, particularly motorcycles. In the analysis, the effects of individual income levels to children's school attendance in basic education were not explicitly shown. These results imply the attendance would be influenced by HHs' economic capacities and characteristics including the number of their members and thoughts on their children's educational attainments.

The chapter reveals that transportation ownership could be a factor determining the attendance. However, this interpretation calls for a reminder that whether to own new mode(s) of transportation after road improvements was an outcome of decision-makings within a HH based on road conditions around houses and school facilities, its economic capacities, and others. Considering such complicated decision-making processes within a HH, policy-makers should take comprehensive approaches in their decision-making process in their sector by incorporating the associated sectors' strategies and needs, instead of using conventional vertical approaches. Such integral approaches could help allocate effectively national budgets and contributions from international communities to the education sector for improving educational quality and coverage, increasing the productivity of future generations.

Chapter 9. Synthesis of Results of the Case Study

9.1 Introduction

This chapter illustrates the overall impacts of the case project of the research on local populations of diverse socioeconomic capacities in the study area. Chapters 5–8 revealed that a variety of impacts observed through the rural road improvement might be subject to economic capacities of individuals and their households owned, such as rice fields and travel modes. The impacts could be also affected by non-economic aspects, such as educational attainment and social networks. Further, it was revealed that improving rural roads could enhance only individual mobility but not necessarily accessibility to satisfy social and educational needs.

The remainder of the chapter is as follows. Section 9.2 overviews the entire impact distribution mechanism and draws major items underlying the mechanism which would influence the impacts' realization. Further, it examines discrepancies between the identified mechanism and the one assumed for formulating the project. Section 9.3 discusses on potential long-term impacts of the project with referring to the previous studies, and Section 9.4 follows with the conclusive remarks, including items to be considered at formulating rural roads projects in developing countries for further discussion in Chapter 10.

9.2 Mechanisms of Generating the Project's Effects within the Study Areas and its Verification

Figure 9-1 illustrates a causal network of impacts identified of the case project, while Figure 9-2 is the assumed one at formulating the case project based on the project appraisal document (Asian Development Bank, 2010). The section discusses the outstanding items in Figure 9-1 and examines the major differences between the two figures.

Figure 9-1 identifies the four factors significantly influencing the distribution of impacts of the case project. The first is the influxes of people from outside the roadsides, which could be caused by the connectivity to national roads. The improvement attracted the attention of outside people to the roadside areas in question and boosted their influxes mainly for direct economic interactions with residents along the roads or passing by toward other areas. Because of such increases in users of the roads from both outside and inside the roadsides, the local population opened grocery shops as a complementary income source to producing and selling rice or having better deals of rice with approaching traders. Without such regional connectivity, those changes could not have happened. This implies that only improving selected roads could not have realized changes in individual economic activities and local economic structure in the areas.

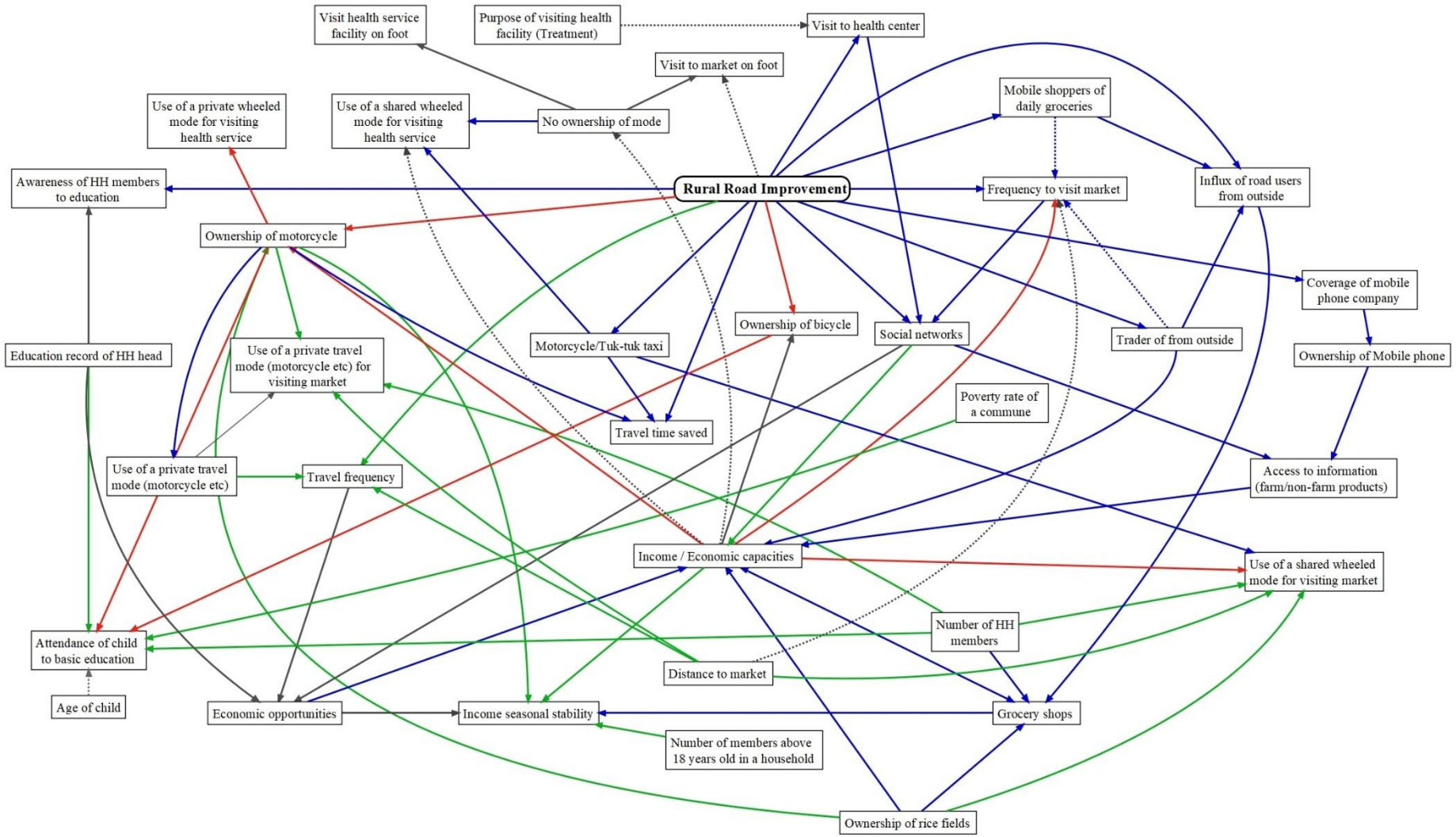
The second is the income level and/or economic capacities of a household. The follow-up survey reveals that savings or other types of economic resources like rice fields enable people to gain new income generation opportunities, such as opening grocery shops on a part of their land or starting a motorcycle taxi business. Those people continue rice farming as another income source, but some

changed their primary source from selling rice to a new business. Such benefits, e.g., diversifying income sources with flexibilities, could be enjoyed only when households have robust economic resources accommodating local socioeconomic contexts before the rural road improvement, as those resources are not easily attained.

The third is accessibility to public service facilities (education and health) related to human capital's attainments. The follow-up survey revealed that the attainments were considered critical for becoming engaged in non-farm sectors; otherwise, work options would be limited to working only as daily contracted labor in farm sectors, e.g., picking fruits and vegetables or harvesting rice, which are seasonal work and make the laborers' households socioeconomically vulnerable. Such accessibility could be constrained by physical and economic aspects. The physical aspects are travel distances and availabilities of travel modes, while the economic ones could be related to financial burdens for traveling to the service facilities and associated costs for receiving the services. As described in Chapter 8, households have to shoulder financial burdens related to uniform, textbooks and private tutoring for helping children continue to go to school and catch up the government's curriculums for their smooth promotion. Those burdens would make it hard for people to go to the facilities regardless of the roads' conditions, and the level of their human capital would remain low, which could continue for the next generation.

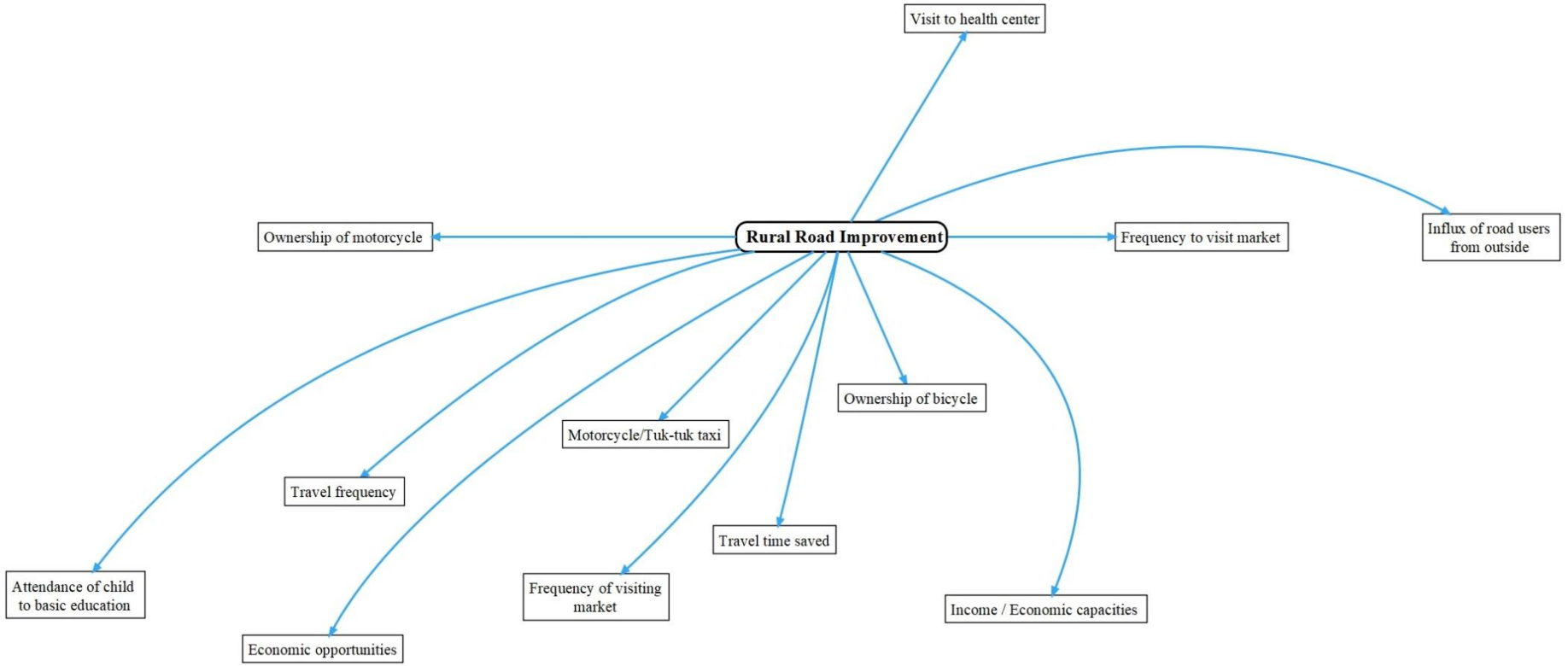
The last item is whether a household could obtain bi-wheeled modes of transportation, particularly motorcycle(s). Those modes were found as one of the common assets of households, and their ownerships would determine benefits from the rural roads improvement on household members' mobility, accessibility to markets and health service facilities, participation in social networking, and attendance of their children in basic education facilities. The ownerships could be interrelated with economic capacities of households. Interviews during the follow-up survey verified the interrelations, but also indicated another finding that some low-income households were given those modes by their relatives who stayed in other towns or countries and found that the physical conveniences were enhanced by the rural road improvement. This suggests that, in the study areas, we could consider household composition as one determinant of the economic capacities.

The comparison of Figures 9-1 and 9-2 extracted major differences between the two networks. The one critical issue is that some socioeconomic endowments not directly related to rural roads were required for being a part of the impact distribution networks shown in Figure 9-1 because those endowments were found as a catalyst to bring about results as shown in Figure 9-2. However, the issue was not addressed during the formulation of the project. The oversight would have resulted in the exclusion of people not endowed with such necessities from the networks.



— : Identified from the model estimation and during the follow-up survey; — : Identified from the model estimation; — : Confirmed during the follow-up survey;
- - : Confirmed during the follow-up survey (Adverse effects); — : Assumed based on the previous studies;- - : Identified from the model estimation (Adverse effects)

Figure 9-1 Impact Distribution of the Case Study



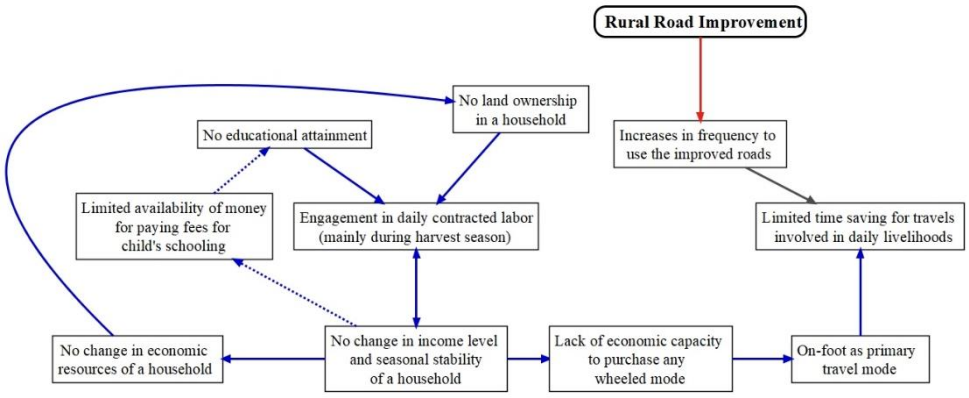
— : Assumed at formulating the case project (Positive effects)

Figure 9-2 Assumed Mechanism of Impact Distribution

On the other hand, the follow-up survey revealed that some of the interviewed people could not recognize any change in their socioeconomic level or modal ownerships. Those people had the following common characteristics: (i) do not own any land in a household for rice farming for income earning; (ii) are engaged in daily labor in farming activities for neighbors; and/or (iii) never received primary education. Note that characteristic (i) includes one who owns rice fields only for self-supply. If an individual has two of the three characteristics, he or she would have been very likely not to benefit.

In fact, those three characteristics are interrelated. In areas that overly rely on rice farming, like the study area, people without rice fields for income earning would earn a living only from daily labor in neighbors' farming activities and events like wedding parties or funerals. However, opportunities for daily contracting activities are often limited according to farmers' convenience and needs. Characteristic (iii) could be also a fundamental cause for (ii), as employment opportunities in tertiary sectors are limited in the study areas and education attainment—at least completion of higher secondary education—is often required for applying. Hence, a person with (i) and (iii) would have no other option than working as daily contracted labor in farming activities. Note that, as stated in Chapter 8, people who never attended school were found to be able to maintain their livelihoods with their household members if they owned rice fields for selling rice to others. Figure 9-3 illustrates the possible mechanism where effects from rural road improvements would be realized for people who fit some of these three characteristics.

In this regard, it would be necessary to scrutinize whether the provincial poverty rate employed for selecting areas for interventions under the project was appropriate, since the rate would be almost the average of a province and not always representative of commune-level rates. To involve those poorly resourced people in the impact distribution network for benefits of achieving the ultimate project object of reducing poverty, it is necessary to examine how to select such areas as well.



— : Identified from the model estimation and during the follow-up survey;
— : Confirmed during the follow-up survey: — : Assumed based on the previous studies;
- - : Confirmed during the follow-up survey (Adverse effects)

Figure 9-3 Potential Distribution Mechanisms of Impacts of Rural Road Improvements for Poorly Endowed People

Lastly, the outlook on what would critically influence individual receipt of benefits from the project is displayed in Figure 9-4, a conceptual diagram, based on the above discussions in the section. The diagram was divided into two levels, individual and regional, and featured the four items of determinants on whether local people could benefit or not: (i) influx of outsiders; (ii) income and economic capacities; (iii) human capital; and (iv) ownership of travel modes. In particular, individual situations of items (ii) and (iii) before the project were found as determinants on their receipt of benefits, which were discussed earlier. Situations related to items (i) and (iv) are also essential but mainly after rehabilitation works were completed. However, due to significant influences of item (i) on the study areas in the case project, it would be ideal to know in advance who could come as well as their origins/final destinations and purpose(s) for entry to the roadsides during the formulation process. Such knowledge would help to estimate traffic flows not only along the roads in question but beyond. Item (iv) may be different from the others, as travel modes are like a catalyst for items (ii) and (iii). Ownership of those modes are largely subject to income and economic capacities of a household and its composition but may be influenced by local market systems of those modes, particularly when marked for secondhand ones are active. Hence, it would be better to grasp modal ownership at a household level.

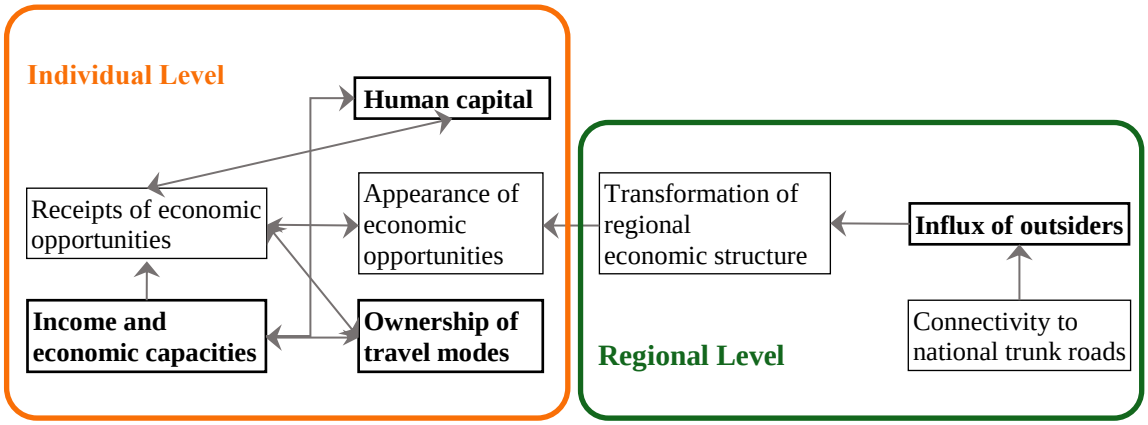


Figure 9-4 Conceptual Mechanism of Impact Distribution of A Rural Road Improvement Project

9.3 Possible Distribution of Impacts of Rural Road Improvements in the Long Run

The research looked at impacts of the rural road improvements realized about one year after the civil works completion; hence, impacts identified and discussed above are considered "short-term." As discussed above, the short-term benefits came up only to people with robust economic capacities in their households. Considering the previous studies' results, the improvements could continuously bring impacts to the livelihoods of inhabitants along the roads, including who would not recognize any benefit right after the improvement, and even those living beyond the roadside (Khandker & Koolwal, 2011).

While employing a completed rural road improvement project in Vietnam, Mu and van de Walle (2011) carried out an impact evaluation study utilizing the datasets of 1997 (baseline prior to the

concerned project), 2001 (at the project's completion), and 2003 (the follow-up to the project) in the project areas and the non-project areas. Further, they conducted detailed field surveys to observe individual livelihoods and regional socio-economic landscapes. Their quantitative and qualitative examination confirmed that the number of the population engaged in trade and service sectors increased in the project areas more than in the non-project areas and such increases were significant with the 2003 dataset with appearance of hairdressing and tailoring shops and restaurants along the improved roads. The 2003 dataset also indicated the continuous increase of enrollment in primary schools in the project areas than in the non-project areas, which, of the adults surveyed, had the same literacy rates. The increases were significant between the 2001 dataset and the 2003, compared to between the 1997 dataset and the 2001. Those evidences indicated that effects of rural road improvements would continue over the years with changing their forms, reminding of the need for continuous observation after the project completion, as most impacts related to economic improvements to the local population appeared only after 27 months on average in the areas of the project's influences. Similar observations were made in Nicaragua by Rand (2011), who found that farmers with farmlands were able to benefit and improve productivities in their economic activities soon after the project completion. To accommodate new business partners' requests, those farmers needed more manpower and increased the employment of daily contracted labors working on their farmlands, which could benefit poor people, particularly those without their own farmland. Further, the farmers were observed to have started new non-farm business in parallel to farming activities and gained additional income sources.

Findings from the above two studies indicate that rural road improvements would continuously generate benefits to the local population with various economic capacities and social backgrounds over years, and we should be aware of lags among them on timings when they recognize receipt of benefits in their livelihoods. The portion of the population poorly endowed in terms of economic capacities and human capitals, including education attainments, could benefit only after the better resourced population changed their economic activities and led the transformation of local economic structures along/adjacent to the improved roads. This reminds us of two things: a possibility that impacts identified in Chapters 5–8 would be continuously transformed and hopefully expanded to poorly endowed people, and a need for continuous observation in the study areas.

Further, if looking at long-term impacts of rural road improvements, particularly on local economic structure, regional economic progress and locational advantages could be a determinant considering the statistical significances of the variable "poverty rate of commune" employed in some model estimations in the previous chapters. For instance, rice farmers and shops in Area TK who were interviewed in the follow-up survey said that they had benefited from increases in their trading volumes with new road users working in businesses in the border areas of Vietnam or in markets in Phnom Penh, about a one-hour drive from the start/end points of Road TK. It was further found that those interviewees became aware of the rise in competition in their economic environments after the roads were improved. Such situations were not reported in the other two areas of Areas BB and KC, which were poorer than Area TK. Possible reasons were that most of their local population still relied on the primary sector of

rice or vegetable farming and that their major business partners came mainly from the roadside areas or the provincial capitals, about 20 km from the start point of Road KC and about 60 km from the end point of Road BB, respectively, limiting the increase in trade volumes.

9.4 Conclusions

The chapter examined the overall impact distribution of the case project employed in the research, based on the discussions in Chapters 5–8, and revealed that rural road improvements benefitted the local population endowed with economic and/or human capitals more than the less endowed. Within one or two years after civil works were completed, those original endowments would have determined the degree of changes which individuals or their households experienced. However, due to the natures of roads, types of impacts recognized by local populations would be transformed over years, which were empirically evidenced by the previous studies. Hence, there are some hopes that poorly endowed people would benefit later and, eventually, disparities in economic capacities among those would be closed.

Disparities in individual receipts of benefits from the rural road improvement could be underlain by the assumption in formulating the project, as explained in a form of the differences between Figures 9-1 and 9-2, and unexpected impacts and their consequent situations to poor people as shown in Figure 9-3. Figure 9-4 indicates that individual accessibility to human capital/economic resources are essential for enabling people to get involved in the impact distribution network, and their accessibility to utilities satisfying basic needs related to their well-being should be taken into concern at the beginning of formulating rural roads projects. Hence, “accessibility” could be one key item to be considered in formulating rural roads projects in developing countries, particularly as items employed at selecting roads. Chapter 10 will examine further how those two could be incorporated in the formulation process of rural roads projects to enhance their pro-poor effects.

Chapter 10. Implications for Formulating Pro-Poor Rural Roads Projects

10.1 Reflections from Previous Chapters

This chapter is to present suggestions for future rural road improvement projects in developing countries, particularly of aiming at alleviating existing poverty in those projects' areas, with referring to results of the previous chapters.

Chapter 3 presented recent discourses related to the process of formulating rural roads projects and derived two primary issues influencing (or determining) effects of those projects on target populations' livelihood, of (i) lacking awareness to accessibility of prospective beneficiaries of those projects at selecting areas and/or roads for improvement works to be carried out; and (ii) little attention to those beneficiaries' economic activities and structure and uses of social services and those facilities. Then, based on the detailed examination of the case project in Chapters 5-8, Chapter 9 analyzed the gaps between the assumed impact distribution mechanisms at the project's formulation process and the confirmed at the above examination, and drew what could have been addressed at the stage of formulating the project, (i) socio-economic profiles of local individuals and (ii) local economic structure and their associated areas, in consideration with factors as critically influential to the project's impacts on local population's livelihoods.

By reflecting those discussions, Section 10.2 is to present implications to incorporate those two suggested items in the formulation process of rural road improvement projects in developing countries, particularly financed by international financial institutions (IFIs), and the expected results when applying the implications to the project case studied in the research. Section 10.3 discusses what IFIs could do for operationalizing those proposed measures.

10.2 Implications for Formulating Pro-Poor Rural Roads Projects

10.2.1 Implication Obtained from the Research

Here are possible approaches drawn from the above discussion:

- At the beginning stage, the project's stakeholders need to define "accessibility" that a planned rural roads project would be expected to improve for reducing existing poverty in its target areas. These stakeholders would include the project's recipient country's government, its local authorities, and concerned financiers such as IFIs.
- As criteria for selecting roads for planned interventions from among the list of candidate roads, include indicators related to accessibility, according to the above definition, in addition to conventional economic and socio-demographic indicators, such as population and poverty rates.
- Specify the utility location along the candidate roads to which the local population should be guaranteed accessibility for their survival. Conduct a detailed socioeconomic survey of this population on which utilities and how often they visit and/or need available services. In addition to economic assets, include the modal ownerships and income levels of the surveyed population.

- Select roads for intervention by employing the criteria related to the defined accessibility.

The above proposed approach could help to identify roads along which population suffered from poor accessibility to services required for maintaining their livelihoods, sometimes over generations, and contribute to the improvement of those populations' economic status and well-being as the availability of those services could be enhanced physically and non-physically.

10.2.2 Application of the Implications to the Case Project in Cambodia

The above was quite different from the approaches taken in the case project (detailed in Sub-Section 3.4.1). If having considered "accessibility" at the local contexts before selecting roads for rehabilitation works, the shortlist, e.g., the output of the road selection process, would be different.

Through the case study, it was learned that economic capacities, particularly rice fields, and education attainments of household members were determinants of receipts of benefits from the project and eventually of changes in individual accessibility to the three items needed for maintaining daily subsistence, education, health service and economic opportunities with others from outside the road.

For instance, Area TK (areas adjacent to Road TK) was populated and the most economically active. Hence, the public facilities were relatively well located compared to the other two areas, which is evidenced in Chapters 6-8 as the number of the facilities related to the above three was commonly the largest. If "accessibility" was defined at the beginning with incorporating rural people's immediate needs related to those three, the road would not have been considered at the road selection assuming that road conditions were impassable at the same level as the other candidate roads.

10.3 Expected Roles of the IFIs

Then, how could we implement the above suggested process on ground? As most of the projects have involved the participation of IFIs as financiers, often with providing technical suggestions, it is necessary to consider

As discussed in Chapter 3, IFIs would be aware of the two items at formulating new rural roads projects; (i) assurance of governance and project administrative capacities of the projects' recipient countries and (ii) economic viabilities for justifying the IFIs' investments. The two suggested in the above sub-section would not necessarily support those two, but probably contribute to the item (ii) at least with emphasizing effectiveness of investing in rural road improvements on poverty reduction in rural areas in developing countries. One possible approach could be that two types of roads generating low economic returns and high ones would be selected among candidate roads. Conventional approaches would prioritize roads with potentials of yielding high economic returns at computation. That might cause risks of unselecting roads in poor areas being used by people who can't afford to use motorized mode, which may remain those areas and people poor and left behind the development.

This implementation, however, is new in the current international development sector, particularly the area of rural development. Hence, the IFIs are expected to play a leading role to

implement the above by (i) publishing and disseminating guidance notes at the beginning of project formulation on the importance the defined accessibility in the respective local contexts; and (ii) fostering their staff's knowledge and skills to provide appropriate guidance to client countries who are willing to have rural roads projects implemented to alleviate poverty.

Moreover, as discussed in Chapter 9, impacts of rural road improvements could last over years with changing their forms following changes in their beneficiaries' situations. Results from long-term studies could influence directions of the target areas' socio-economic development. Therefore, IFIs would add a task of follow-up surveys as one of the project scope for the recipient countries, such as post-completion studies. Potential timings of the survey are one right after the civil works completion and another at an estimated five or ten years after the completion. Their timeframe should be discussed as well at formulating the project together with the milestone indicators for chronological change over years. The results could be accumulated as knowledge and showcased in the above (i) and (ii). Such comprehensive IFI's initiatives could promote dialogues among the governmental agencies relating local population's needs for subsistence in rural areas in developing countries.

Lastly, like the DFID-led ReCAP, we may consider instituting a multilateral platform, probably a financial pool among the IFIs, to provide financial and technical assistance with consolidating knowledge and experiences for further investments in rural roads projects across the world. In the comparative analysis of the above five projects, their approaches are found to be quite different, which could be not only because of the local socio-economic conditions but also because of institutional policies and knowledge of developing countries' governments and the IFIs, as financiers of rural roads projects, related to the rural roads sector.

Chapter 11. Conclusions

11.1 Introduction

This research aimed at analyzing the impact of a rural roads project on potential beneficiaries' livelihoods utilizing the obtained results and drawing essentials of designing pro-poor rural roads projects in developing countries. To achieve these aims, the research examined two factors: (i) approaches taken to formulate rural roads improvement projects financed by international financial institutes (IFIs); and (ii) mechanisms to generate and distribute the impacts of a completed rural roads improvement project on local people's livelihoods and local economic structures. These examinations identified an essential requirement to account for "accessibility" in formulating rural roads projects in developing countries, based on the overall goal of reducing existing poverty by improving accessibility to resources required for subsistence. This chapter contains individual summaries for these examinations and presents future studies to elaborate on the research.

11.2 Major Outputs of the Research

11.2.1 Approaches to Formulating IFI-financed Rural Road Improvement Projects

The research reviewed theoretical approaches related to rural road improvement projects and practices from five selected projects financed by three IFIs: the Asian Development Bank; the World Bank; and the Department of International Development, United Kingdom.

The comparative review identified common and differing factors as related to the projects' formulation processes. There were two common, major themes among the five projects. The first was their immediate objective to improve people's access and eventually contribute to poverty reduction. The second was the several areas and roads that were selected for rehabilitation within the designed budgets and timeframe. The projects employed a set of criteria for selecting areas and roads for intervention. For selecting areas, four criteria were found to be essential: (i) consistencies with IFIs' aid strategies and the recipient country's development priorities; (ii) administrative capacities of the countries and target areas to execute project implementation activities; (iii) geographic distribution; (iv) poverty rates and population (or population densities). Of these criteria, (i) was addressed across the five, while (ii), (iii) and (iv) were subject to the projects' aims and local contexts. To select the roads, the criteria were more diverse and could be categorized into the two based on whether the criteria directly relate to poverty and individual accessibility. Items directly related were population densities, location of public service facilities, and local people's views shared at preparatory meetings in the localities. Other items were related to connectivity to trunk road networks, and intervention viabilities or justification, such as economic returns, safeguards, or technical requirements.

This review revealed that, despite the projects' objective to improve individual accessibility to reduce existing poverty in rural areas, criteria related to "accessibility" and "poverty" were not always incorporated in IFI-financed rural roads projects. This implies a possibility that benefits from the

projects' interventions would not have been disseminated to poor people and that these people would continuously suffer from inadequate physical accessibility to social and economic opportunities.

11.2.2 Mechanisms for Generating and Distributing Impacts of a Completed Rural Road Improvement Project

To employ a completed project to improve rural roads in selected high poverty areas in Cambodia, a mechanism to generate and distribute impacts from the project was clarified to reflect the voices of the project's potential beneficiaries on the three factors: (i) mobility; (ii) economic-related factors; and (iii) accessibility to social services essential for people's daily lives. This clarification was made based on a dataset compiled approximately one year after the rural roads were rehabilitated.

The research confirmed that mobility was enhanced for the local population along the improved roads regardless of income levels. Meanwhile, improvements to economic activities and accessibilities to public utilities such as basic education/schools and health service facilities were determined by income levels and economic capacities at household (HH) levels. Benefits were attributed to the following four features in the study areas (not necessarily all, but a mix): influxes of people from outside the roadsides; income levels and economic capacities at HH levels; fulfillments of basic needs to maintain individual well-being, such as education and health; and ownership of travel modes, particularly motorcycles in the project's local contexts. The following people did not benefit: those who did not own rice fields for the purpose of generating income; those not engaged in stable income generation activities; and/or those who never attended/did not complete basic education programs.

Differences in the project's benefits receipts might have been caused by factors not addressed when formulating the project. Some requirements would be needed to receive benefits, which were not equipped to poor people. One of the critical requirements was accessibility to local resources to manage their livelihoods in their local contexts. Further, there would be time gaps in the receipts among individuals based on the level at which those requirements were satisfied.

11.2.3 Implications for Formulating Pro-Poor Rural Roads Projects

Based on the above findings, the research draws the following implications to be considered at the formulation stage for IFI-financed rural roads projects in developing countries. IFIs have their own institutional mandates and requirements to determine their decisions on whether to provide loans or grants to those countries. However, these requirements might not always fit with the expected roles of rural roads. Such gaps were also considered in the proposal. Further, focus was placed on the process for selecting roads for rehabilitation under projects, as it was learned that individual accessibility to utilities to satisfy basic needs for daily subsistence in the given contexts was often overlooked, even though the projects' ultimate goal is to reduce poverty by improving the accessibility. Here is the summary of the implications drawn from the above discussion:

- At the beginning stage, the project's stakeholders need to define the accessibility that a planned

rural roads project would be expected to improve to reduce existing poverty in its target areas. These stakeholders would include the project's recipient country's government, its local authorities, and concerned financiers such as IFIs.

- As criteria for selecting roads for planned interventions from among the list of candidate roads which would be improved by the government, include indicators related to accessibility, according to the above definition, along with conventional economic and socio-demographic indicators, such as population and poverty rates.
- Specify the utility location along the candidate roads to which the local population should be guaranteed accessibility for their survival. Conduct a detailed socioeconomic survey of this population on which utilities and how much/often they visit them and/or need available services. In addition to economic assets, include the modal ownerships and income levels of the surveyed population.
- Select roads for intervention by scoring candidate roads on the criteria related to the defined accessibility and prioritizing.

The above proposed approach could help to identify roads along which populations have suffered, sometimes for generations, from poor accessibility to services required to maintain their subsistence. This approach could contribute to improving those populations' well-being by enhancing the availability of those services.

However, this implementation is new to the current rural transportation sector in developing countries. Hence, the IFIs are expected to play a leading role in implementing the above process by (i) publishing and disseminating guidance notes at the beginning of project formulation on the importance the defined accessibility in the respective local contexts; (ii) fostering their staff's knowledge and skills to provide appropriate guidance to client countries who are willing to have rural roads projects implemented to alleviate poverty; and (iii) including post-completion studies, such as one right after the civil works completion and another at an estimated five or ten years after the completion, to understand how people's accessibility has transformed and to confirm whether there have been improvements to one of the groups that had suffered from poor accessibility prior to the project. From the wider viewpoints, IFIs are expected to play a role of fostering dialogues among the governmental agencies relating local population's needs for subsistence.

11.3 Future Researches

This research has several items that require further studies. The first is follow-up observations to the revealed impacts of the Cambodian case project. As discussed in Chapter 9, the impact distribution mechanism could be transformed over years as per previous findings. We could expect that more local populations along the rehabilitated road would benefit in different forms from what was observed in the research. Such long-term observations could provide evidence-based knowledge on how a rural roads project could transform regions in question in the long term. This knowledge would contribute to the

formulation of development policies and strategies for projects' recipient countries and concerned local administrations. It could also contribute to developing short-/long-term IFI aid policies to the countries for sectors and areas for intervention. Related to this, it could be also worth to investigate contributions of the rural road improvement to the other infrastructure's development. This is because the author was informed during the follow-up survey that the coverage of infrastructure of electricity and mobile phone had been expanding as civil works for those expansions were well progressed after the road conditions were smoothened.

The second item is on potential influences of the rural road improvements on decision-making processes within an HH. The case study revealed that the improvements made some of local HHs decide to allocate their economic resources for purchasing new travel mode(s) as they wanted to help their child(ren) to go to school continuously or ease their HH members' daily travel. Further, during the follow-up survey, it was found that their decision-making processes were influenced by their neighbors' behaviors because they could meet with the neighbors more often. Those imply a possibility that the improvements could transform relationships among the HH members and societal structures of their communities along the rehabilitated roads. It could be worth to study how a rural roads project would influence and transform the decision-making processes and relations within a HH and a roadside community.

The third item is how to integrate local populations in the proposed process. Recently, IFIs have revisited the importance of investing in and implementing a "community-driven development" approach, which involves grassroot populations at the beginning of project formulations. The concept is that local communities should involve their populations, particularly ones in poor or vulnerable conditions, in the decision-making process with regard to the development directions, including resource allocation and external input from IFIs. This is based on findings that poor people remain voiceless in their societies and are left behind in economic development streams (Wong, 2012; World Bank, 2017e). Further, the Rural Access Programme, which continues to execute the Integrated Rural Accessibility Planning, is now in the third phase (Government of Nepal & UK Aid, 2017). It could be valuable to examine how such recent movements in international development could be integrated in the proposed process.

The fourth item is related to the selection of areas for intervention. As presented in Chapter 3, procedures to select the areas are critical to determine results of rural roads projects on the livelihoods of their prospective beneficiaries. The procedures are influenced by institutional and political factors with respect given to the strategies and policies of IFIs and projects' recipient countries as the common criteria for the five reviewed projects. Considerations for selecting project areas would be essential, as the area selection often comes earlier than the road selection, the latter of which is this research's focus.

The fifth item is a pilot implementation of the formulation process proposed in the research and its follow-up studies from completion or beyond to confirm performance, particularly on its pro-poorness. As presented above, the process requires a variety of information and data prior to the formulation process to examine existing individual accessibility in the local populations along candidate

roads for intervention. This would require strengthening (or building from scratch if needed) the project's administration agency's technical and operational capacities, either at a national or a regional level, and developing horizontal partnerships between the agency and other sectoral agencies related to basic human needs, such as education and health. This could be in line with the second, transformation (or complication) of decision-making process and relational structures of HHs and their society which were observed after the road improvements.

Lastly, it could be suggested to examine whether a rural roads project should be a standalone investment or could be one component of a regional development investment comprised of developing several physical infrastructure or non-physical programs, like technical training in locally primary sectors, to enhance economic productivities at individual and local levels. This could also relate to entrepreneurships emerged only after the rural roads were improved, which could be fostered more strategically if horizontal approaches among the relevant sectoral ministries and agencies evolved.

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APPENDICES

Appendix 1. Interview Note on January 11-19, 2017 and January 9, 2018

1. January 11, 2017 (11:00-11:45)

Approaches of Community-Driven Development Taken in Rural Roads Projects in Developing Countries, Financed by the World Bank

- At appraising projects in any sector, it is required to comply with Operational Policies No. 4.10 (Indigenous Peoples) and No. 4.12 (Involuntary Resettlement) to ensure that any safeguard-related issue is cleared prior to implementation. In addition, it is required to conduct gender assessment and, if applicable, include gender-specific component(s) in a project. For an example, gender-related components have been included in urban transportation projects in the Latin America.
- The World Bank (the Bank) has been promoting "citizen engagement" at implementing its financed projects, which is expected to enhance the involvement of local population in the project implementation process.
- There is a document discussing gender aspects in rural roads projects, published by the World Bank.
  - Roads to Agency: Effects of enhancing Women's Participation in Rural Roads Projects on Women's Agency – A Comparative Assessment of rural Transport Projects in Argentina, Nicaragua, and Peru (2015)
- To materialize (immediate) needs of population in target areas, an approach of community-driven development (CDD) has been employed. The Bank invests approximately 2 billion US dollars per year in CDD projects. When being identified as a need of beneficiaries of CDD projects, roads are selected a one of those projects' component for implementation. The Bank maintains a database of CDD projects in its website.
  - In a CDD project in Philippines (Philippines National Community Driven Development Program), to capture local population's needs, community mobilizers have been trained and engaged to help the population to identify their needs through consultation and formulate into projects. Communities get "block grants" that they manage and decide on what to invest in. This process can take place every year or two years.
- The Bank has published several documents discussing the CDD approaches as below:
  - Operations and Maintenance of Rural Infrastructure in Community-Driven Development and Community-Based Projects: Lessons Learned and Case Studies of Good Practice (2015)
  - What Have Been the Impacts of World Bank Community-Driven Development Programs? CDD Impact Evaluation Review and Operational & Maintenance Implications (2012)
  - Participatory and Community-Driven Development in Urban Areas (2015)

2. January 11, 2017 (14:00-15:00)

Second Rural Access and Mobility Project (RAMP-2) in Nigeria (Financed by the World Bank)

- In Nigeria, about a half of the population lives is urban and the rest is rural. In rural areas, most of local population are engaged in small-scaled subsistence farming. Roads in those area are trails

and not always passable, rather impassable during rainy season.

- Roads for rehabilitation under the projects were selected through multi-criteria analysis, and the three criteria were employed including (i) social impacts (population served and connection to hospitals and schools), (ii) economic efficiency (road investment costs, travel revenues generated and connection to major markets), and (iii) accessibility and mobility (connection to a main road and all-weather road connection). Each criterion is given a weight value respectively to score for prioritization. The analysis is expected to avoid political influences or preferences.
- At selecting, the following three steps were taken: (i) submission by the target four states' government of longlists of roads needing rehabilitation; (ii) shortlisting roads through multi-criteria analysis; and (iii) finalizing the list of roads for rehabilitation by conducting the road economic decision model. The overall procedure took about six months. After the step (iii), the government conducted detailed designs works.
- Prior to the step (i), the feasibility study was conducted by a consultant team. In the study, districts in the target states provided a list of roads needing rehabilitation and the consultant team surveyed those listed roads and their associated information, including demographics, agricultural productivities, influential areas, possible engineering design, and cost estimation, and developed an inventory, which was the basis of the abovementioned longlists. Needed costs for those preparatory works were financed in advance from the approved project loan.
- At appraisal, economic viability analysis, safeguards assessments and gender analysis were conducted in line with the World Bank's requirements, but poverty/social assessment was not. The economic viability analysis relies on the poverty/social assessment carried out as part of the multi-criteria analysis. At the multi-criteria analysis, poverty rates were considered.
- At the mid-term review in October 2012, positive impacts were acknowledged, including (i) increases in agricultural products' prices; (ii) rises of land prices along the roads rehabilitated under the project; and (iii) reduction in travel costs. Further, the improvement of roads is expected to enhance rural farmers' productivity.

3. January 12, 2017 (10:00-11:00)

New Rural Access Index (RAI)

- The rural access index (RAI) was originally invented in 2005/2006 and was redefined in 2016 in line with the Sustainable Development Goal (SDG) 9.1. The original RAI was computed by utilizing the data collected through household surveys and involved difficulties in terms of accuracy and regional biases, as it was not practical to implement such surveys everywhere in developing countries and regression modelling was needed to adjust in some places. Further it was questioned on how those methods could provide reasonable values of people's accessibility, e.g., number of population regularly accessible to an all-weather road or distance/travel time of those population to the road.

- The new RAI (hereinafter called "the index") is computable with using the existing inventories and satellite images, some of which have been maintained and/or updated with financial supports from the Department for International Development, United Kingdom (DFID) in a part of its Research for Community Access Partnership (ReCAP). Those inventory systems have become regularly updatable.
- The index has been utilized manly in the eastern part of the African countries. For an instance, the World Bank (the Bank) is preparing a rural roads project in Zambia to rehabilitate roads, totaling 1,500 km, in 10 districts in the selected six provinces and employs the index as one of the criteria to help the recipient country's government to select and prioritize roads for rehabilitation. The other criteria are poverty rate, agricultural productivities and growth rate of agricultural industries. Scores of shortlisted roads are computed by multiplying values of those respective criteria by their assigned weights. The computation was designed to identify and select areas with lower values of the index, as poverty rates may be correlated to people's accessibility.
- In the other countries in the region and its surrounding (Ethiopia, Ghana, Liberia, Madagascar, Malawi, Mozambique, and Rwanda were mentioned in the meeting), the index has been utilized widely to measure the progress of the development of rural roads networks. Collecting the related data and providing the assistance to develop the inventory have been helped as a part of the Bank-financed projects or using its trust funds, as long as the country's initiatives exist. However, there is uncertainty on how much the idea of using the index could be expanded for use to the other areas because of a number of reasons, including (i) ReCAP remains limited only to the eight countries (6 in the eastern Africa and 2 in the south Asia), (ii) present inventory systems of roads networks does not exist or are not usable in the other countries, (iii) there are some countries who may not be interested in to operationalize in their system, among others.

4. January 12, 2017 (13:00-14:00)

Second Rural Transport Improvement Project (Component A: Accessibility Improvement) (Financed by the World Bank)

- The project covered 26 districts and was to rehabilitate national and rural roads in those districts.
- Criteria employed at selecting roads for rehabilitation under the project were described in Annex 7 of the project's appraisal document. In principal, the selection was led jointly by the government's executing agency (Local Government Engineering Department) and the World Bank's project team. In the selection process, local population were not involved directly though being invited to public consultation, as part of safeguards tasks.
- At the selection process, the executing agency was responsible for disseminating the information related to the project through media, including newspapers, and providing the inventory list of roads existing in the target districts for prioritization.
- At first, the long list was prepared, which was the basis of the shortlists, totaling 5,000 km, and

eventually reduced to 3,550 km. The shortlisting work involved (i) inspecting all listed roads to ensure whether each road satisfies with the specification (length and width) and threshold of daily traffic volumes, (ii) estimating the cost per road, and (iii) computing the economic internal rate of return per road. The shortlisting took 2-3 months, and the prioritization task followed.

- The prioritization was conducted at project appraisal stage only for the first year, and the employed criteria were population possibly served, poverty rate (rate of population in extreme poverty as identified by the district) and needs for immediate maintenance works. The prioritization task was conducted by each district respectively, as a district was given with its indicative length to be rehabilitated and the length was varied among the districts, and the overall work took averagely one month. After the selection was ended, safeguards assessments works were conducted in accordance with the World Bank's requirements (O.P 4.01, 4.04, 4.10, 4.11, and 4.12), but any poverty and social assessment was not conducted.

5. January 13, 2017 (08:00-08:45)

Operation of Rural Roads Development of the Department for International Development, United Kingdom (DFID)

- The headquarter in London plays an umbrella role of making its institutional policies and strategies and providing necessary supports and guidance to the country offices on their operation, while DFID's country offices in its client countries are responsible for formulating and implementing projects. Those country offices generally lead the preparation of business cases jointly with the client countries' government agency(ies) for the Minister's approval to finance.
- DFID has traditionally supported rural and low volume road programs. More recently DFID has been expanded its remit to providing more financial supports to urban transportation and regional corridor projects than rural roads projects, partly because of (1) increasing demands to those high-volume transportation facilities and (2) difficulties to measure quantitatively benefits of financing rural roads as their traffic volumes are generally low. However, it sometimes attaches a component of constructing/rehabilitating feeder roads to a regional corridor project if potential roads are identified in areas adjacent to the corridor to be mainly invested or to a comprehensive rural development project as one of relevant rural infrastructure. It would be worth to take a look at those projects' business cases and relevant project documents if cofinanced with other donor agencies.
- DFID works in low income countries and areas that are fragile and conflict affected. In these circumstances, conventional cost benefit approaches would be supplemented with deeper analysis of social, livelihood and other criteria.

6. January 14, 2017 (14:10-15:00)

Recent Trends on the Rural Transportation Sector in Developing Countries

- Rural roads development is expected to contribute to economic growth or poverty reduction, sometimes both. If a road is selected for improvement on its connectivity to trunk roads like national or provincial roads, that will become a driver to economic growth in the area as it boosts traffic and movements inside/outside the connected roads.
- There is a common tendency observed as a result of rural roads development in the world: increases in the number of motorcycles owned after the intervention. Major reasons are (i) reasonable prices to purchase and flexibilities to be given to users, compared to other motorized modes; and (ii) physical and technical toughness/robustness and speeds, compared to bicycles and walks. Such unique natures of motorcycles allow people to change their travel and economic behaviors, including starting new business, such as motor taxi and mobile shops, and make themselves accessible to social services, which may improve those people's quality of life and be a driver to both of economic growth and poverty reduction in their areas.
- However, one of the critical recent movements is for the government in developing countries to apply the enforcement of laws/regulations against the use of motorcycles to rural areas as well as in urban areas (ex. Myanmar). Such enforcements often involve additional financial resources to mobilize governmental officers in the areas to regulate local population and impose unnecessarily expensive fines to local populations when violated, which may discourage people's use of motorcycles for their daily life and reduce their opportunities for socio-economic activities and mobility. Hence, the enforcements have been criticized and warned. Considering socio-economic natures of rural areas in developing countries, flexibilities should be assured for achieving economic growth and poverty reduction.
- The rural access index (RAI), recently refined in line with the SDG 9.1, is an index measuring people's accessibility to all-weather roads by indicating the proportion of people living within 2-km distance from an existing all-weather road (percentage against the total number of people in the concerned area). The RAI will help to know where poor people reside as poverty and isolations (remoteness) are relevant. However, an issue exists that roads unclassified and/or unlisted on governments' inventories are overlooked at the assessment.
- Rural roads development needs involvements of other associated factors, like transport service, road safety or maintenance, for enhancing usability of those roads in local people's life.
- There have been several ongoing rural roads project in Nepal, and their main financiers are the Asian Development Bank, the Department for International Development, United Kingdom, and the Swiss Agency for Development and Cooperation. Some of the projects have involved labor-based approaches, and their impacts have been closely monitored. Their works could be worth to be examined.

7. January 17, 2017 (12:30-15:00)

Operation of Rural Road Improvement Projects in Developing Countries

- Rural roads should be considered as part of existing road networks, instead of a standalone road. The concept, as its basis, is described in the Overseas Road Note No. 5 (Management of rural roads networks).
- Maintenance works are the continuation to civil works (construction or rehabilitation). To conduct maintenance works properly, the ownership of each road needs to be well identified before civil works. Without identification, maintenance works are hard to be guaranteed.
- The Universal Rural Road Accessibility Program in Ethiopia is a self-financed program to improve conditions of roads at the Wereda and Kabele levels. Some of roads covered in the program were outside the road networks but were counted during the program as part of the networks. At the beginning, roads at the abovementioned two administrative levels were studied on their length, conditions, whether to be passable all year round, major modes used and so on, and inventoried.
- Maintenance works of roads are hard to be conducted only on local populations' initiatives, as they are used by a variety of people either inside or outside their adjacent areas after their improvement. Further, maintenance works involve always expenses at any level, which cannot be simply owned to local residents. To reflect such lessons, cash transfer and food transfer programs have been attached to road maintenance works in Ethiopia, with support from the United Nations Development Programme, which ensures local population to be paid and maintenance works to be sustainably carried out under the local administration's responsibility (reference: ipc-undp.org). Another approach taken in the Latin America was to employ existing local groups, including microenterprises and groups for other social purposes, to carrying out regular maintenance works. From these experiences, maintenance works could be considered an opportunity to generate incomes for people residing along and using the roads.
- In the Rural Access Programme (RAPs) in Nepal being financed by the Department for International Development, United Kingdom, civil works have been carried out by local population particularly in socially vulnerable and economically poor situations. Further, in its first phase, about 10-15% of the project cost was allocated to the wealth creation activities, designed for generating income opportunities for those populations through road improvement. In the RAPs, with initiatives of village development committees (VDCs), road building groups (RBGs) are formed and assigned to carry out civil works.
- The first phase of the RAP started in 1999 and was designed to contribute to enhancing rural areas' economic growth and reducing their poverty through rural roads' rehabilitation, which reflected the DFID's newly defined institutional mandate of reducing poverty in its client countries. In the phase, district accessibility plans and transport management plans were formed at the beginning in the six target districts with help of the Department of Local Infrastructure Development and Agricultural Roads, and those plans were used as the basis for selecting roads for improvement under the projects. The districts were selected in the three typed areas of flood-prone, hilly and

mountainous. Road rehabilitated under the RAPs were selected on various criteria, described for the first phase in the Project Completion Report in 2008 (draft final version's electric file was shared at the meeting for further review).

8. January 18, 2017 (10:00-11:10)

Overview of the Research for Community Access Partnership (ReCAP)

- The Research for Community Access Partnership (ReCAP) is a program (2014–2020) on rural roads in the countries selected in the Africa and Asia, and its major coverages are transport services, road safety and engineering aspects (surface, cost-effectiveness, mechanics of civil works, and designs). The ReCAP is solely financed by the Department for International Development, United Kingdom (DFID) as a succeeding program of the DFID's Knowledge and Research Activities.
- The ReCAP is also expected to play several roles, one of which is for helping developing countries make policies and strengthen their capacities to conduct research activities related to their rural transport sector, and another is a platform for networking among practitioners working in rural roads development. A part of outputs from the ReCAP has been utilized as training materials of annual senior executives' courses in the University of Birmingham for governmental officers working in transport sector in developing countries. Manuals of road designs and other research outputs produced under the ReCAP are also disseminated through its website.
- The program's progress was reviewed and the Way Forward 2017-2020 (WF 17-20) Strategy was formed in 2017. The strategy's targets were the three: "provision of rural access," "preservation of rural access," and "effective use of rural access (or transportation services)," which would be supported by the four thematic topics: "capacity development," "knowledge management," "gender," and "inclusion."

Experiences involved in rural roads interventions

- There is an observation where three years are averagely needed for beneficiaries of rural roads projects to make any change in travel and economic behaviors, because they would ensure whether their improved roads' conditions are sustained for their daily use prior to committing to allocate their limited resources to something new and different.
- Poverty is closely correlated to physical isolation, and rural roads intervention (construction, reconstruction and maintenance) is one of measures to improve people's accessibility and reduce isolated areas. If applying "labor-based approaches" at civil works, the intervention could provide opportunities to generate incomes for people around the interventions' target areas.
- At selecting roads for improvement in interventions, the multi-criteria analysis method is proposed to be employed. Criteria used are various and subject to given contexts, but population (density), agricultural productivities and food production amount are primarily considered. At computing economic benefits of the interventions, Highway Development and Management VI (HDM-4),

used for economic benefit analysis for high-volume roads like highways, cannot be used without any adjustment due to the rural roads' uniqueness like low volume and unquantifiable social benefits.

- Sharing information with grass-root population at the beginning of the intervention is a key to make the interventions a driver for reducing existing poverty, otherwise generated economic benefits will be taken predominantly by some specific groups and won't be trickled down to poor or isolated population. Public consultation is a possible measure, as possible beneficiaries are allowed to know correctly and timely benefits which they could enjoy through the upcoming intervention. Such participatory approaches are often taken in projects financed by bilateral development agencies like the Danish International Cooperation Agency, the Japan International Cooperation Agency and the Swedish International Cooperation Agency
- The International Fund for Agricultural Development is also active to implement rural roads projects. In their projects, local population's voices have been well incorporated at selecting roads for construction/rehabilitation. In their participatory workshops for the selection task, "pairwise ranking" methods are often used for participants to prioritize their roads. Their projects in the African countries, particularly Kenya, are worth studying further.
- At designing the intervention, it is recommendable to include non-physical components, related to farming, processing and/or other part of farm products' value chain systems, because most of population in rural areas are engaged in subsistence farming. Such relevant inputs are able to enhance their agricultural productivities and better their accessibility to markets and cash. To optimize such opportunities, necessary information should be also disseminated appropriately in terms of timing and contents and local situations (traffic volumes, socio-economic activities, and local decision-making systems) should be carefully assessed.

9. January 19, 2017 (15:10-15:30)

Overview of the Research for Community Access Partnership (ReCAP)

- The Research for Community Access Partnership (ReCAP) is an extensive research program on low volume roads development in 12 African and 5 Asian countries, and its total amount is over GBP 26 million for over 15 years. The ReCAP aims to provide implications to those countries at making policies and development programmes on rural transport sector. Prior to the ReCAP, the Department for International Development, United Kingdom (DFID) financed GBP 4 million to the 6-year Africa Community Access Programme (AFCAP) for the seven African countries. The AFCAP researched primarily engineering and design standards and their manuals, and the ReCAP continues to retain those as its themes and newly includes the one related to rural transport services.
- Under the ReCAP, the DFID has been helping the target countries to develop a platform of data related to rural roads networks for monitoring. In the database, satellite images are included, as that will enable to visualize network densities and help to allocate financial resources appropriately

for further development. Those countries lacked such databases and were not able to monitor and track their roads networks' conditions. The DFID expects the platform development to enhance the efficiency and transparencies of such monitoring works and to make the countries' road asset management systems robust. Eventually, the platform is planned to get cloud-sourced and more accessible and enable those countries to share relevant information more closely and timely.

- One indicator employed in the database for monitoring the road networks' development is the rural access index (RAI). The RAI was originally developed in 2005 and refined jointly with the World Bank in 2016 in line with the Sustainable Development Goal 9.1.
- The DFID actively finances rural roads development projects, out of which are often co-financed with multilateral banks like the African Development Bank, the Asian Development Bank and the World Bank, and plans to continue the investment at the same levels as the present. Some of those projects are designed with reflecting outputs of the ReCAP. It has also provided Nepal with the grant finances under a comprehensive rural roads development program, the Rural Access Programme (RAP). The programme, lasting for more than ten years, aims to link isolated areas to economic centres and includes non-physical components related to job creation and female's involvement for local socio-economic development.

10. January 9, 2018 (16:00-17:00)

Rural Access and Mobility Project-Kaduna (RAMP-1) and Second Rural Access and Mobility Project (RAMP-2) in Nigeria

- Selection criteria employed in the RAMP-1:
  - Community preference was local people's views and needs identified at the state-level workshops at the project's preparation stage. The preference would be respected the most to respond to their immediate needs.
  - The Kaduna State was selected because of the two reasons. The first was that the state adopted the public procurement law, which assured that the state government comply with the World Bank's procurement policies and would guarantee the transparency during implementation. Another was that the state completed necessary preparatory studies for the project with the help from the World Bank in a form of project advance. The other states were considered in the RAMP-2, and the process of prioritizing and selecting roads for rehabilitation was principally same as the one taken in the RAMP-1.
- Prioritization/Selection of roads for rehabilitation under RAMP-1 and RAMP-2
  - Prioritization/Selection would exclude some roads from the list of roads for rehabilitation under the two, some of which could be located along localities of poor people. Such roads are expected to be taken into account in following projects.
  - The basic assumption of the two projects is that physical isolations from service facilities needed for people's life are one of major causes for poverty and improving accessibility to

those facilities could contribute to reducing existing poverty.

- 3. Results of RAMP-1 and RAMP-2
  - Remarkable impacts were found in agricultural markets around the improved roads, e.g., reduction of time and costs for transporting farm products to markets and improvement of those products' prices.
  - The aide-memoire for mid-term review of RAMP-2 was provided, which explained the above finding.

Appendix 2. Field Note of a Study on February 24 – March 6, 2016

This is to report major findings during the visit (February 24 - March 6, 2016) to the three sites of the project, Rural Roads Improvement Project (Loan 2670-CAM), a project financed by the Government of Cambodia and the Asian Development Bank. Notes summarizing meetings and interviews with relevant project stakeholders, collected demographic information each commune, and photos taken during the visit are attached in Attachments 1, 2 and 3 respectively.

A. Backgrounds of the Field Trip

This field trip was planned as a part of the research, aiming at (i) clarifying how transport infrastructure projects contribute to poverty reduction in developing countries and (ii) proposing methodologies of designing pro-poor transport infrastructure projects. The aim (i) is to address one of the critical issues in recent development contexts, as project impacts' distributional mechanism(s) have been considered as a black box, and been recognized necessary to identify for enhancing investment effects of reducing poverty in developing countries. The aim (ii) is to respond another need of identifying how social benefits could be captured and quantified at appraising new projects, as such benefits are not well considered in conventional economic analysis or cost-benefit analysis methods. For the research, rural roads projects were selected as its objective, because about 70% of poor population live in rural areas in developing countries and the research is expected to make impacts on their livelihoods with design methodologies to be proposed.

¥¥To achieve these aims, the research comprises the two major components of (i) analysis of changes in livelihoods of beneficiaries of a transport infrastructure project through comprehensive beneficiary interview surveys and (ii) examination of previous social benefit analysis for transport infrastructure projects. This field study is a part of the component (i) to interview with representatives of the communes along the project roads on their findings or observations of changes in their local populations' livelihoods after the road improvement. Another comprising the component (i) is the beneficiary interview surveys, designed to comprehend how their livelihoods were changed from the beginning of the projects toward the post-completion

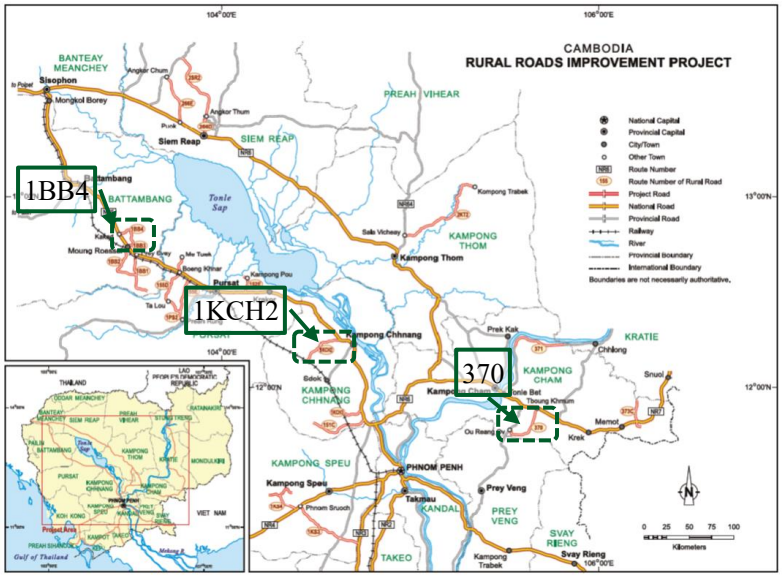


Figure Site visited

(Source: Report and Recommendation of the President to the Board of Directors of Proposed Loan to the Kingdom of Cambodia: Rural Roads Improvement Project, ADB, 2010))

stage with placing the focus on economic activities, employment conditions and social networks. The surveys were conducted in parallel to this field study. With the analysis results of the collected survey data, the component (ii) will commence later this year.

As a case study to the research, the Rural Roads Improvement Project in Cambodia (the project) was selected, because of the following reasons. Firstly, the timing of the project's completion was very fit to the research as all the civil works were completed in April 2015, about one year ago. We may be able to capture how people have observed changes around their livelihoods before and after the project. The second is a possibility of regional comparative analysis as the project's coverage of several areas with varied socio-economic and natural conditions. That uniqueness in the project's design is expected to enable us to comprehend how such uncontrollable factors would affect the abovementioned mechanisms.

B. Purposes of the Field Trip

- Visit the project sites selected for the research;
- Understand the sites' demographic and socio-economic situations; and
- Provide necessary supports to the beneficiary interview survey team.

C. Schedule

The field trip was conducted following the schedule shown below.

Date	Items
February 24, 2016	・ Arrival at Phnom Penh from Tokyo
February 25, 2016	・ Meeting with the detailed design and implementation/supervision consultant for Loan 2697-CAM and the government's official. ・ Kick-off workshop to the survey team
February 26, 2016	・ Visit to the site of Road 1KCH2 (in Kampong Chhnang Province) and Road 1BB4 (in Battambang Province) ・ Interview with the chef and council members of Pongro, Krang Skear, and Banteay Preal Communes
February 27, 2016	・ Visit to the site of Road 1KCH2 ・ Meeting with the enumerators, and participation in their beneficiary interview surveys (the surveys)
February 28, 2016	・ Visit to the site of Road 1BB4 ・ Meeting with the enumerators ・ Interview with the chef and council members of Chrey Commune
February 29, 2016	・ Interview with the chef and council members of Kear, Ta Loas and Kakoh Communes
March 1, 2016	・ Move to Kampong Cham ・ Field visit to the site of Road No. 370 (in Tboung Khmum Province) ・ Interview with the chef and council members of Chak Commune
March 2, 2016	・ Interview with the chef and council members of Kong Chey, Tuol Sophi and Damril Communes ・ Meeting with the enumerators ・ Participation in the survey
March 3, 2016	・ Interview with the chef and council members of Mong Riev and Chikor Communes ・ Meeting with the enumerators ・ Participation in the survey
March 4, 2016	・ Return to Phnom Penh
March 5, 2016	・ Departure at Phnom Penh for Tokyo

Date	Items
March 6, 2016	・ Arrival at Tokyo

D. Summary of Findings

The interview surveys were conducted with chefs and council members of the communes located along the project roads to collect their demographic and socio-economic information and comprehend how those representatives of local population had recognized changes or impacts in their life after the project roads' improvement. The surveys will be helpful when interpreting the data collected through the beneficiary interview surveys.

In the surveys, various findings and observations were obtained on changes in the project beneficiaries' livelihoods. Here, commonly observed items are presented, and the detailed results each survey are given in Attachment 1.

Commonly observed in the three sites:

- The project road became passable all year around, and subsequently economic activities got active, i.e., people from outside the communes used the road more often for agricultural trades with farmers in the communes, more people used motorized transport means, including koyons and motorcycles, some people started new business along the road, and the number of the project road users were increased.
- Accessibility to public services, like health, education and administrative services, were improved in terms of time and cost for travel, because (i) the roads became more passable and (ii) people possessed motorized means or bicycles.
- Income levels of local populations were generally improved, mainly because more products could be transported to markets in better conditions and sold at better prices, while fewer changed their jobs.
- Dust on the road was reduced as the surface was smoothened, which eased and encouraged people to use the road.

Road 370 in the Tboung Khmum Province

- The local population's travel frequency was increased.
- More people from outside the communes visited the local farmers more often to purchase the farmers' products for selling at markets in Ou Reang Ov, Soung, or other adjacent towns along the national road Nos. 7 and 11.
- The total volume of agricultural yields was increased for transporting in better conditions to the markets above. The transported were sold at better prices compared to the ones before the project.

Road 1KCH2 in the Kampong Chhnang Province

- The number of the road users was increased as the road improvement enabled them to travel for more various purposes. One of the outstanding findings was that the road was recognized as a

shortcut to a resort area, Chrok Laieng. Associated business along the road became active.

Road 1BB4 in the Battambang Province

- The entry of heavy-loaded trucks was controlled by gates installed limiting the height of vehicles, which kept the road surface little damaged but limited the bulk transportation of agricultural products to outside.
- The number of mobile shops of groceries by motorcycles from outside the project area was increased, which eased the local population's life.

Attachments:

1. Minutes of meetings and interviews held during February 25 – March 3, 2016
2. Demographic information of the communes located along the studied project roads
3. Photos taken during the site visits

Attachment 1: Minutes of meetings and interviews held during February 25 – March 3, 2016

February 25, 2016

1. 09:00-09:30

Person met: Team Leader for the Detailed Design and Implementation/Supervision (DDIS) Consultant for the ADB-financed project, Rural Roads Improvement Project

Item discussed:

- Overall agenda during my stay, including logistics arrangement.

2. 09:45-10:05 (Courtesy Call)

Person met: Director General for Technical Affairs, Ministry of Rural Development, and concurrently the project director for the ADB-financed project, Rural Roads Improvement Project

3. 13:30-18:45: Kick-off workshop including training of the enumerators

Persons met: Team members of Post-completion socio-economic survey

Agenda of the program:

- Read through all the questions in English/Khmer and modified as needed to ensure their clarity for the enumerators for the beneficiary interview surveys (hereafter called as "the surveys"), with providing the explanations of backgrounds and intentions of the questions.
- Clarified the importance of using the project maps as a supplemental tool for the surveys, and confirmed that all the enumerators would document geographical information to be given during the household survey as required in the questionnaire on the maps prepared by the DDIS consultant, and maps the enumerators would work on during the surveys would be a part of their outputs.
- Discussed the survey schedule and team assignment, and confirmed that the survey was to commence each project site on 27 February, 2016 (Kampong Chhnang, Battambang, and Tboung Khmum).

February 26, 2016

Major activities:

- Visit to the sites of Road 1KCH2 in the Kampong Chhnang Province and Road 1BB4 in the Battambang Province.
- Interview with the chiefs and council members of the communes along the project roads.

1. 11:10-12:00: Pongro Commune Council

Findings:

- There are three primary schools, out of which one is next to a secondary school and another is attached to a secondary and high school.
- Economic activities in the commune.

- Men are engaged in growing rice and vegetable, planting palm trees and selling their products to the market, located 2 km far from the commune.
- Women are engaged in producing palm sugar and growing vegetable with their male family members.
- Some of the women go to garment factories in the Kampong Chhnang City or Thailand and send remittance to their families in the commune, while fewer men go.

・ Changes observed after the project.
- The number of koyons in the commune was increased to 342 from 162.
- Some of the people residing along the road renovated their houses.
- The area for commercial activities was expanded, as more people moved to the roadside area to live.
- The number of users of the project road was increased, partially because travelers to the resort area, Chrok Laieng, use the project road as a shortcut.
- More people in the commune own motorized transport.
- The number of families receiving food security services was more than 200 before the project, but reduced to 150 (in February 2016).
- The number of the families in the commune was increased in one year (2014-2015) by 111, because of the two reasons, (i) establishment of new families through marriage inside the commune and (ii) movement of families from outside.
- The surface of the road was smoothened and became less dusty, which improved the people's health conditions and eased people's travel.

2. 13:50-14:05: Krang Skear Commune Council

Findings:

・ There is a kindergarten, a primary school and a secondary school and a health center respectively in the commune.

3. 14:30-14:55: Banteay Preal Commune Council

Findings:

・ Changes observed after the project.
- The number of koyons in the commune was increased to 500 from 70 before the project.
- More people use motorcycles and vehicles, and travel to Pursat more often.
- Due to the surface improvement, dust was reduced.

February 27, 2016

Major activities:

・ Visit to the site of Road 1KCH2.

・ Participation in the pre-test by the survey team.

1. 11:10-11:45: Kick-off meeting with the survey team

Items discussed:

・ Reminder of the items discussed and agreed during the workshop of 25 February, 2016.
・ Explanation of the project road.

2. 14:10-17:00: Participation in the pre-test interview survey, including feedback discussion.

February 28, 2016

Major activities:

・ Visit to the site of Road 1BB4.
・ Meeting with the enumerators' team leader for follow-up.
・ Interview with the chief of Chrey commune.

1. 09:30-09:50: Chrey Commune Council

Findings:

・ There is one primary and secondary school and one health center in the commune.
・ Economic activities in the commune.
  - More than 90% of the local population are engaged in growing rice and vegetable, raising cows and selling their products to markets nearby.
  - There are three self-help associations in the commune. The one is for old men, another is to provide financial assistance for rice farming, and the last is a financial association which provides loans with lower interests than the ones of other financial institutions, including banks. The association for the men requires membership fees for participation.
・ Changes observed after the project.
  - The local population's income level was improved.

2. 10:10-10:30 Discussion with the enumerators' team leader for the road

・ Held consultations on how to achieve the quality interview surveys with documenting necessary information on the maps, as discussed during the workshop.

February 29, 2016

Major activities:

・ Visit to the site of Road 1BB4.
・ Interview with the chiefs of the three communes of Kear, Ta Loas and Kakoh.

・ Follow-up meeting to the enumerators' team leader

1. 09:30-09:50: Kear Commune Council

Item discussed:

・ Demographic information of the village along the project road.
・ Socio-economic situations before and after the project.

Findings:

・ In the commune, there are 7 schools, consisting of 6 for primary education and 1 secondary and high school respectively, and one health center.
・ Economic activities in the commune.
  - 95% of the population in the commune are engaged in growing rice, vegetables and fruits, raising cows, and selling their products to markets outside the commune.
  - Two self-help groups are active of (i) water association by men and (ii) hygienic and sanitary issues for children. Participating in their activity is optional and requires the payment of membership fees.
・ Changes observed after the project.
  - The population's income level was improved.
  - The access to markets located along the national road No. 5 was improved, which enabled the local farmers to transport their perishable agricultural products more in better quality to those markets and sell at better price.
  - The access to schools and health centers was improved, which shortened travel time and enabled people to be there on time.

2. 10:30-11:20: Ta Loas Commune Council

Findings:

・ There are 5 schools and one health center in the commune.
・ Economic activities in the commune.
  - Most of the local population are engaged in growing rice and vegetable, catching fishes in natural reservoirs and lakes inside the commune, and selling their products to markets along the national road No. 5.
  - Some of the women go to garment factories in Thailand or Phnom Penh.
  - One self-help group is active for providing loans to the members. The interest rate is almost same as that of other microfinance institutions or banks. The group members should pay the monthly membership fee of US$0.5.
・ Changes observed after the project.
  - More people own motorcycles, koyons, and motorized agricultural machines.
  - The local population's income level was improved.
  - Before the project, the local population needed to visit the fields for buying agricultural

products, while such products became available easily at the markets. Further, after the road was improved, the number of mobile shops for daily groceries (operated with motorcycles) was increased.

- The number of over-loaded trucks was increased after the road was improved. Farmers around the area with better access for those trucks benefit better prices to agricultural products, compared to the areas where the trucks' access was limited due to the gate barrier.
- More people left the commune for seeking job opportunities while there were very few immigrants to the commune.

・ NGO's activity in the village.

- Buddhism for Development, an international NGO, works on helping HIV/AIDS-affected groups.

3. 12:40-13:30: Kakoh Commune Council

Findings:

・ There are one primary school and one health center along the road in the commune.

・ Economic activities in the commune.

- Most of the local population are engaged in growing rice, cultivating fishes, and raising livestock. Some produce vegetables for self-consumption.
- Two self-help groups are active, (i) for men aged at or over 55 years on providing financial supports to raising cows and rice farming and (ii) fishers' association.

・ Changes observed after the project.

- The travel cost to the health center was reduced, around by half.
- The improved road conditions enabled students to go to school on time.
- There was less dust than before the project.
- More active business environment was created for both buyers and sellers.

・ International organizations' activity in the village.

- World Vision: To help children's sanitary conditions.
- Korea International Cooperation Agency: To support the abovementioned men's self-help activities to enable the member farmers to sell all their products at the markets and raise their income levels.

March 1, 2016

Major activities:

・ Transfer to Kampong Cham and visit to the site of Road 370.

・ Meeting with the enumerator team leader.

・ Interview with the chief and his assistant of Chak Commune.

1. 17:10-17:40: Chak Commune Council

Findings:

- There are five primary schools, one secondary and high school, and one health center along the road.
- More than 90% of the local population are engaged in growing rice during rainy season (June-November) and some of them plant watermelons, and sell their products to markets in Ou Reang Ov, Soung or other towns along the national road No. 7. During dry season, some of them migrate to other areas in the country or Thailand for agricultural jobs to maintain their livelihoods.
- The remainder of the local population operates grocery shops and material shops of bricks and cement pipes.
- The two self-help groups are operational, of (i) microfinance and (ii) rice bank. For (i), the membership fee is more than US$10 per month, which is pooled and used for financial supports to the members' needs. Both are open to all the population.
- A local NGO supports the community council members' study of the traffic law, while international NGOs (CARE and Save the Children) provides (i) educational programs to the members about trafficking and migration, (ii) assistances to develop their commune development plan, and (iii) educational supports to dropped-out children.
- Changes after the project.
  - The travel time to market areas was shortened to one hour from one day before the project, and the local population could save expenses for fuel.
  - Prices of agricultural products were increased, and the local population's income level was improved.
  - Immigrants into the commune were found after the project.
  - The number of motorcycles and koyons were increased.

March 2, 2016

Major activities:

- Interview with the chiefs and council members of the three communes (Kong Chey, Tuol Sophi and Damril).
- Participation in the interview surveys.

1. 08:45-09:50: Kong Chey Commune Council

Findings:

- There are three primary schools, one secondary and high school, and one health center in the commune. There is one pagoda along the road.
- 95% of the population are engaged in growing rice, cassava and soy beans. People from the other villages and communes in the district come to the farmers' fields or house and purchase their

products.

- The remaining, 5% of the population, operate small business, mainly grocery shops nearby markets in Ou Reang Ov or other towns along the national road No. 11.
- There is one active self-help group, which is for microfinance and open to all the population in the commune. The collected money is pooled in the association for providing financial supports to the members' agricultural activities on a need basis.
- About 400 are registered as migrated to the other regions in the country, while 50 to Thailand. They don't own any land for self-farming but some of them return to the commune for helping other farmers only during harvest season.
- There is no assistance from any NGO or international donor.
- Changes after the project.
  - The number of owners of vehicles and trucks was increased by 40%, the one of motorcycles by 50% and the one of koyons by 55%.
  - More people got to approach the commune from outside for purchasing agricultural products.
  - The income level of the local population was improved, though not significantly.
  - There was no change in the number of rice mill machines in the commune.

2. 10:15-11:10: Tuol Sophi Commune Council

Findings:

- There are five primary schools, one secondary and high school, and a health center in the commune.
- 95% of the population are engaged in growing rice, cassava and pepper. People from markets in On Reang Ov come to the farmers' fields or house, and collect and buy their products, while owners of rice mill machines transport their products to the markets and sell by themselves.
- The remaining 5% of the population consists of (i) laborers for civil works or helping other farmers' activities and (ii) owners of grocery shops, pharmacies and other business along the road.
- 820 are registered as emigrated to other regions in the country, while 926 to Thailand. They are engaged in farming or civil works and, only during harvest season, very few people among them return to the commune for helping other farmers' work.
- There are two self-help groups. The one is to pool the money collected from the member families (US$0.25 per month) for giving financial supports to hold a funeral, and another is a microcredit association. Both are open to all the commune members.
- There is no assistance from any NGO and international donor.
- Changes after the project.
  - Some houses were renovated or extended after the project, particularly along the road.
  - The income level was improved and the number of people with debts or receipt of financial helps from the microcredit association decreased.

3. 14:05-15:50: Meeting with the enumerator team (Road 370) and participation in the interview

survey in the Chak Commune.

- Discussed on the sample numbers allocated each village along the road
- Clarified unclear questions from the enumerators with providing additional explanation.
- Attended an interview survey.

4. 16:10-17:05: Damril Commune Council

Findings:

- There are one kindergarten, three primary schools, one secondary and high school in the commune.
- 90% of the population are engaged in growing rice, cassava, soy beans and sesame. People from markets in Ou Reang Ov come to the farmers' fields or house and collect and buy their products. The remaining 10% are laborers for civil works or other farmers' assistance especially during the harvest season.
- 5% of the population immigrated into the commune to reside, while 3% moved out. The emigrants from the commune to the other regions were counted 575 (female: 241), while those to Thailand and Korea were 791 (female: 376), and their main purposes for emigration is to find job opportunities in civil works or farming or otherwise starting to trade goods.
- A group activity of microcredit exists and is open to all the people in the commune. The group provides financial assistances to members' rice farming activities.
- Changes after the project.
  - The access to the commune from outside became easier, e.g., travel time was reduced, and travel cost decreased. For example, the travel cost from the national road No. 7 to the commune council was reduced from 10,000 Riel by bike-taxi to 1,000 Riel by motor taxi.
  - The traffic volumes along the road was significantly increased, because the ownerships of motorcycles, vehicles and koyons were increased. In addition, after the road improvement, car taxis started to operate on the road, which also eased people's travel in terms of cost and time.
  - The income level was improved, and the number of poor families decreased.
  - Some houses were renovated or extended, particularly ones located along the road.

March 3, 2016

Major activities:

- Interview with the chief and council members of the two communes (Mong Riev and Chikor).
- Participation in the interview surveys.

1. 08:45-09:55: Mong Riev Commune Council

Findings:

- There are two primary school, one of which is located along the road, and one secondary and high school.

- There is one health center in the commune though not along the road. Residents along the road go to the provincial hospital located along the national road No. 7 instead as the hospital is closer for them.
- There is one pagoda along the road, while another about 5 km far from the road.
- 95% of the local population in the commune are engaged in growing rice and cassava, while 4% works for helping other families' farming works and the remaining 1% own shops along the road or operate their business. All farmers in the commune own their land. Most of them sell their products to various people approaching from inside/outside the commune, including traders, including individuals, factory operators (particularly for cassava to process in the factories outside the commune) and traders who are active in markets in Suong or the other towns along the national road No. 7.
- Some of the local population are continuously migrated to other regions in Cambodia (555 in 2015, including 241 women) or outside the country like Thailand, Korea and Japan (795 in 2015, including 275 women). They are engaged mainly in farming and construction works and send remittances to the family members in the commune. Some of them, but few, return to the commune for helping other families' farming activities during the harvest seasons.
- A microcredit association exists in the commune, and provides the members financial supports with lower interests than other formal institutions when needed. When joining the association, a member is required to pay 10,000 Riel though no specific amount is determined to pool afterward.
- There is no assistance from any international donor or NGO.
- Changes after the project
    - Local population's travel frequency was increased, as the ownerships of motorcycles, koyons and vehicles were increased following the improvement of their income levels. Such economic improvement at the individual level was caused by (i) the road improvement and (ii) the recent economic growth.
    - Along the road, some houses were renovated or extended. Further, some of the commune population moved to the roadside and started new business activities in parallel to their original farming works in their land.
    - The number of car taxis was increased along the road. On the other hand, the number of bike taxis was decreased as more people got to use their motorcycle for their daily travel.

2. 10:15-11:40: Chikor Commune Council

Item discussed:

- Demographic information of the villages along the project road.
- Socio-economic situations before and after the project.

Findings:

- A primary and secondary school is located along the road, while there are three primary schools in the commune.

- There is one health center along the road.
- 95% of the population in the commune are engaged in growing rice, cassava and cashew nuts, while the remaining work on civil works, help other farmers, or operate their shop business along the road. 3% of the farmers rent lands from the others during harvest season.
- People from outside the commune, including traders, collect and purchase the farmers' products at their houses and sell them to Vietnam (70% in total) or Suong (30%), which was made possible only after the road improvement because those people couldn't enter the commune before due to the road's impassable condition.
- Almost every year, about 5% of the families are emigrated to the other areas, either inside or outside the commune, for seeking job opportunities.
- There is no group activity in the commune. When people need financial helps, they approach formal institutions like banks or microfinance organizations for borrowing.
- Two local NGO, namely as Water Safe and Chadder, are active in the commune for providing support to sanitary systems.
- Changes after the project
  - Since the road was impassable before the project, products were not able to be transported anywhere for selling. However, after the road improvement, people started double cropping in (i) April-August and (ii) August-December as they found trader or buyers of their products from outside, which generated new employment opportunities and contributed to increase in their income.
  - Following the improvement of households' economic situation, more people owned motorcycles, vehicles, trucks, koyons, and tractors. Motorcycles became the major travel mode for the population.
  - The traffic volume along the road was increased, which involved the increase in traffic accidents. The commune council considered the need for providing the population road safety education.

3. 13:35-16:15: Participated in the interview survey

Attachment 2: Demographic information of the communes located along the studied project roads

The information shown below was collected directly from the commune councils during the interview surveys as their latest as of February/March, 2016[1].

[1] "Poor family" stated each table means a family receiving the support of the national food security programs.

Along Road KCH2

Commune: Pongro **(2015 Stat)** **Pop: 8081** **F: 4307** **Family: 2015** **HH: 1892**

A. Demographic information of the villages located along the 1KCH2 road

	Village	Population		No. HH	No. of Family		Poor family
		Total	Female		Total	Female-headed	
1	Thmei	668	351	136	171	35	4
2	Pran Bei Chom	865	451	181	209	30	9
3	Trapang Thom	663	373	129	153	53	23
4	Tumar Reap	666	363	138	170	40	6

B. No. of Family receiving the support of food secruity program
(Commune-level)

1	Partial	150
2	Full-year	

C. No. of Family receiving electricity supply
(Commune-level) 1,382 90%

Commune: Banteay Preal **(2015 Stat)** **Pop: 4583** **F: 4400** **Family: 1132** **HH: 1036**

A. Demographic information of the villages located along the 1KCH2 road

	Village	Population		No. HH	No. of Family		Poor family
		Total	Female		Total	Female-headed	
1	Ou Leaah	436	225	90	100	35	18
2	Thnar Reap	305	155	61	76	11	13
3	Teup Stor	573	305	145	156	30	19
4	Trapang Phkim	601	325	139	141	44	17

B. No. of Family receiving the support of food secruity program
(Commune-level)

1	Partial	152
2	Full-year	170

C. No. of Family receiving electricity supply
(Commune-level) 202

Commune: Krang Skear **(2015 Stat)** **Pop: 15015** **F: 7626** **Family: 3375** **HH: 2994**

A. Demographic information of the villages located along the 1KCH2 road

	Village	Population		No. HH	No. of Family		Poor family
		Total	Female		Total	Female-headed	
1	Tuol Sumroy	828	436	175	210	27	60
2	Trapang Malu	818	462	195	206	23	59
3	Krang Skear	1,088	605	269	269	41	90
4	Krang Skear Tbong	1,385	709	217	340	43	101

B. No. of Family receiving the support of food secruity program
(Commune-level)

1	Partial	1,010
2	Full-year	

C. No. of Family receiving electricity supply
(Commune-level) 0

Along Road 1BB4

Commune: Kear **(2015 Stat)** **Pop: 17614** **F: 9196** **Family: 3283** **HH: 3046**

A. Demographic information of the villages located along the 1BB4 road

	Village	Population		No. HH	No. of Family		Poor family
		Total	Female		Total	Female-headed	
1	Pou Muy	1,805	973	345	385	75	52

B. No. of Family receiving the support of food secruity program
(Commune-level)

1	Partial	467
2	Full-year	400

C. No. of Family receiving electricity supply
(Commune-level) 95%

Commune: Chrey **(2014 Stat)** **Pop: 12796** **F: 6511** **Family: 2779** **HH: 2199**

A. Demographic information of the villages located along the 1BB4 road (2014)

	Village	Population		No. HH	No. of Family		Poor family
		Total	Female		Total	Female-headed	
1	Chrey Chheung	1,452	769	281	351	53	57
2	Chong Sam Nay	2,068	1,061	436	449	111	141

B. No. of Family receiving the support of food secruity program (2013)
(Commune-level)

	Category	Total	Female-headed
1	Partial	437	113
2	Full-year	539	132

C. No. of Family receiving electricity supply
(Commune-level) 98%

Commune: Ta Loas **(2015 Stat)** **Pop: 10037** **F: 4740** **Family: 2159** **HH: 1839**

A. Demographic information of the villages located along the 1BB4 road

	Village	Population		No. HH	No. of Family		Poor family
		Total	Female		Total	Female-headed	
1	Sur Sdei	1,810	549	336	381	63	137
2	Sdei Stueng	1,039	549	201	215	27	108
3	Stueng Thmei	819	443	141	198	33	19
4	Veal	623	319	120	152	38	46
5	Chong Bralay	1,345	690	223	260	36	59
6	Tros	1,008	517	169	219	46	71
7	Bralay Sdao	715	364	136	163	38	46

B. No. of Family receiving the support of food secruity program
(Commune-level)

1	Partial	228
2	Full-year	338

C. No. of Family receiving electricity supply
(Commune-level) 95%

Commune: Kakoh **(2015 Stat)** **Pop: 12819** **F: 6617** **Family: 6619** **HH: 2602**

A. Demographic information of the villages located along the 1BB4 road

	Village	Population		No. HH	No. of Family		Poor family
		Total	Female		Total	Female-headed	
1	Kakaoh	2,030	989	350	385	43	136
2	Rom Chek	1,128	555	209	258	47	145
3	Tool Prom Muy	1,753	907	329	387	87	215
4	Tuol Prom Pir	1,434	694	243	209	35	158

B. No. of Family receiving the support of food secruity program

(Commune-level)

1	Partial	739
2	Full-year	514

C. No. of Family receiving electricity supply

(Commune-level) 90%

Along Road 370

Commune: Chak **(2015 Stat)** **Pop: 13734** **F: 7218** **Family: 3725** **HH: 3692**

A. Demographic information of the villages located along the No. 370 road

	Village	Population		No. HH	No. of Family		Poor family
		Total	Female		Total	Female-headed	
1	Cham Lack	755	482	175	175	9	17
2	Chruol	865	452	176	190	12	21
3	Chak	2,082	1,063	266	387	60	28
4	Prasat	1,072	932	252	252	7	36

B. No. of Family receiving the support of food secruity program
(Commune-level)

1	Partial	80
2	Full-year	230

C. No. of Family receiving electricity supply
(Commune-level) 90%

Commune: Damril **(2015 Stat)** **Pop: 10162** **F: 5321** **Family: 2513** **HH: 2111**

A. Demographic information of the villages located along the No. 370 road

	Village	Population		No. HH	No. of Family		Poor family
		Total	Female		Total	Female-headed	
1	Damril Ti Boun	529	267	107	119	12	4
2	Damil Ti Bei	440	214	65	85	1	7
3	Yeak Chheung	696	356	170	166	6	21
4	Yeak Tbong	627	322	162	167	19	19

B. No. of Family receiving the support of food secruity program
(Commune-level)

1	Partial	138
2	Full-year	190

C. No. of Family receiving electricity supply
(Commune-level) 70%

Commune: Mong Riev **(2015 Stat)** **Pop: 15956** **F: 8159** **Family: 3249** **HH: 2748**

A. Demographic information of the villages located along the No. 370 road

	Village	Population		No. HH	No. of Family		Poor family
		Total	Female		Total	Female-headed	
1	Trapeang Snoa	902	486	181	186	12	28
2	Chipeang	593	309	120	161	27	15
3	Riv	818	446	147	189	57	44

B. No. of Family receiving the support of food secruity program
(Commune-level) Not available

1	Partial	61
2	Full-year	291

C. No. of Family receiving electricity supply
(Commune-level) 98%

Commune: Chikor **(2015 Stat)** **Pop: 12955** **F: 6668** **Family: 2895** **HH: 2530**

A. Demographic information of the villages located along the No. 370 road

	Village	Population		No. HH	No. of Family		Poor family
		Total	Female		Total	Female-headed	
1	Roka Khnuoch Chheung	743	386	146	188	16	59
2	Roka Khnuoch Tbong	1,106	795	199	242	22	70
3	Tuolkanadal Chheung	751	347	161	180	21	31
4	Tuolkanadal Tbong	926	587	177	179	45	45
5	Kan Reng	659	316	103	134	19	33
6	Sleng	963	429	149	236	83	47
7	Tuol Thmei	498	253	62	137	7	24

B. No. of Family receiving the support of food secruity program
(Commune-level)

1	Partial	69
2	Full-year	704

C. No. of Family receiving electricity supply
(Commune-level) 98%

Ou Reang Ov District

Commune: Kong Chey **(2015 Stat)** **Pop: 17902** **F: 9227** **Family: 3759** **HH: 3359**

A. Demographic information of the villages located along the No. 370 road

	Village	Population		No. HH	No. of Family		Poor family (2012)
		Total	Female		Total	Female-headed	
1	Lek Muy	1,039	734	285	339	12	2
2	Lek Pir	1,051	534	216	218	10	15
3	Thmei	1,058	552	221	227	9	22
4	Chheung Vat	854	413	162	166	14	27
5	Kong Chey	900	424	155	152	10	9
6	Stueng Chhey	908	402	126	135	17	18
7	Stueng Rieng	1,005	439	162	227	18	20
8	Thnal Keng	778	390	137	161	9	15
9	Ou Damray	620	315	126	143	9	28
10	Changva	366	199	97	97	6	11
11	Tuol Trach	728	334	105	105	13	8

B. No. of Family receiving the support of food secruity program
(Commune-level)

1	Partial	229
2	Full-year	150

C. No. of Family receiving electricity supply
(Commune-level) 95%

Commune: Tuol Sophi **(2015 Stat)** **Pop: 9999** **F: 5156** **Family: 2223** **HH: 1953**

A. Demographic information of the villages located along the No. 370 road

	Village	Population		No. HH	No. of Family		Poor family
		Total	Female		Total	Female-headed	
1	Tuel Sophi	596	344	117	153	25	33
2	Trapenag Lavea Chheng	233	125	39	47	10	16

B. No. of Family receiving the support of food secruity program
(Commune-level)

	Category	Total
1	Partial	308
2	Full-year	83

C. No. of Family receiving electricity supply
(Commune-level) 95%

Attachment 3: Photos taken during the site visits

Kick-off workshop for the beneficiary interview surveys on February 25, 2016

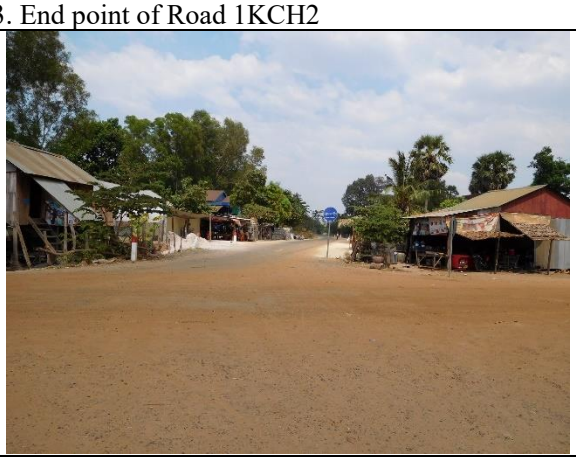
Interview with the commune chief of Pongro, Kampong Chhnang

Interview with the commune member of Krang Skear, Kampong Chhnang

Road 1KCH2:
1. Junction of the national road No.5 and Road 1KCH2

2. Middle points

3. End point of Road 1KCH2



Meeting with the enumerator team for Road 1KCH2

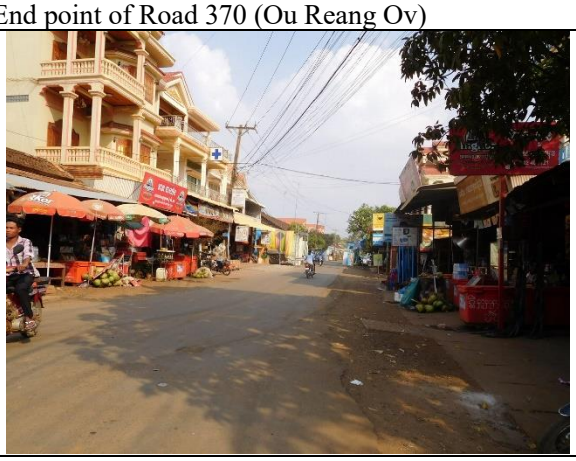
Beneficiary interview survey by an enumerator (Road 1KCH2)

Interview survey with the commune chief of Ta Loas, Battambang Province	Interview survey with the commun council members of Kakoh, Battambang Province
	
Overview of Road 1BB4	
	
Gate barrier limiting the height of vehicles and trucks, placed on Road 1BB4	End point of Road 1BB4 (Kakoh)
	

Interview with the commune council members of Damril, Tboung Khmum Province	Interview with the commune council members of Chak, Tboung Khmum Province
	
Interview with the commune concil members of Tuol Sophi, Tboung Khmum Province	Interview with the commune council members of Mong Riev, Tboung Khmum Province
	
Meetings with the emunerators for Road 370	
	

Overview of Road 370

End point of Road 370 (Ou Reang Ov)



Appendix 3. Field Note on December 13-26, 2016

1. December 13, 2016 (13:53-14:30)

- Location: Pram Bey Chaom Village, Pongro Commune
- Sex: Male
- No. family members: 6 (himself, parents-in-law, wife, a child (4 years old))
- Household head or not: No
- Asset owned: a house, a shop, rice farm (for renting out to somebody)
- Mode owned: a car, 3 motorcycles
- Major income: US$ 15 per day from restaurant operation
- Length of stay: 4 years (He moved from Phnom Penh when getting married)
- The number of family member(s) who attend(s) school: One
- Economic activities:
  - The number of customers from inside and outside the village increased.
  - Most of customers from outside the village are employees of companies around the road.
  - Local population along the road come to the restaurant for coffee and chat.
- Travel behaviors after the project:
  - His family purchased a car on US$4,000 in 2016 for expected family travel and transporting a big amount of products.
  - He walks more often around the house and visits other shops for shopping for his family business (running a restaurant) and daily life and networking. Before the project, he did not so often walk, due to the muddy and rough road condition. As a result, he is able to get networked more closely among people along the road.
  - Three motorcycles are shared among the family for their daily travels, including shopping and meeting friends.
- Education
  - His son goes to Svey Chum Primary School from this year (2016). When the rehabilitation works commenced, he was born.
  - No issue in daily transportation, as the school is located along the National Road No. 5 (note: the school is outside the project road) and there is no difficulty to bring him to the school.

2. December 14, 2016 (08:52-09:30)

- Location: Rom Chek Village, Kear Commune
- Sex: Male
- No. family members: 3 (himself, wife, and son)
- Household head or not: Yes
- Asset owned: a house, rice farm, a binder
- Mode owned: a car, a motorcycle
- Major income: US$120 per month for serving as a commune council staff, incomes from selling

rice and renting a machine during harvest season

- Length of stay: 37 years since 1979
- The number of family member(s) who attend(s) school: None
- Economic activities:
  - After the road rehabilitation, he and his family do not need to go to selling outside as customers come to their house to buy rice at higher prices. Before, they had to bring their rice to areas along the Road No. 5.
  - Main customers are from his village, but some are from his district or commune.
  - The total sales increased from KR 7 mil for 40 ton to KR 10 mil.
  - He and his family produce rice once a year, around October and November.
- Travel behaviors:
  - He purchased a car for US$14,000 in 2016 for daily travel, including commuting to the commune council and meeting friends and relatives outside the village.
  - His wife and son use motorcycles for their daily travel.
  - The road rehabilitation enables them to travel to more places safely and faster.
- Education: Not applicable, as there is no children attending the school education.

3. December 14, 2016 (11:20-11:55/ 16:00-16:30)

- Location: Jong Sanuay Village, Kear Commune
- Sex: Female
- No. family members: 9 (including her husband, son, his wife (daughter-in-law), two daughters, and grandson)
- Household head or not: No
- Asset owned: a house, rice farm
- Mode owned: two bicycles, a motorcycle, a koyon
- Major income: US$40 per month for serving as the deputy village chief, incomes from selling rice and vegetables
- Final academic record: 9th grade (equivalent to 4th grade at present)
- The number of family member(s) who attend(s) school: Two
- Economic activities:
  - After the road rehabilitation, her family does not need to go to selling outside as customers come to their house to buy rice at higher prices. Before, they had to deliver their products to the customers' houses.
  - Main customers are unchanged even after the road improvement, and most of those customers are in her village.
  - The total sales increased from KR 3.1 mil to KR 4.5 mil. The amount for sale remains 4 ton.
  - Her family produces rice once a year.
  - The koyon, purchased in 2001, is used to transport rice from the field to the house.

- Travel behaviors:
  - Her family purchased a motorcycle in 2014 (US$700) and two bicycles in 2015 (US$80 each) without borrowing any money from outside. The bicycles are mainly for the daughters' school commuting. Travel time to the school is approximately 20 minutes by bicycle.
  - The road rehabilitation enables them to travel more easily anywhere around their house and go to the referral hospital, the Moung Ruessei Hospital.
- Education:
  - She has two daughters of 10th grade and 12th grade in Moung Ruessei High School.
  - Before the road rehabilitation, the daughters went to Plov Kat Primary School, located from their house with 5-min walk. Now, they have been to Moung Ruessei High School since 2015.
  - As her family has no financial and property asset for wealth, their daughters go to school in order to gain knowledge for being employed in good job.

4. December 14, 2016 (15:18-16:00)

- Location: Tros Village, Ta Loas Commune
- Sex: Female
- No. family members: 5 (including her mother, father, and brothers)
- Household head or not: No
- Asset owned: a house, a shop, a small space for washing motorcycles
- Mode owned: a bicycle, two motorcycles
- Major income: US$150 per month for selling daily commodities, and US$100-150 from brothers outside the village (Phnom Penh and Thailand)
- Length of stay: Since her birth (about 25 years)
- Final academic record: 9th grade
- The number of family member(s) who attend(s) school: One
- Economic activities:
  - They sell soft drinks, snacks and cookies to villagers around their shop.
  - The daily sales was around KR 10,000 per day, which was enough to purchase daily foods for maintaining her family's livelihoods.
  - Before the road rehabilitation, her father ran the shop. The sales and the number of customers were smaller.
- Travel behaviors:
  - Two motorcycles were purchased in 2015 by her brothers outside the village, as the youngest brother entered Moung Ruessei High School and the second youngest was employed in a company in Moung Ruessei. The total price was $2,800 ($1,700 for the youngest and $1,000 for the second youngest).
  - She used their motorcycles for purchasing goods to be sold in her shop.
  - A bicycle was purchased before the road rehabilitation. Her main travel mode is the bicycle,

which enables her to travel to the Moung Ruessei Market (travel time: one hour to 0.5 hour) and friends' houses (travel time: one hour to 20-30 minutes)
  - The motorcycle enables the second youngest to come back to home by the evening, which allows him to live together with his family.
- Education:
  - Her youngest brother has been to Moung Ruessei High School since 2015.
  - She stopped to go to school at the 9th grade, as she joined the migration program to Thailand but returned to her village after 5 months passed.
  - (Her father's comment on his motivation to send his sons to school) Education would provide knowledge needed for getting good job and securing their life. For instance, her second youngest brother completed the high school education, which helped him to get a full-time job in Moung Ruessei.

5. December 15, 2016 (11:30-11:50)

- Location: Sur Sdey Village, Chrey Commune
- Sex: Male
- No. family members: 4 (including her husband, a son and a daughter)
- Age: 30
- Household head or not: No
- Asset owned: a house (land was owned by her aunt.)
- Mode owned: a bicycle
- Major income: US$75 per month plus $10 (US$5 x 2) per day when working in corn farm when requested
- Length of stay: 16 years
- Final academic record: Never schooled
- The number of family member(s) who attend(s) school: None
- Economic activities:
  - No major change after the road rehabilitation. The daily wage from the corn farm's owner is not changed.
- Travel behaviors:
  - Travel time to Ta Loas Market was reduced from 30 minutes to 20 minutes after the road rehabilitation.
- Education:
  - Her 5-year old boy would attend Manark Primary School from 2017.
  - She expected him to acquire knowledge for getting well-paid jobs, unlike themselves.

6. December 15, 2016 (13:45-14:15)

- Location: Kear Commune (Beginning Point of 1BB4)

- Sex: Female
- No. family members: 12
- Age: 62
- Household head or not: No
- Asset owned: a house, a shop, rice field
- Mode owned: a bicycle, two motorcycles, a car
- Major income: Not answered
- Length of stay: Since 1991 (about 25 years)
- Final academic record: 4th grade
- The number of family member(s) who attend(s) school: Seven
- Economic activities:
  - Her family sells electric appliances, rice and mobile telephone cards. Those products are purchased and transported from Phnom Penh by themselves, or companies from Phnom Penh come to them to sell.
  - After the road rehabilitation, the number of customers along the road increases to about 10 per day from 5 per day before.
  - Income increases from her family business (before: 50% of the total household > after: 65% of the total household income)
  - Income from rice production and sales increases from US$ 1,500 for 10 tons to US$ 1,750. Before the road rehabilitation, main customers were from people around Kear commune, and now were from Vietnam or Thailand.
  - More people visits the Moung Ruessei Market (another side as well) from the roadside area.
- Changes in his own travel behaviors after the project:
  - They purchased a car in 2015 for US$10,000, mainly aiming at long travel to Phnom Penh or her home town in Kander Province. Two bicycles were purchased in 2000, and three motorcycles were purchased in 2006.
  - Motorcycles ae used for going to rice fields. Previously, it took one hour to go to the fields but reduces to 0.5 hour after the road rehabilitation.
- Education:
  - Out of her three children, one daughter stopped schooling at 12th grade, one daughter-in-law stopped at 10th grade and son at 12th grade. They work in her shop together.
  - Out of her seven children, two go to Moung Ruessei High School by motorcycle and five go to Moung Ruessei Primary School. The five are accompanied by her husband. Out of those five, some attend at the morning session and the other attend at the afternoon session, hence he can manage to bring all to the school by motorcycle.
  - She expects their grandchildren to gain knowledge at school and complete higher education for getting well-paid jobs in companies and assuring they can earn income stably, as her shop's income is not stable and her assets can't be distributed to all of them.

7. December 15, 2016 (14:21-14:35)

- Location: Moung Ruessei Market (Moung Village, Moung Commune: Outside the project road)
- Sex: Male
- Age: 38
- No. family members: 4 (including his wife and two children)
- Household head or not: Yes
- Asset owned: a house, a shop, land
- Mode owned: a motorcycle
- Major income: Not answered
- Length of stay: Since 1991 (about 25 years)
- Final academic record: High School
- The number of family member(s) who attend(s) school: Two
- Changes in business after the project:
  - They sell daily commodities and baby goods. Those are transported by companies in Battambang and Phnom Penh.
  - After the road rehabilitation, the number of the customer from the roadside is increased to 20 per day from 10 per day before the rehabilitation.
  - The income is increased by 40% after the road rehabilitation, mainly due to increases in the number of the customers, and he scaled up his shop in 2014 with purchasing more varied goods for his shop.
- Changes in his own travel behaviors after the project:
  - He uses a motorcycle, purchased in 2007, to bring his two children to Hun Sen Mong Primary School or meet with his friends along the project roads.
  - He uses the project road only for special occasions, like meeting with friends since he was in Moung Ruessei High School and attending parties.
- Education:
  - He expects the school to help his children to build/develop his capacity and gain knowledge, for getting well-paid jobs.

8. December 15, 2016 (14:48-15:20)

- Location: Ta Loas Market (Veal Village, Ta Loas Commune) (Residence: Stun Thurey Village)
- Sex: Female
- Age: 38
- No. family members: 3 (including her husband and son)
- Household head or not: No
- Asset owned: a house, a shop operation right, rice field
- Mode owned: a motorcycle, one bicycle
- Major income: US$ 25 per day from sales in the market

- Length of stay: Since 2009 (about 7 years)
- Final academic record: High School
- The number of family member(s) who attend(s) school: Two
- Economic activities:
  - They sell vegetable, fruits and tea (black and green tea).
  - Before the rehabilitation, the road condition was not good, as there were many potholes over the muddy surface. But the current smoothened surface can shorten travel time to markets.
  - The shop business started in 2012 with expectation of increases in customers and people using the road after the rehabilitation works completed. She pays US$ 3 per month to the leader organizing the market.
  - She visits the Moung Ruessei Market by motorcycle to purchases vegetable and products. The busiest time at the market is 07-09 am.
  - After the road was rehabilitated, more people started mobile shops selling and delivering vegetables from the Moung Ruessei Market and daily commodities to individual houses. Hence, the business becomes more competitive.
  - Income from rice production and sales increased to US$750 for 10 tons in 2015 from US$500 for 6 tons before the rehabilitation works were held.
  - She closed the shop when busy particularly for attending school events for their children.
- Travel behaviors:
  - In 2014, her family bought a bicycle for US$ 24 and a motorcycle in 2014 for US$ 1,900 without borrowing any money from outside.
  - She can save her travel time to the Moung Ruessei Market by motorcycle from 20 minutes to 10-15 minutes.
- Education:
  - She expects the school and its good teachers to provide her child with supports to build/develop his capacity and gain knowledge, for getting well-paid jobs.

9. December 15, 2016 (15:31-16:10)

- Location: Chong Prolai Village, Ta Loas Commune
- Sex: Male
- Age: 38
- No. family members: 4 (including his father, wife and a daughter)
- Household head or not: No (his father was HH head)
- Asset owned: a house
- Mode owned: a motorcycle, two bicycles
- Major income: US$ 5 per day from motor taxi business, and some extra from selling fishes which he catches from rivers with using nets
- Length of stay: Since 2009 (about 7 years)

- Final academic record: 5th grade
- The number of family member(s) who attend(s) school: One
- Economic activities:
  - He started the motor taxi business before the civil works started (maybe in 2013), as he was not able to get employed to other jobs. He considers one of the reasons as he completed only 5th grade.
  - Before the civil works started, the number of customers per day was only 3-4, while the number after the works completed was increased to 7-10. One of possible reasons for such increases is the reduction in travel time each person from 30 minutes to 20 minutes.
  - The average price per customer is KR 3,000, almost double than the one of KR 1,500 before the rehabilitation, partially because of increases in petrol prices (from KR 3,900 per liter to KR 4,350 per liter). Prices are not fixed and subject to negotiation with customers and their travel distance.
  - His major customers are residents around his house, e.g., in the villages in Chrey and Ta Loas communes. Their major destination is the Moung Ruessei Market, while he brings to the village or around from person from the national road or the Moung Ruessei Market. His business area is limited to 1BB4.
- Travel behaviors:
  - He bought a motorcycle before the civil works started (in 2012 or 2013) for US$1,800 to start his motor taxi business.
  - Two bicycles were obtained for US$ 40 each in 2008, one of which is mainly used by his wife for daily activities.
- Daily livelihoods:
  - They purchase food (vegetable, rice, fruits and so on) at the Ta Loas Market. Or, they harvest vegetables and/or fruits in their garden for self-consumption.
  - They consume the rice of 50 kg for two months, which costs US$ 25. Prices of rice are the most expensive in April-May while the lowest in November-December.
- Education:
  - His daughter is 6 years old, but is allowed to study in the 2nd grade due to her good performance.
  - He expects his daughter to gain knowledge and experience interactions with teachers and other students for her growth and getting well-paid jobs.
  - Her class has around 40 students.

10. December 15, 2016 (16:18-17:00)

- Location: Ta Loas Commune
- Sex: Male
- Age: around 40

- No. family members: 5
- Household head or not: No
- Asset owned: a house, land, a shop inside his land, 2 rice fields
- Mode owned: three bicycles and one motorcycle
- Major income: US$ 2,000 for 10-ton rice sales (US$ 1,000-1,500 before the road improvement), plus sales of home-made white wines
- Length of stay: Since 2009 (about 7 years)
- Final academic record: High School
- The number of family member(s) who attend(s) school: Two
- Changes in business after the project:
  - He never brings his rice to markets or areas along the national road for sales, as local traders approach regularly. Those traders, based in Battambang City, offer prices to him when receiving orders from people (individuals or traders) in Phnom Penh. His income from rice sales increases more than twice since the road rehabilitation.
  - He transports rice from his rice fields to his house by a koyon borrowed from his neighbors and polished rice.
- Changes in his own travel behaviors after the project:
  - He purchased two bicycles in 2013 and one in 2014 for their daughters to go to schools for US$ 80 at average, and one motorcycle in 2004 for US$ 1,950. He did not borrow any money for those purchase.
  - He goes by motorcycle to his two rice fields. For the nearer, the travel time remains 5 minutes, while the travel time to the farther is reduced from 30 minutes to 10 minutes.
  - Before the road rehabilitation, it took 45-60 minutes on foot to Ta Loas Secondary School and to Moung Ruessei High School, while it takes 20 minutes to the secondary school and 25 minutes to the high school.
  - The motorcycle is used mainly by him for going to rice fields and markets and his wife's errands.
  - More people from outside, including ones whose hometown was around the village, are observed to come to his village or its surrounding areas after the road rehabilitation, particularly during the Khmer New Year.
- Daily livelihoods:
  - To buy foods, his family goes to Moung Ruessei Market or Ta Loas Market by motorcycle.
- Education:
  - He has three daughters, out of which one goes to Moung Ruessei High School, another is in Ta Loas Secondary School and the last stopped at 10th grade.
  - A reason for the daughter's stopping the education was that she did not want to continue studying. The other two are willing to continue studying until obtaining a bachelor's degree. The one in the high school wants to go to a university in Battambang.

- He expects his daughters to acquire knowledge from good teachers, which would help them to get well-paid jobs in their future.

11. December 16, 2016 (11:13-11:45)

- Location: Tuol Prom Village, Kakoh Commune
- Sex: Female
- Age: mid 30
- No. family members: 8 (including her husband, and four children)
- Household head or not: Yes
- Asset owned: a house, a shop attached to the house, rice field, land where the house was located (under her father)
- Mode owned: one bicycle
- Major income: KR 7,000 per day, plus US$ 400 in 2015 from 2-ton rice production and sales (before the road rehabilitation, only US$ 300)
- Length of stay: Since her birth
- Final academic record: 3rd grade
- The number of family member(s) who attend(s) school: Two
- Economic activities:
  - She started her business in January 2015, after the road was rehabilitated. She sells soft drinks, snacks, bread, kitchen supplies, vegetable and so on, which are purchased by herself at the Moung Ruessei Market twice a week at 0700-0830 am. At one purchase, she spends approximately US$ 50 each time, and round-travel cost is KR 7,000 either by *tuk-tuk* or motorcycle taxi. She sells rice produced in her rice field, too. This shop business helps her family's livelihoods, as the major income source was solely from selling rice before she started the shop.
  - Major customers are travelers from outside the village to buy drinks, neighbors around her house and students from the school nearby (Tuol Prom Primary School) and her brother's English school to buy snacks and drinks.
  - She expects continuous growth of her business for future.
  - Her brother started his English school in January 2015 too (5 days later than her business). He utilizes his available time weekdays, while he attends a weekend bachelor program in a university in Battambang. He opens his class in the morning, afternoon and evening time, and the number of students is 40, 25 and 20 each session. The monthly fee is only US$ 3.
- Travel behaviors:
  - She bought a bicycle in 2015 for her children to go to school. The price was US$ 40.
  - To her rice field, she travels by bicycle or on foot, and transports rice from the field to her house by a koyon of her neighbors. The travel to the fields becomes easier than before as the time shortened from 1.5 hrs to 1 hr only.

- Education:
  - She has three daughters (13 years old, 3 years old and 8 months old) and one son (11 years old). The eldest goes to Kakoh Secondary School and the son to Tuol Prom Primary School.
  - She expects her children to acquire knowledge to get well-paid jobs unlike workers in garment factories and rice fields.

12. December 16, 2016 (11:48-12:30)

- Location: Tuol Prom Village, Kakoh Commune
- Sex: Female
- Age: around 50
- No. family members: 8 (including her husband and 4 children (17, 15, 11 and 9 years old))
- Household head or not: Yes
- Asset owned: a house, rice field, land where the house was located
- Mode owned: one bicycle and one koyon
- Major income: KR 20,000 from selling fishes her husband catches, plus US$ 40-50 remitted irregularly from her son in Thailand and fees gained at renting out her koyon to her neighbors (KR 10,000 each time)
- Length of stay: Since her birth
- Final academic record: 4th grade
- The number of family member(s) who attend(s) school: Four
- Economic activities:
  - No major change in her family's economic conditions
  - Rice produced in her field is not for sales, mainly for their self-consumption, due to the small production amount.
- Travel behaviors:
  - She bought a bicycle in 2013 for her second child (boy) to go to Kakoh Secondary School. The travel time is 0.5 hrs. Before the road rehabilitation work started, he went to Tuol Prom Primary School on foot for 10 minutes. Her 9-year old daughter also travels to the school on foot for 10 minutes.
  - She bought a koyon to transport rice from the field to her house, but as the field was divided with her children, the production amount was reduced and the koyon was no longer used for that purpose.
- Education:
  - She expects her children to acquire knowledge including newly developed high technologies to get well-paid jobs in companies.
  - She is satisfied with performances of her children's teachers.

13. December 16, 2016 (13:25-14:10)

- Location: Kakoh Village, Kakoh Commune
- Sex: Male
- Age: 51
- No. family members: 6 (including his wife, one daughter, one son-in-law and two grandchildren)
- Household head or not: Yes
- Asset owned: a house, land where the house was located
- Mode owned: one bicycle and one pick-up
- Major income: KR 50,000-60,000 from her husband's taxi business, plus income from selling pigs to people from Moung Ruessei Market and renting a pick-up vehicle to her neighbors
- Length of stay: Since her birth
- Final academic record: 4th grade
- Economic activities:
  - No major change observed in her husband's taxi business, as his customers remain same in his village and in the Moung Ruessei Market.
  - Her husband operates taxi business on his own for more than 10 years.
- Travel behaviors:
  - She bought a motorcycle in 2013 for US$ 1,800 for her husband and first daughter with expectations to travel around more easily after the civil works completed, and a bicycle in 2015 for KR 400,000 for her children to go to school.
  - For her daughter, before the road rehabilitation, she walked to Kakoh Secondary School for 30 minutes and eventually stopped at the 8th grade due to travel burdens to herself.
  - Saving travel time enables her to spend more time on chatting with her neighbors and housekeeping tasks including taking care of her grandchildren.
- Daily livelihoods:
  - Her family buys daily foods at Moung Ruessei Market or from mobile shops around her house. Before the road was rehabilitated, her travel time to the market was around 30-40 minutes but now reduces to 20-25 minutes.
  - They buy rice from their neighbors.
- Education:
  - She expects her children to get knowledge at school for their future.
  - Her son stopped to go to school at the 10th grade, as he wanted to start business. She respected his decision.

14. December 16, 2016 (13:57-14:35)

- Location: Kakoh Village, Kakoh Commune
- Sex: Female
- Age: 55

- No. family members: 8 (including her husband, son, daughter, son-in-law, and grandchildren)
- Household head or not: Yes
- Asset owned: a house, land where the house was located, rice field
- Mode owned: one bicycle, three motorcycles, two koyons
- Major income: US$ 100 remitted from his son in Battambang, plus sales of rice produced in the field (KR 8 million in 2015)
- Length of stay: Since her birth
- Final academic record: 4th grade
- The number of family member(s) who attend(s) school: Two
- Economic activities:
  - Rice production and sales is increased from KR 5-6 million before the road rehabilitation. All the customers are individuals around her house for their daily livelihoods, not traders for bulk purchase.
  - Rice prices are determined subject to negotiation.
  - She and her family never brought their rice to any market or road-side area, as their customers approach them to buy.
- Travel behaviors:
  - Her family bought a bicycle in 2016 for her grandchild for KR 370,000, one motorcycle in 2016 for US$ 2,300 and two for US$ 1,300 each before the civil works started, and two koyons in 2007 for US$ 2,200.
  - Three motorcycles are used by her son, daughter and son-in-law for their daily travel, while the bicycle is for her grandchild of 4th grade to go to Kakoh Primary School. Before having the bicycle, he walked.
- Daily livelihoods:
  - Her family brings daily foods from shops around her house.
- Education:
  - One of her daughters goes by motorcycle to a university in Battambang.
  - She expects her children to acquire good knowledge for getting employed in well-paid business works rather than working in rice farms.

15. December 17, 2016 (09:50-10:30)

- Location: Krang Skear Village, Krang Skear Commune
- Sex: Male
- Age: 40-50
- No. family members: 3 (including his wife and son)
- Household head or not: Yes
- Asset owned: a house, land where the house was located
- Mode owned: one bicycle and one motorcycle

- Major income: US$ 300
- Length of stay: Since her birth
- Final academic record: 5th grade
- The number of family member(s) who attend(s) school: One
- Economic activities:
  - He started motorcycle taxi business in 2015, as he retired from the village council and only small initial investment was needed for starting. He earns around US$ 50 (US$5-10 per day).
  - In addition, he earns income from selling chickens at his house (US$ 130, monthly at average) and pensions from the government as he served the village council for many years.
  - He does not find any change in the business environment of selling chickens, as prices remain same. However, to check market prices in Pongro Market, he can now travel there in 40 minutes, while 1-1.5 hrs before the road rehabilitation.
  - The bicycle was purchased in 2014 for KR 180,000 for his son to go to Krang Skear Primary School.
- Travel behaviors:
  - He purchased a motorcycle in 2008 for US$ 1,800 for his daily commuting to the village council.
- Daily livelihoods:
  - His wife stays at house and sometimes goes by motorcycle taxi to Pongro and Romero Markets. To Pongro Markets, it took one hour and costed US$ 8 before the road rehabilitation but now 0.5 hrs and US$ 4, while to the Romero Market, it took 5 hrs by lorry and US$ 3 before and now reduced to 0.5 hrs and US$ 2-2.5 by motorcycle. She increases the frequency to visit relatives' houses and Phnom Penh as the road rehabilitation enables her to go when needed. To Phnom Penh, she takes a local taxi, charged with US$ 5, from her house and visited for special occasions, while she could go there only once a year before the road rehabilitation.
  - Daily food is purchased at South Krang Skear Market, where his house is located. The rice price is increased to US$ 30 per 50 kg while KR 70,000 before the road rehabilitation, and similar increases are observed in other products' prices. However, such increases might be canceled out by conveniences gained from the road rehabilitation.
- Education:
  - He and his wife expected her son to acquire knowledge at school to get a job in the government, including the village council as himself, as the benefits were good. For that, his son is required to complete the high school education.

16. December 17, 2016 (14:31-15:00)

- Location: Krang Skear Village, Krang Skear Commune
- Sex: Female
- Age: around 30

- No. family members: 3 (including her husband and daughter)
- Household head or not: Yes
- Asset owned: a house, land where the house was located, shop
- Mode owned: one bicycle and one motorcycle
- Major income: US$ 250
- Length of stay: Since her birth
- Final academic record: 3rd grade
- The number of family member(s) who attend(s) school: None
- Economic activities:
  - She sells snacks, soft drinks, oil, soap, notebook and pen, and purchases those from suppliers from Kampong Chhnang, Pusat and Phnom Penh.
  - She started the roadside business in 2013, but the total income for her household remains at US$ 250. She also earns US$ 100 annually from rice production and sales.
- Travel behaviors:
  - She purchased a motorcycle in 2014 for US$ 500 for his husband to start his new business of buying animals like cows. She also uses when needed.
- Daily livelihoods:
  - She purchases daily food at Pongro Market. Her travel time to the market by motorcycle is shortened from 2 hrs to 1 hr.
  - Around the area, she never finds any mobile shop selling vegetable and daily commodities.
  - The road condition is better and enables her to visit friends more often. Further, she finds more people to travel along the road.
- Education:
  - Her daughter is 6 years old and will go to Oukoki Primary School. She expects her daughter to go to high school at minimum for getting a well-paid job, and is also supportive if the daughter wants to go to a university and has adequate capacity for further study.

17. December 18, 2016 (13:12-14:01)

- Location: Tropeng Mlu Village, Krang Skear Commune
- Sex: Female
- Age: 60
- No. family members: 3 (including her husband and daughter)
- Household head or not: No
- Asset owned: a house, land where the house was located, shop
- Mode owned: one bicycle and one motorcycle
- Major income: US$ 100 (Before: below US$ 100)
- Length of stay: Since her birth
- Final academic record: 9th grade

- The number of family member(s) who attend(s) school: None
- Changes in business after the project:
  - Main income sources include (i) rice production, (ii) sales of pigs, (iii) monthly salary to receive as the deputy village chief (US$ 35), and (iv) daughter's shop operation.
  - The income in 2015 from producing and selling rice was $2,500 for 12 ton, while US$ 1,200 for the amount smaller than 12 ton before the road rehabilitation. The increase in the production amount was because her daughter and son, working in Phnom Penh, are now able to help her couple and the manpower for rice production is increased.
  - Rice is sold to 3 persons, out of which one comes from Top Srauv Market since before the road improvement and two come from Pongro Market only after the improvement. Her family never brought to any market.
  - Her daughter started her new business in 2014 to sell cosmetics and make-up goods in a part of her land. She buys those products in Pongro Market or Kampong Chnnang City by herself.
- Changes in her/her family's travel behaviors after the project:
  - She purchased a motorcycle in 2006 for US$ 1,800 and a bicycle in 2004 for US$ 30. The motorcycle was for her husband's business, and the bicycle was for their two children to go to school.
  - There was no mobile shop seen.
  - She uses both bicycle and motorcycle upon her purpose to travel. Her travel time by motorcycle to Pongro Market is 0.5 hrs after the road rehabilitation, shortened from one hr.
  - Her husband went to their rice field on foot or by motorcycle. Since the field was close to their house, the travel time remained almost same, 0.5 hrs on foot and 10-15 minutes by motorcycle.
  - The road improvement generates savings in her/her family's travel time and enables them to travel outside their house more easily, for instance, visiting their relatives more frequently, and avoid missing business opportunities to sell their products.
  - As travel time is saved due to the road improvement, she has more free time, which enables her to utilize her time more flexibly for staying longer at home or working on whatever she needs to do.
- Daily livelihoods:
  - She purchases daily food at Pongro Market.
- Education:
  - She has a son and a daughter, and her daughter operates her business along the road since 2014 and contributes to her family's incomes. Both of them graduated from Pongro High School, but only the son finished a university in Kampong Chhnang City. He works in Phnom Penh.
  - They went to the lower secondary school by bicycle for 1.5 hrs due to the impassable road condition and to a secondary school along the national road No.5 for around one hour and 45 minutes. Those travel times at present may be shortened now, while they finished the degrees

before the road improvement. They went to Krang Skear Primary School.

- She observes increases in the number of students enrolling to Pongro High School.

18. December 18, 2016 (14:10-15:02)

- Location: Tropeng Mlu Village, Krang Skear Commune
- Sex: Male
- Age: 35
- No. family members: 3 (including her husband and daughter)
- Household head or not: No
- Asset owned: a house, land where the house was located, shop
- Mode owned: one bicycle, one motorcycle, and one koyon
- Major income: US$ 850 for selling two-ton rice, plus daily seasonal employment in the neighbor's bean fields (US$ 4 per day x 2 (himself and his wife)) in February-May
- Final academic record: 9th grade
- The number of family member(s) who attend(s) school: Three (Two of 14 years old in the secondary school and one of 10 years old in the primary school)
- Changes in business after the project:
  - His family sells rice and earned US$ 850 for two ton in 2015, while KR two million per year before the road improvement.
  - They have two customers from Pongro Market since before the road improvement.
  - Before the road improvement, rice was transported to the market by lorry.
  - Before the road improvement, they produced palm sugar with using palm trees nearby their house, which was however not well profitable. Since 2013, he and his wife have engaged in seasonal employment opportunities (February-May) to work in their bean farms and earn US$ 4 per day each.
- Changes in her/her family's travel behaviors after the project:
  - His family bought a bicycle in 2015 for US$ 50 as a replacement of the broken.
  - The motorcycle was purchased in 2014 for US$ 900 for him to travel more outside for various purposes, including visiting friends.
  - His mother does not use either the bicycle or the motorcycle and travels around on foot only, but he gives a ride to her by motorcycle when she wants/needs.
  - The road improvement saves his/his family members' travel time and increases free time and flexibility on their daily time use. For instance, his mother can stay at home longer and get engaged in more housekeeping works.
  - He bought a koyon in 2014 for US$ 1,100 (Gains from selling three cows for US$ 2,000 in total (US$ 750 x 2+US$ 500), out of which US$ 900 was spent for a motorcycle). The koyon helps him to go to his rice field, 3 km far from his house, in shorter time (one hour by foot before, but now 0.5 hours), transport rice from the field in the harvest season and earn

additional incomes by renting out to his neighbors (US$ 2.5 each time).

- Daily livelihoods:
  - His family buys their daily food from mobile shops since before the road improvement. Those shops offer more expensive prices to goods (for instance, KR 14,000 per kilo for meat, while KR 10,000 in the market), but they accept as they can save time and cost for traveling to the market. Prices generally are higher than ones before the road improvement.
- Education:
  - His twin are 14 years old, 8th grade, and his youngest is 10 years old, 4th grade.

19. December 19, 2016 (15:03-15:49)

- Location: Toul Sophi Village, Toul Sophi Commune
- Sex: Female
- Age: 45
- No. family members: 8 (including her husband, son (26), daughter-in-law, 1st daughter (24), son-in-law, 2nd daughter (16), and two grandchildren)
- Household head or not: Yes
- Asset owned: a house, land where the house was located, a shop (used for free from the village leader), and rice field
- Mode owned: one motorcycle
- Major income: US$ 250-500 per month, from the shop operation, no seasonal fluctuation
- The number of family member(s) who attend(s) school: One
- Economic activities:
  - The number of customers increases to 10-20 per day, while 5-10 per day before the road rehabilitation. The number of student customers from Tuol Sophi Primary School remains same as 10-20 per day.
  - Her family produces rice of one ton, but did not sell recently because that was mainly for self-consumption. She values this year production approximately US$ 125 as the quality was not good and the amount for consumption was reduced to 600-700 kg while valuing US$ 175 for 2015.
  - Her husband helps her business and/or stays home to look after furniture, while her son takes care of a cow (female, 1-2 years old). A pig was also there but recently died, which means “economic loss” for her household. Her family expects to have baby cows a few years later to sell and earn additional incomes. Her first daughter manages her business in a small stall inside Tuol Sophi Primary School to sell snacks and soft drinks.
  - She buys banana and rice for her business in Ou Reang Ov Market once every 10 days with helps of her husband and son to transport them to her shop. The market is located 8 km far from her shop and it takes 20 minutes by motorcycle after the road improvement while one hour before the improvement.

- Travel behaviors:
  - Her family bought a second-hand motorcycle for US$ 150 in 2013-2014, which is used by her family members, to ease their daily travel for themselves and her business. The reason for purchasing the second-hand were (i) its price was reasonable and (ii) it was not attractive to be stolen if she leaves it outside her shop. Her family could not afford to buy a new as they had to repay to the loan from a microfinance nongovernmental organization for building their house in 2008.
  - Her daughter's couple use the son's motorcycle.
- Daily livelihoods:
  - Her family buys daily food at Ou Reang Ov Market and shops alongside the road and does not use any mobile shop.
  - The abovementioned one-ton rice sufficed her family only for half a year. Hence, the family needed to purchase rice every month in the rest. The price was averagely US$ 22.5 per bag of 50 kg.
- Education:
  - Her son and first daughter stopped at 9th and 7th grade respectively, due to insufficient money for their schooling. Before their stopping, she explained them such family issues and they agreed to stop.
  - Afterwards, her son went to Phnom Penh for to work but returned home recently as he became sick. Her daughter went to Kampong Cham Town to work but alike returned home.
  - Her second daughter went to Ou Reang Ov High School and stayed in a house within a walking distance from the school. She paid less than US$ 10 per month for rent. She hopes her daughter to go to a university for acquiring further knowledge, if the daughter is qualified, get employed in a well-paid job and provide some financial supports to her family.

20. December 20, 2016 (9:08-10:06)

- Location: Chak Village, Chak Commune
- Sex: Female
- Age: 53
- No. family members: 4 (including her husband, daughter (27), and son-in-law)
- Household head or not: Yes
- Asset owned: a house, land where the house was located, rice field
- Mode owned: one motorcycle, one car and one koyon
- Major income: US$ 75 for 700-kg rice sales in 2015, and incomes from contracted employment of her daughter's couple in neighbors' rice fields and cassava plantations.
- Final academic record: 2nd year
- The number of family member(s) who attend(s) school: None
- Economic activities:

- Before the road improvement, her couple sold rice for US$ 25 and kept the rest worth of US$ 225 for self-consumption. In 2015, they earned US$ 75 from rice selling with increasing the self-consumption at the worth of US$ 425. That is because her couple purchased their additional lands 2 or 3 years ago and their daughter's couple returned from Thailand and joined their rice production works in June 2015. For purchasing the land, she used the saving in her house.
- In 2015, their produced rice's price was increased to KR 1,000 per kg for grade one (the highest quality) and KR 700-800 per kg for grade two or three. However, due to poor quality of their rice in 2016, the price was down to KR 700 per kg. The price per kg before the road improvement for grade one was around KR 700, but considering recent currency inflation, the real value could be almost same.
- They sell their produced rice to the whole rice buyer in front of her house who moved to live 2-3 years ago, and the above prices are offered by the buyer. Before its family moved in, her couple had to transport rice by her koyon to Chak Market, 2 km far from her house or some buyers approached by truck.
- They bought a rice mill machine in 2011 for US$ 700 and a binder in 2014 for US$ 250 for easing their rice production works in the harvest season, which were both second-hand but fixed by her husband.
- Their daughter's couple also gets employed in seasonal contracted works in the others' rice and cassava fields. The couple earns US$ 5 (US$ 2.5 x 2) per day in rice fields in November-December, while US$ 3-5 per day in the remaining 10 months. They work for 7 days for a whole year, and the daily fees are almost same through a year though depending on their employers.
- They produce rice once a year.

・ Travel behaviors:
- In 2011, her family bought a koyon for US$ 1,000 so as to transport harvested rice from their field to their house with selling a buffalo for US$ 200, borrowing money from her relative (US$ 100) and daughter (US$ 250) and using her saving money for the remaining of US$ 450. The repayment to the loan of US$ 350 was completed within a year.
- They bought also a motorcycle for US$ 1,000 in 2011 with remittances from her daughter, and a car for US$ 2,000 in 2016 with borrowing money from a microfinance NGO in Ou Reang Ov to ease their daily travel. The monthly interest rate of the loan is 2.5%, and the repayment schedule was not fixed.

・ Daily livelihoods:
- They buy vegetable and meat, only if they had extra money, in Chak Market. After the road improvement, they buy those from mobile shops and trucks from Suong Market. The truck is operated by a member of their village and brings daily food from Suong Market. Prices are determined through individual negotiation.

- Their food expense decreases after the road improvement.

・ Education:
  - Their daughter stopped the schooling at 7th grade to take care of her because she was hospitalized in Phnom Penh. Their son-in-law completed the high school education.

21. December 20, 2016 (10:53-11:30)

・ Location: Yeak Tbong Village, Damril Commune
・ Sex: Female
・ Age: 60
・ No. family members: 2 (including her husband)
・ Household head or not: No
・ Asset owned: a house, land where the house was located, rice field
・ Mode owned: one motorcycle, and one bicycle
・ Major income: US$ 600 for 2 tons per annum
・ Final academic record: No schooling
・ The number of family member(s) who attend(s) school: None
・ Economic activities:
  - Their major income source is rice sales, and the total amount was KR 2.5 million for two tons before the road improvement while US$ 600 after the improvement. The number of the customers is reduced from 4-5 traders to 2-3, subject to the price negotiation. They are mainly from Damril. However, the road improvement enables traders to approach them for price negotiation.
  - They produce rice once a year and transport their rice to their house for milling by koyon, borrowed from their neighbor for KR 25,000 per day (two days normally in the harvest season).
・ Changes in her/her family's travel behaviors after the project:
  - The family purchased a second-hand motorcycle in 2015 or 2016 for US$ 700 because of (i) willingness to travel more and (ii) following their neighbors' purchase, and a bicycle for KR 30,000 more than 10 years ago for their son to go to school.
  - She changed travel behaviors to markets as below. Her main travel mode is motorcycle taxi or walk, as the bicycle is for her husband to travel around their house and visit the pagoda and the motorcycle is with their son.

Market	Visit frequency		Mode used	Round-trip cost
	Before road improvement	After road improvement		
Suong	Once every 3 months	Once a month	Motortaxi	US$ 5
Ou Reang Ov	Never	Once a month	Motortaxi	KR 15,000

・ Daily livelihoods:

- She buys food, including vegetable and meat, in Yeak Chhnang Market.

・ Education:
  - Their son stopped schooling at 10th grade as their poor economic situation did not allow him to go to high school. To attend high school, around KR 30,000 was needed for maintain his school life, which covered the costs of textbooks, notebooks, foods, stationaries and so on. Afterwards, he studied mechanics by himself and opened a shop repairing motorcycles in June 2015 in his aunt's land in Kampong Thom.

22. December 21, 2016 (10:14-11:00), inside Chak Market

・ Location: Chak Village, Chak Commune
・ Sex: Female
・ Age: 45
・ No. family members: 7 (including her mother, husband, children (24 and 4 years old) and nieces (14 and 11 years old))
・ Household head or not: Yes
・ Asset owned: a house, land where the house was located, rice field (for renting the others out)
・ Mode owned: two motorcycles, and one bicycle
・ Major income: KR 150,000 per day from shop business (for this season), there is seasonal fluctuation in her daily income because people tend to catch fishes by themselves in the river and ponds, instead of coming to shops to buy, as more fishes are available there during the dry season. In the rainy season, her income is around KR 300,000.
・ Final academic record: 4th grade
・ The number of family member(s) who attend(s) school: Two
・ Changes in business after the project:
  - She started her shop business along the road since December 2015 due to her two findings: (i) more people started to use the road and (ii) neighbors started new business along the road. She purchases vegetable and fishes in Ou Reang Ov Market every morning by motorcycle.
  - Her family engaged in producing and selling rice even before the civil works commenced, and sold two ton for US$ 750. The amount for sales was reduced since 2015 to 500 kg and her family earned US$ 100 in 2015 because of the recent drop in rice price. The remaining 150 kg was kept for self-consumption.
  - They produce rice once a year. When needing more help for works in their rice field, the family seeks help to neighbors. When the neighbors need help, they join. Such labor exchanges are popular in their area.
  - Before the civil works commenced, 6-7 traders approached from Ou Reang Ov Market to buy their rice. They still approach to buy, though their amount to purchase is smaller. Those traders sell the collected rice to Vietnam.
  - During civil works, her husband was employed.

- Changes in her/her family's travel behaviors after the project:
  - She goes to Ou Reang Ov Market every day for her business by motorcycle for 15 minutes after the road improvement, while she went to Suong Market by motorcycle for 0.5 hours earlier. Suong Market was farther but better than Ou Reang Ov Market at that time, but after the road improvement, she finds that Ou Reang Ov Market more accessible and convenient.
  - Her family purchased a motorcycle for US$ 2,000 in 2006 with using the money saved in her house, and another for US$ 120 in 2016. The first is used mainly by her husband to travel to their rice field, and sometimes by her to travel to the rice field and Suong Market. Another, a second-hand, is mainly for her to go to the field and Ou Reang Ov Market.
  - To transport their rice from the field to their house, her family borrowed a koyon for KR 100,000 one time in a season before the road improvement, but now borrows a truck for KR 150,000. Before the road improvement, some sections could not be passable by koyon in the flood season.
  - Her mobility is improved as she is able to travel more often and save her travel time. Further, she observes more people on the road from inside the commune, though not many people are found from outside the commune.
- Daily livelihoods:
  - She purchases daily food in Ou Reang Ov Market.
  - She notices increases in prices of foods after the road improvement. For instance, a price for 1-kg fish increased from KR 8,000 to KR 10,000-12,000. She also finds business environment around her area became competitive due to progressive increases in shops and mobile shops.
- Education:
  - Her 14-year old niece goes by bicycle to Hen Samrin Secondary School, and attends at a private teaching class at her school teacher's house. The private teaching schedule is up to the secondary school's schedule and flexible and her family pays to the private teaching class for KR 5,000 per day.
  - Her 11-year old niece goes to Chak Primary School by walk for 15 minutes, though sometimes she brings her niece by motorcycle to the school.
  - Her 24-year daughter completed a bachelor program of accounting and works as an accountant in Phnom Penh.
  - She expects her daughters and nieces to acquire more knowledge in schools and get engaged in well-paid jobs.

23. December 21, 2016 (11:28-11:45) T. Mill Rice

- The company was established in 1985, of buying rice from farmers in Tboung Khmum and Kampong Thom Provinces and selling to shops in Ratanakiri Province, where little rice was produced.
- The company staff approaches farmers along the project road to purchase mainly from December

to April. Prices are determined upon their negotiation, considering seasonal fluctuations, and different among those farmers.

- Rice prices have been generally increased around the road, due to the improvement of its road surface. Before civil works commenced, their trade partners needed to bring their rice to the firm, but now they no longer need to bring. The change is one of the contribution to recent rice prices' improvement.
- The company sold 10 tons per day to other areas in Cambodia before the road improvement, but now 30 ton per day. During the harvest season, it bought 15 ton per day from local farmers before now increased to 50 ton per day (as of 2015).

24. December 21, 2016 (12:32-13:30)

- Location: Thmey Village, Kong Chey Commune
- Sex: Female
- Age: around mid 30s
- No. family members: 8 (including her husband, grandfather, and 5 children)
- Household head or not: Yes
- Asset owned: a house, land where the house was located, rice field (for renting the others out)
- Mode owned: two bicycles
- Major income: US$ 150 earned by her husband as a driver for a company in Ou Reang Ov, US$ 60 from rice production and sales in 2015.
- She stayed at her place since her birth.
- The number of family member(s) who attend(s) school: Three
- Economic activities:
  - It was hard for her family to travel to Ou Reang Ov Market before the road improvement as the road surface was rough and slippery and it took approximately 50 minutes to go by motorcycle, but she experiences decreases in travel time now. She can travel to the market by motorcycle taxi only for 3-4 minutes, but the price increases to KR 2,000 per time to KR 1,000.
  - Her family bought two bicycles in 2012 for $50 each. One is for her daughter of 10 years old (4^{th} grade), as she thinks her daughter is old enough to use. Since then, she goes to school and Ou Reang Ov Market by the bicycle.
  - Her daughter suffered from rough conditions of the road before the improvement, because of mud spatters made her uniform dirty and dusty on the way to school, which was however resolved after the improvement. Now, she feels scared at faster driving.
  - Another bicycle is used by her grandfather to go to the pagoda on holidays.
  - Her own primary travel mode is still a motorcycle taxi, though sometimes using one of the bicycles in her house when available.
- Daily livelihoods:
  - She finds mobile shops only after the road improvement, but normally goes to Ou Reang Ov

Market to buy daily foods like vegetable, rice and meat.

- Her family owns rice fields but rents out to other people and shares the total sales. Hence, her family has to buy rice when needed. She purchased about 10 bags and paid US$ 20 per bag before the road improvement, while she purchases 12 bags and pays US$ 25 per bag (50 kg).

・ Education:

- She has four children, out of which the eldest of 13 years old goes by bicycle to Ou Reang Ov Secondary School and the second of 10 years old and the third of 7 years old go to Ou Reang Ov Primary School on foot or are brought by herself on bicycle. She pays KR 5,000 per day for the eldest and KR 3,000 for the second and third each for their schooling, including lunch, snacks, notebooks and whatever needed for their study in the school. The fourth of 3 years old and the fifth of 2 years old stay with her at home.
- She expects her children to gain knowledge in the school and enjoys good opportunities to get employed in good conditioned jobs. For that, she wants them to complete high school education at least.

25. December 22, 2016 (09:59-10:20) K. Rice Mill

・ The road improvement has made little change in the company's business, as the company is located around the road's entrance/exit point.

・ 10 traders along the road sell to the company rice collected from farmers to the company since before the road improvement until now. There is no change in them.

・ The company negotiates with those traders and determines prices, based on price information of Soung Market. The price per kg was increased from KR 850 before the civil works started to KR 1,360-1,400 in 2015, though a drop in the price was observed in 2016 likely because there was extra rice in the country due to the government's recent policy related to export of rice. The amount to purchase was not changed significantly, and the amount remains around 20 tons since before the civil works.

・ After collected, the company transports rice to its partners in Kroch, Stung Treng, Ratanakiri and Mondulkiri Provinces, who chronically suffer from the shortage.

26. December 22, 2016 (11:07-12:00)

・ Location: Rokakhhnoch Tbong Village, Chikor Commune

・ Sex: Female

・ Age: 39

・ No. family members: 6 (including her husband, grandfather, 2 children and a nephew)

・ Household head or not: No

・ Asset owned: a house, land where the house was located, and rice field

・ Mode owned: one motorcycle and one bicycle

・ Major income: US$ 150 per month earned by her husband with working in a construction company

in Suong, and US$ 500 from rice production and sales (in 2015).

- Final academic record: 3rd grade
- She stayed at her place since her birth.
- The number of family member(s) who attend(s) school: Three
- Economic activities:
  - She sells two-ton rice her family produced for US$ 500, though she sold only US$ 150 for the smaller amount before the road improvement. The reason for the increase was the rise in rice prices in 2015. One trader approaches by truck to buy her rice, while by motorcycle before the road improvement.
  - Her family produces rice twice a year, which is popular around her house. The first season is from April to August and the second from mid of September to December. Their annual production is two tons.
  - Since 2016, she has occasionally helped a company of coordinating ceremonies and parties, when the company needs more help from local population. She earns KR 50,000 per day.
- Travel behaviors:
  - Her family purchased a motorcycle in 2013 for US$ 600. For the purchase, she borrowed money from her brother and paid the rest with her savings in her house. The motorcycle is for use to go to hospitals and for her husband to travel to his workplace in Suong. In addition, she purchased a bicycle in 2010 for KR 40,000 for her traveling to the rice fields and accompanying her children and nephew to their schools.
  - She travels to rice fields by motorcycle for 15 minutes after the road improvement, but couldn't use any mode before due to the rough road surface and had to walk for 30 minutes.
  - As her daily travel time decreases, she can have more time to stay home for housekeeping and taking care of her children.
- Daily livelihoods:
  - She purchases vegetables, fishes and meats from mobile shops, as more shops started after the civil works completed. She knows mobile shops offer higher prices compared to ones in the local markets, which is however at acceptable levels because she bought only small amounts.
  - As selling more amount of rice due to the recent price increase than before, her family needs to buy rice for themselves from neighbors.
  - Her family goes to Suong Market for buying daily necessities only when needed.
- Education:
  - Her children and nephew go to Rokakhhnoch Primary School on foot for 5 minutes. Her family pays KR 4,000 each every day for their schooling, covering textbooks, notebooks and food, aside from uniforms they bought at the beginning.
  - She sends them to the school with her expectation of their acquiring knowledge to get employed in good jobs.

27. December 22, 2016 (15:10-16:00)

- Location: Prasat Village, Chak Commune
- Sex: Male
- Age: 80
- No. family members: 3 (including her wife and son (33))
- Household head or not: Yes
- Asset owned: a house with a workshop place attached, land where the house was located, and rice field
- Mode owned: one motorcycle and one bicycle
- Major income: KR 100,000-500,000 from selling his wooden furniture per order and US$ 275 (in 2015) for 1-ton rice sold to traders along the road (connecting to the project road)
- Final academic record: 5th grade
- He stayed at her place since his birth.
- The number of family member(s) who attend(s) school: None
- Economic activities:
  - His business of rice production and furniture making was succeeded to his son who lives with him.
  - The family sells their rice at their place, not bringing to markets, as traders approach to collect. When needing help to rice production works, his son asks the neighbors to seek help. In their custom, they exchange helps among neighbors for free or sometimes pay US$ 5 per day.
  - The family sold their rice for US$ 275 for one ton in 2015, while selling for US$ 200 before the civil works started. The number of traders approaching was three only before but now four. In 2016, they found the reduction in rice prices.
- Travel behaviors:
  - One new motorcycle was given in 2016 by his son, living in Ratanakiri, and one bicycle was purchased in 2012 for US$ 40 for him to go to pagoda and markets, mainly Chak Market.
  - The project road's improvement enables him to meet with his sons more often, as they can travel the road more smoothly. One of his son, living in Memot, is able to visit this house more often in the morning and return home by the evening through the project road.
  - He travels more often after the civil works completed. He visits pagoda the most often and chats with friends along the project road with smoking. Further, the project road's improvement increases free time for him and his family to do whatever they need (or want) to do at home or anywhere.
- Daily livelihoods:
  - They buy daily glossaries from a mobile shop running along the road which appeared in 2014 and sold fresh food in the morning and cooked ones in the evening. Other than the shop, the increase in mobile shops has been found. Prices are higher than ones in the market, but he and his family accept.

- Education:
  - His son stopped schooling at 6th grade to help his couple to maintain the rice fields and take care of livestock, as they were too old to do by themselves. He had four sons, out of which only the youngest stays with him and the others live in Ratanakiri and Memot respectively.

28. December 23, 2016 (10:07-11:00)

- Location: Thnol Kaeng Village, Kong Chey Commune
- Sex: Female
- Age: 45
- No. family members: 5 (including her husband, a daughter (24) and two sons (18 and 14))
- Household head or not: Yes
- Asset owned: a house, land where the house was located, and rice field
- Mode owned: one motorcycle and one bicycle
- Major income: US$ 80-100 per day
- Final academic record: 7th grade
- He stayed at her place since his birth.
- The number of family member(s) who attend(s) school: None
- Economic activities:
  - She started her shop in January 2015, as she found more people traveled around her house after the project road was improved and expected profits. When opened, the condition of the road in front of her house was not well paved but the project road's improvement motivated people to come to her house and buy. Major customers are along the project road or come from Kachreach or the border to Vietnam. The income at the beginning was around US$ 50 but increased to US$ 80-100. The average in 2016 was US$ 80.
  - Her husband purchases vegetable, meat and fruits by motorcycle every morning (4 am – 6 am) in Ou Reang Ov Market, and she sells them in her shop from the morning and cooked foods around noon or onwards.
  - Her family rents out their rice field to a couple who lives in near their field since 2012 or 2013. They earn US$ 200 in 2015 but, before the road improvement, US$ 150 or around, as the amount is subject to the market. Before renting, they worked by themselves, however found less profitable and decided to rent out.
- Changes in her/her family's travel behaviors after the project:
  - Before the project road was improved, her family took 0.5 hrs by motorcycle to Ou Reang Ov Market but reduced to 10-20 minutes after the civil works completed.
  - Her family purchased a motorcycle in 2012 for US$ 1,500 mainly to bring their children to their school or to use for daily travel, while purchasing a bicycle in 2010 for KR 480,000 for their children to go to Thnal Kaeng Primary School. They spent money saved in their house to purchase those modes.

- Before buying those modes, they borrowed from her brother when needed or took a motorcycle taxi. However, they stopped after buying.
- After the project road's improvement, she could visit Ou Reang Ov Market and her friends' houses more often and had more her free time to look after her family. Further, the improvement let more people visit her house.

・ Daily livelihoods:
- Prices of vegetables were down in 2016, because of oversupply.

・ Education:
- She has three children, out of which 18-year old son stopped schooling at 9th grade and 14-year old son stopped at 7th grade. The elder was not able to proceed to the high school because he failed to pass the exam, and now works as a driver in the construction company in Suong. The younger did not like studying and was willing very much to start business and take care of/help her together. She tried to convince the younger to continue studying for acquiring knowledge, as she learned from her experience that it was powerful, but eventually agreed with him to stop.

29. December 23, 2016 (12:08-12:20), inside Ou Reang Ov Market (Vegetable shop)

・ Sex: Female
・ Age: 36
・ Household head or not: No
・ Residential area: Village 5, Kong Chey Commune
・ Total sales: KR 3.15 million in 2015, against KR 2 million before the civil works started
・ No. of customers per day: more than 20 in 2015, against 10-15 before the civil works started
・ She sells vegetable, citrus and fruits.
・ Changes in business after the project:
- She notices the increase in customers from the roadside area, after the civil works completed.
- The number of similar shops and mobile shops is found increased, and the business environment became competitive.
- She purchases her products in Phnom Penh every early morning, around 03:00 am, and transports to her shop. Her husband took care of her business in the afternoon.

30. December 23, 2016 (12:27-12:50), inside Ou Reang Ov Market (Rice shop)

・ Sex: Male
・ Age: 55
・ Household head or not: Yes
・ Residential area: Along the National Road No. 11, Kong Chey Commune
・ Total sales: KR 3.15 million in 2015, against KR 2 million before the civil works started
・ No. of customers per day: more than 20 in 2015, against 10-15 before the civil works started

- He sells rice.
- Changes in business after the project:
  - The shop purchases rice from three traders from Kampong Cham and one rice mill company in Kong Chey. His wife goes to Kampong Cham to purchase rice, while the rice mill company delivers rice to his shop with charging KR 1,000 per bag. The transportation charge remains same even after the road was improved. They purchase when they need some more for sales and sell them averagely one ton per month.
  - Rice prices peak from July to September, while the lowest from November to May, the harvest season. The price in the shop is determined mainly on the basis of prices which the traders negotiated with farmers.
  - Rice prices have been recently fluctuating as KR 90,000 per bag was marked in 2014, KR 95,000 per bag in 2015 and KR 87,000 per bag in 2016, mainly because exporting rice was regulated by the government and rice was oversupplied inside the country.
  - In 2015, the number of customers increased to 20 persons per day from 10 persons per day before. However, their amount to buy one time was reduced. The road improvement boosted people's flow into Ou Reang Ov Market but calmed down, because some people migrated to Thailand and the number of local population decreased.

31. December 23, 2016 (13:16-14:00)

- Location: Tuol Sophi Village, Tuol Sophi Commune
- Sex: Female
- Age: 33
- No. family members: 5 (including her father, mother and husband)
- Household head or not: No
- Asset owned: a house, land where the house was located, and rice field
- Mode owned: one motorcycle
- Major income: US$ 250 per month, earned by her husband as a public soldier
- Final academic record: 9th grade
- She stayed at her place since his birth.
- The number of family member(s) who attend(s) school: None
- Economic activities:
  - Her family produces rice. (Details were not provided.)
- Travel behaviors:
  - Her family bought a motorcycle in 2008 for US$ 600, and her husband brought it to Kampong Cham as he was assigned there.
  - She does not take any transportation mode, and asks her sister, brother or nephew to take her by motorcycle where she needs, including Tuol Sophi Health Center, or otherwise she walks.
- Daily livelihoods:

- She buys daily food, vegetable, fish and meat, from mobile shops along the road. Those mobile shops come from Ou Reang Ov and Suong Markets, and their number has increased. Before the road improvement, she found three mobile shops but disappeared later. Instead, at present, five are active around her house. Out of five, two sell vegetables and three sell meat and fish. Her family planted vegetable in their garden, but currently stopped.
- Prices of vegetable and rice increased.

・ Education:
- She went to Tuol Sophi Primary School and Tuol Sophi Secondary School, but did not go further, as her friends stopped at the 9th grade and she did not want to go to high school alone. Afterwards, she helped their parents' works in rice field.

・ Health:
- Until 2015, she went to Chak Health Center, and since 2016, went to Tuol Sophi Health Center, built in 2016. When going to Chak Health Center, she took 0.5 hrs on foot but, after the road improvement, 10 minutes.
- She found the increase in patients in Chak Health Center in 2015.

32. December 23, 2016 (14:06-15:00)

・ Location: Chak Village, Chak Commune

・ Sex: Female

・ The rice mill business started in 2000, as she and her husband were willing to expand their business.

・ There were individual farmers in the four villages of Tuol Kandoul, Chak, Steung Rhey and Tuol Trach, who had relationships with her couple, and she often went there by motorcycle to check the quality of rice. Those farmers produce rice twice a year, though once only for some of them subject to their crop schedule. When they are ready to collect, they inform her by phone and ask to come. For collecting, she uses a koyon.

・ The number of those farmers was 10 before the road improvement, and has increased as some farmers newly approached her with their rice after the improvement.

・ The table below compares the annual amount to trade before and after the road rehabilitation.

	Amount ('million KR)		Amount ('million ton)	
	Before	After (2015)	Before	After (2015)
Purchase	2.7	6.65	3	7
Sales	2.8	7.7	3	7

・ Before the civil works completed, the average price per ton to purchase from farmers was KR 900,000 and the one to sell was KR 920,000. In 2015, the average price to purchase was KR 950,000 and the one to sell was KR 1,100,000. At negotiating with farmers, prices were determined on market prices in Kampong Cham and Prey Veng.

・ Recently, the amount per farmer to deal decreased, as farmers are willing to sell more than before as they do not need to keep rice for their self-consumption as much as before due to recent

emigration to the other regions in Cambodia or Thailand.

- She sells the collected and polished rice to a trader who works around the Cambodia-Vietnam border. The trader comes to her place by truck to collect. Before the road improvement, it took two days from his place to hers, which is now one day.
- She bought a motorcycle in 2013 for US$ 1,700 and a vehicle in 2015 for US$ 17,000, both with expectations to ease their travel after the road improvement. They do not buy those when the road condition was not good. The motorcycle enables her to travel more often to farmers for regular check of their rice's quality. Those modes were purchased with the couple's own saving.
- They have rice fields but rent out to a farmer with receiving KR 1 million as a rent.
- She purchases vegetable, fish and meats from mobile shops or at Chak Market.

33. December 24, 2016 (08:51-09:15), inside Suong Market (Vegetable shop)

- Sex: Female
- Residence: Suong Village, Sangkat Suong Commune
- She started her business in 2000, and sold vegetable. Products in her shop were from Vietnam.
- She observed about 10% of the total customers came from the project road area before the road improvement, but finds an increases by 20-15% in 2015 as more individual farmers and mobile shoppers approach. Changes in her income may be correlated to the increase from KR 500,000 per day before the road improvement to KR 1 million in 2015. However, she found recent decreases in the number of customers because the environment around simple grocery shops like hers became more competitive in Suong Market.
- She uses the project road only for special occasions like wedding parties or funerals and visiting friends residing along the road, and finds her travel along the project road become faster and easier.
- She opens her shop at 0300 am and mobile shoppers and customers come at 0400 am, while her husband goes at 0700 am to the Cambodia-Vietnam border through the national road (not bypassing the project road) to purchase products for sales and returns Suong Market around noon.
- Rice price was KR 90,000 per bag in 2012, while KR 100,000 in 2015.

34. December 23, 2016 (9:15-9:30), inside Suong Market (Rice shop)

- Sex: Female
- She sells rice which her nephew collects directly from farmers in Trapeng Snao, Rokaknouch Cherng, Chikor and Moung Riev. Some farmers from Rokaknouch Cherng and Komreng bring her their rice individually to sell. She also sells pepper and dried green beans.
- She buys around 200 kg from her nephew two or three times a week and sells around 7 ton per month. At determining rice price, she refers to price information which is determined among rice shops in Suong Market around noon every day.
- She polishes rice from her nephew with her husband, not through rice mill companies.
- The table below compares her business situations before and after the road improvement.

	Income per day	Rice price (grade 2: kg)	Rice price (grade 2: per bag)
Before	US$ 25	KR 900	KR 90,000
After	US$ 50	KR 1,100	KR 95,000

- Rice prices are the lowest from December to April and relatively higher from June to November.
- She uses the project road for special occasions, like wedding, and visiting relatives.

35. December 23, 2016 (09:46-10:30)

- Location: Riev Village, Mong Riev Commune
- Sex: Female
- Age: 40
- No. family members: 4 (including her husband (in Kampong Thom), one daughter and one son (Note: She had another two daughters, living in Kampong Thom with her husband and in Phnom Penh))
- Household head or not: No
- Asset owned: a house, land where the house was located, and rice field
- Mode owned: one motorcycle, two bicycles
- Major income: KR 2 million per month, earned by her husband in cashew nut fields in Kampong Thom (started in 2016)
- Final academic record: 3rd grade
- She stayed at her place since 1990.
- The number of family member(s) who attend(s) school: Two
- Economic activities:
  - She rents her family's rice fields to the other and earns some from his sales, for instance, US$ 150 in 2015. The amount to receive is subject to the market. He produces rice twice a year.
- Travel behaviors:
  - She purchased a motorcycle in 2015 for US$ 1,200 and a bicycle in 2015 for US$ 75, with saving in her house. The motorcycle was expected to be used for bringing her daughter to school, while the bicycle for going to rice fields.
  - She visits the most often Suong Market by motorcycle. It took 30 minutes by bicycle before the road improvement, but now only 15 minutes by motorcycle.
  - She has now more free time, as travel time can be saved, which enables her to work more on housekeeping at home.
- Daily livelihoods:
  - For purchasing daily foods, she goes to Suong Market but sometimes buys from mobile shops. However, she prefers to visit the market because the mobile shops offer higher prices and their variety of available products is limited.

- Rice price hiked in 2015 to US$ 30 per bag from US$ 25 per bag before the civil works started. She buys a bag a month from a trader in Riev Village.

・ Education:
  - One of her daughters, staying with her at present, stopped at school at 7th grade due to her family's economic situations. Her son is in 6th grade in Brochea Komar Suong Primary School and is going to a secondary school next year. The school is located far, but she selected because of the teachers' quality. She brings him to the school by motorcycle for 10 minutes after she purchased it, though taking 40-60 minutes by bicycle before purchasing it. As the road condition was improved, it would take only 20-30 minutes at present if she uses the bicycle instead.

・ Health:
  - She goes to Suong Health Center when going to the market.

36. December 23, 2016 (10:31-11:12)

・ Location: Tuol Kadal Tbong Village, Chikor Commune
・ Sex: Female
・ Age: 46
・ No. family members: 4 (including her husband and a daughter (Note: She had another two daughters studying in universities in Phnom Penh))
・ Household head or not: No
・ Asset owned: a house, land where the house was located, and rice field
・ Mode owned: one motorcycle, one bicycles
・ Major income: KR 30,000 per day from shop business, occasional from catching fishes in nearby ponds, and KR 500,000 from rice production in 2015
・ Final academic record: None
・ She stayed at her place since her birth.
・ The number of family member(s) who attend(s) school: Three (out of which, two were in Phnom Penh to attend bachelor programs)
・ Economic activities:
  - She started her shop in 2015 to sell drinks and snacks. She found the increase in people and traffic along the road after the civil works completed and was motivated to start business. However, she did not have knowledge of business and decided to open a shop as only the initial investment was needed.
  - Products in her shop are purchased in Suong Market by herself or her husband. She goes to the market by motorcycle taxi and paid US$ 1 for her round trip. The motorcycle taxi she uses is a motorcycle attached to a cart accommodating 6-8 persons.
  - She sold rice for KR 500,000 in 2015, though KR 350,000 in 2010-2011. A trader from Thmey Village purchased her rice in 2015 as he reached an agreement with her, but in previous years,

different traders came to her.

- Travel behaviors:
  - She purchased a motorcycle in 2008 for US$ 150 and a bicycle in 2012 for US$ 40, to enable her family to travel when needed. In particular, the bicycle was purchased for her daughters to go to their school (Tuol Kandal Primary School, Tuol Kandal Secondary School, and Samdech Decho Hun Sen Suong High School).
  - From her house to Suong Market, it takes 25 minutes by motorcycle taxi.
  - She was aware that the road before improved was too quiet for their daughters to travel alone and seemed unsafe.
  - The travel time to school is changed as below (unit: minute(s)):

	Tuol Kandal Primary School	Tuol Kandal Secondary School	Samdech Decho Hun Sen Suong High School
Before	15 on foot	15 on foot	40 by bicycle
After	5 on foot	5 on foot	30 by bicycle

- Daily livelihoods:
  - She buys daily food of vegetable, meat and fishes around her shop, as several shops are located in the neighborhood. She never uses any mobile shop.
- Education:
  - She does not want her children to face difficulties as she and her husband experienced due to lack of educational attainments, and sends two of her daughters to the universities in Phnom Penh to get well-paid jobs. When needed, she borrows money for their education.
- Health:
  - She went to Chikor Health Center, located within two-minute walk.

37. December 24, 2016 (11:26-11:45)

- Location: Yeak Tbong Village, Damril Commune
- Sex: Female
- Age: 49
- No. family members: 2 (including her son)
- Household head or not: Yes
- Asset owned: a house, land where the house was located, and rice field
- Mode owned: one motorcycle, one bicycles
- Major income: US$ 4.5 per day from her son, working as a company staff in Rokakhhnoch Cherng to sell medicines and oils; and US$ 200 remitted per month from her daughter in Thailand
- Final academic record: 2nd grade
- She stayed at her place since her birth.
- The number of family member(s) who attend(s) school: None
- Economic activities:

- She produces rice once a year by herself and the entire is only for her family's consumption.

・ Travel behaviors:
  - The motorcycle is used by son for his work, and he comes back home every day, though he needs two days for roundtrip between her house and his workplace. She walks around when needed, like buying food, and uses the motorcycle when available.
  - Before the road improvement, it was difficult to travel when needed and people from outside was not able to come in her area.
  - After the road improvement, electricity networks covered her area, and travelling the road in the evening becomes safer than before.

・ Education:
  - Her daughter stopped at 3rd grade and her son at 4th grade. Her daughter could not continue schooling because of her family's economic situations and decided to help her mother. Her son was depressed around that time as she divorced, and stopped going to school.

38. December 25, 2016 (12:59- 13:30)

・ Location: Tuol Samrong Village, Krang Skear Commune
・ Sex: Female
・ Age: 49
・ No. family members: 6 (including her husband, mother, son (4) and daughter (14 months))
・ Household head or not: Yes
・ Asset owned: a house, land where the house was located, and rice field
・ Mode owned: one motorcycle
・ Major income: US$ 150 from her husband, working on civil works in Stung Treng Province
・ Final academic record: 5th grade
・ She stayed at her place since her birth.
・ The number of family member(s) who attend(s) school: None
・ Economic activities:
  - She started a shop in front of her house three days ago, because she had time for extra works at home and found the increase in people using the road after the road was improved. She invested US$ 60 in total to open, out of which she spent KR 1 million to build a shop house.

・ Travel behaviors:
  - They purchased a motorcycle in 2015 for US$ 600 to ease their travel, but mainly for her husband. She plans to buy a bicycle for herself.
  - She goes to Pongro Market for purchasing food and shop goods by motorcycle taxi, costing KR 5,000 for 30-min one-way travel. Before the road improvement, she paid KR 15,000 and took one hour. She notices the increases in mobile shops along the road after the road improvement.

・ Daily livelihoods:

- She produces rice once a year by herself and the entire is only for her family's consumption. Her family's rice field is located in front of her house. During the harvest season, she or her family borrow a koyon from their relative to transport collected rice to their house. They do not pay for the borrowing, and instead work for the relative when s/he needed help. For polishing, a milling machine is borrowed from a milling machine operator from Pongro. They pay him KR 1,000 per bag. The operator started only after the road improvement and until then, her family needed to borrow the machine from their relatives.
- The amount produced suffice their consumption only for nine months and she buys rice for the remaining three months, August, September and October, from a farmer in Tropeng Mlu Village. The farmer delivers his rice to her house for free.
- In 2013, her family paid KR 180,000 for 100 kg, sufficient amount for their survival in the three months, while KR 190,000 in 2015.
- She also found the increase in prices at Pongro Market, for example, 1-kg kang kong costed KR 2,000 three or four years ago but KR 4,000-5,000 at present.
- She also uses mobile shops to buy fish and meat, particularly when she has no time to go to Pongro Market. She finds the increase in mobile shops after the road improvement, from 3 or 4 to more than 10.

・ Education:
  - Her son would go to Krang Skear Primary School three years later, and she expects him to learn and acquire knowledge in the school. The school is 2-3 km far from her house, and she plans to bring him to the school by bicycle. That was another reason for her to buy the bicycle.

39. December 25, 2016 (14:05-14:40)

・ Location: Tropeng Mlu Village, Krang Skear Commune
・ Sex: Female
・ Age: 67
・ No. family members: 2 (including her husband)
・ Household head or not: Yes
・ Asset owned: a house, land where the house was located, and rice field
・ Mode owned: one bicycle, and one koyon
・ Major income: US$ 10 from her son working in a garment factory in Phnom Penh. In addition, she knits a mart and sells to her neighbors for US$ 15 per sheet. The mat is used for drying harvested rice.
・ Final academic record: 5th grade
・ She stayed at her place since her birth.
・ The number of family member(s) who attend(s) school: None
・ Economic activities:
  - In 2015, she sold 10 mats to the villagers but stopped as she got sick, while only two in 2010.

- Travel behaviors:
  - Her family bought a bicycle in 2015 for US$ 45, mainly for her husband to go to a restaurant nearby for coffee and watching the TV with his friends. He goes there three times a week. She also wants to travel more often by bicycle, but her sickness since last year does not allow her.
  - Her daughter bought a koyon in 2012 for US$ 2,000 with borrowing money from a microfinance institute, to earn money by lending to neighbors. However, as the ownership of koyon increased, she does not earn as much as expected. When lending, she charges US$ 2.5 per time.
- Daily livelihoods:
  - She produces rice with her husband only for self-consumption. When she needs additional, she borrows from her relatives. Her rice field is located 500 meters far from her house and she and her husband go there on foot.
  - She goes to Pongro Market once a month by a koyon, operated by one of the villagers. The roundtrip cost is US$ 2.5, and one-way takes 40 minutes, while one hour before the road improvement.
  - She purchases daily food from the mobile shops from Pongro Market. She finds the increase in the number of those shops after the road improvement, 10 at present from 3 or 4 before the road improvement.
- Education:
  - Her son stopped schooling at 4th grade in Krang Skear Primary School, due to her family's economic situation, and helped her couple for rice farming. Afterwards, he moved to Phnom Penh to work.
- Health:
  - She goes to Krang Skear Health Center on foot once a month. She finds the increase in people coming to the health center, compared to before the road improvement. Her travel time is around 5 minutes.

40. December 26, 2016 (9:07-9:40) Discussion with the Chief of Por Srov Village

- He stays in the current residence since 1983.
- Present frequency to use the road: Almost every day to go to Pongro Market for transporting and selling vegetables which he and his villagers plant around their fields. In dry season, the travel time to the market is 20 minutes by motorcycle, while the one in rainy season is 30 minutes.
- He represents his villagers for selling, and shared the sales with his villagers and earns US$ 10-15 per day and. In addition, he is paid KR 180,000 per month by the government as the village chief.
- He and his villagers fetch chickens and produce rice together for sharing under the USAID-financed program, ENRICH, which started in 2007.
- He needs the 20-min walk to the project road. He found the decrease in the travel time to his major travel destinations, Pongro Market and Banteay Preal Commune Council for reporting as a village

chief, after the road improvement. Further, the improvement enables him to transport vegetable more than before. Before the improvement, some customers tried to approach him to buy, but discounted the prices due to the poor road condition. Such improvement of efficiencies raised prices of vegetables in the market.

- He finds the increases in the number of students in Top Srauv Primary and Secondary Schools after the road was improved. However, as there is no high school around his villages, students in Top Srauv Secondary School are discouraged to proceed to higher education. Hence, most of them stop schooling at 9th grade (e.g., only the limited number of the secondary school students go to the closest school along the national road).
- He notices the emergence of mobile shops around his house only after the road improvement, while there was no mobile shop earlier. Those shops come from Pongro Market and sell vegetables and meats.

41. December 26, 2016 (12:41-13:00), inside Pongro Market (Vegetable shop)

- Sex: Feale
- Household head or not: Yes
- Residential area: Along the project road
- Total sales: KR 1 million per day before 2014, while KR 0.8 million per day after 2015.
- She sells vegetable, fruits, meat, fish, bottled water, soft drinks, and snacks.
- Changes in business after the project:
  - She purchases her vegetable for sales from farmers mainly from Tropeng Mlu or Banteay Preal from 4 am till noon.
  - Prices hiked after the road improvement and the number of her customers also increased after the road improvement, but such an increase hit the peak already because of recent competitions among shops in the market and mobile shops. At present, oversupplies are observed.

42. December 26, 2016 (10:22-11:00), inside South Krang Skear Market (Glossary shop)

- Sex: Female
- Household head or not: Yes
- Residential area: Attached to her shop
- Total sales: KR 1 million per day before 2014, while KR 0.8 million per day after 2015.
- She sells vegetable, fruits, meat, fish, bottled water, soft drinks, and snacks.
- Changes in business after the project:
  - In 2014, the shop owner moved to the current place around the center of the marketplace, as she expected increases in customers due to the road improvement.
  - Most of her individual customers are from Krang Skear Commune, while mobile shoppers come as well to buy their products but only in the morning. After the road improvement, the

number of her customers increases. The increase may be attributable the increases in residents around the market, as people from outside purchased their own lands along the project road. However, the total daily sales decreases, because the business environment becomes more competitive due to increases in mobile shops and similar shops to hers.

- She purchases her products at Romeas Market, 18 km far from the marketplace, which is closer to her place than Pongro Market, 29 km far. She travels to Romeas Market by motorcycle taxi at 0400 am and returns by 0600 am. She pays KR 15,000 for her round trip.

・ She uses the project road when going to other towns in Kampong Chhnang Province or for special occasions like wedding and funerals. The project road is quite dark in the evening as there is no roadside light, hence she prefers to use the road in front of her shop.

・ She bought a motorcycle in 2016 for US$ 1,900, with her expectation to use more often the project road. For purchasing, she borrowed from a microfinance institute with the total interest payment of about US$ 100.

・ Her daughter completed Thany Krang Skear Primary School and goes to Krang Skear Secondary School for one hour by bicycle.

43. December 26, 2016 (11:10-11:25), inside South Krang Skear Market (Soup shop)

・ Sex: Female

・ Household head or not: Yes

・ Residential area: Attached to her shop

・ She sells beef soup, bottled water, soft drinks, and snacks.

・ Changes in business after the project:

- She buys meat at Pongro Market only as her daughter has a shop there and helps her to purchase meats as needed for cooking soup every day. She goes to the market by motorcycle and takes 30 minutes for one way, shorter than one hour before the road improvement. She has to go to the market only early morning, 5-6 am, for her duties of preparing soups and taking care of her children.
- She goes to Romeas Market only for limited occasions, like going to a hospital or health center when her children were sick, not for her business-related.

44. December 26, 2016 (13:06-13:35)

・ Location: Pram Bey Chaom Village, Pongro Commune

・ Sex: Female

・ Age: 63

・ No. family members: 6 (including her husband, daughter, son-in-law, son, and grandson (child of another daughter in Battambang))

・ Household head or not: No

・ Asset owned: a house, land where the house was located, and rice field

- Mode owned: one motorcycle, three bicycles
- Major income: US$ 150 per month from her daughter and son-in-law, working as a cook in Battambang; and some money from her daughter living together
- Final academic record: 2nd grade
- She stayed at her place since her birth.
- The number of family member(s) who attend(s) school: One
- Economic activities:
  - Her daughter sells rice in Kampong Chhnang Town for six years, following her sister. The daughter purchases rice at Pongro Market and delivers by motorcycle for selling to her customers in the town. Before the road improvement, she sold a bag (50 kg) for US$ 25 though purchasing for US$ 18 in Pongro Market. At present, she sells a bag for US$ 28 at average against the purchase price of US$ 22 at Pongro Market. Her customers were introduced through her aunt (the interviewee's sister).
- Travel behaviors:
  - Her family purchased a motorcycle in 2012 for US$ 900 and three bicycles in 2011.
  - Three bicycles are for he husband to go to rice fields, for herself to go to Pongro Market, and for her son to go to Balang Primary School. The motorcycle was purchased because the bicycles did not work well on the bad-conditioned road and is now shared among her family members.
  - Her family travels to Pongro Market more often for various purposes, including personal.
  - She finds the increases in the project road's users going to/coming from the National Road No. 5.
- Daily livelihoods:
  - Her family (husband, herself and daughter) produces rice in their rice fields only for self-consumption.
- Education:
  - Her daughter stopped schooling at 8th grade, as her family did not have sufficient money to continue sending the daughter to the secondary school.
  - She sends her son to the school with hoping him to continue further, as he is only the son in her family. She expects to go to the school for getting more knowledge and well-paid jobs.

45. December 26, 2016 (13:51-14:20)

- Location: Thmor Reab Village, Pongro Commune
- Sex: Female
- Age: 52
- No. family members: 1
- Household head or not: Yes
- Asset owned: a house, a shop, land where her house and shop were located, and rice field

- Mode owned: one motorcycle
- Major income: KR 50,000-60,000 per day, from her business selling noodles only in the morning, daily foods like salt, sugar, snacks, fried noodles, bottled water and soft drinks
- Final academic record: 7th grade
- She stayed at her place since her birth.
- The number of family member(s) who attend(s) school: None
- Economic activities:
  - She opened her shop in 2003.
  - She rents her rice field to her sister and earned US$ 100 per year from her in 2015. Her sister produces rice once a year.
- Changes in her/her family's travel behaviors after the project:
  - She purchased a motorcycle in 2015 for US$ 1,350 with using her saving, as she needed to borrow a bicycle from her neighbors when going to Pongro Market.
- Daily livelihoods:
  - She finds the increase in mobile shops selling vegetables, fishes and meats, though there was none before the road improvement. When she does not have money enough to pay, she barters with her products or rice produced from her rice fields.
  - For herself, prices of mobile shoppers' products seem reasonable or sometimes cheaper, fishes for instance, compared to ones in Pongro Market.

Appendix 4. Interview with a Project Officer of the Case-studied Rural Roads Improvement Project

Date: April 2, 2017 (09:30-11:00)

Selection process of the roads rehabilitated under the project

1. Who were involved at determining those criteria, and when did they participate?
   - Ministry of Rural Development (MRD), agreed with the project team of the Asian Development Bank (ADB) who proposed the criteria. The criteria applied for shortlisting roads for improvement was only 5, though the consultant proposed the 14 criteria as stated in their final report.
   - The 5 selection criteria were prioritized in the following order:
     1. Connect to the existing paved road national and provincial networks;
     2. (i) Support ADB's past/ongoing/future investments, and (ii) Be consistent with the MRD's priorities for rural development and decentralization;
     3. Safeguards-related criteria; and
     4. Socio-economic requirements, including meeting the EIRR's threshold of 12%.
   - The entire procedure was:
     1. The ADB and MRD determined the target provinces (details are in the next question).
     2. Based on the MRD's priority list of roads needing improvement, the consultant and the MRD investigated those roads' conditions mainly from perspectives of engineering and safeguards.
     3. The socio-economic assessment (based on the secondary data collected from the government (see the note), including economic analysis, of roads selected in Step 2 was made. (Note: The detailed baseline study was carried out in the selected provinces in 2011, after the project was approved)
     4. The shortlist was agreed among the three parties in a tripartite meeting (December 2009), and the MRD informed the Provincial Departments of Rural Development in the project's seven target provinces.
     5. The shortlist was confirmed and became effective (January 2010).
   - The process of Steps 1-4 took about four months.
2. The project was expected to alleviate poverty in the Tonle Sap Basin by providing all-year roads to local population, according to the RRP (para 12). How did you/your team consider the project's overall objective at finalizing the criteria?
   - Prior to selecting roads, the above three parties selected the seven provinces (later eight, due to administrative split of one province) as their target. The criteria to select them were (i) poverty rates; (ii) population densities; and (iii) past experiences of ADB's interventions. The criteria of (i) and (ii) are relevant to the project's pro-poor characteristic.

- The population density was critical, as populated areas were expected to generate big traffic volumes. Further, in populated areas, it could be expected to spread out the projects' benefits toward more people, compared to in less populated areas. Those would eventually appear as higher EIRRs.
    - As a result, project beneficiaries were about 600,000. 80% is the rural population of Cambodia out of total.

3. Prior to the project's approval, the executing agency had their own priority list, which was considered at the selection and might be the base to select. What were the agency's important factors at that time? Further, were their priorities changed these days?
    - Before the PPTA started, the MRD had established their lists of roads most of which were deteriorated and unpassable and required immediate improvement. Such roads' consideration were the MRD's serious concerns at that time.
    - The project has been scaled up as the downstream project, as their concerns about conditions of roads in rural Cambodia remain same.
4. What were major critical or difficult issues you and your counterpart encountered during the process?
    - MRD staff are well aware of their road network condition. Critical issue I think is the serious lack of capacity.
5. Recently, the rural access index (RAI) was developed as one of the measures to assess the achievement of the Sustainable Development Goal 9.1. For upcoming projects, will you and/or the project's executing agency integrate the index at future rural road improvement projects?
    - None

<u>Assessment of poverty and social aspects in the project area</u>

1. How were the assessment results integrated into the project design, for instance, at selecting the roads to be rehabilitated?
    - The assessment was only done in 2011 as a baseline survey. At the project's preparatory technical assistance (PPTA) stage, the design and monitoring framework (DMF) was made, which was the basis for the baseline survey.
2. About the statement of the listed benefits, how did you define those and monitor during the implementation? (Results of the baseline and post-completion socio-economic assessments were kindly shared.)
    - The described benefits were the DMF targets, general description of common benefits expected from rural roads' development, not regional/project- specific.
    - The monitoring work was made in February/March, 2016.
3. Was any special measure taken to materialize the impact and achieve the benefits as stated in the RRP (impact: para 11; benefits to local population, particularly economically poor and girls/women: para 21)?

- None, road rehabilitation itself induced such benefits.

Conditions of the project roads, particularly Road 370 in Tboung Khmum, Road 1KCH2 in Kampong Chhnang, and Road 1BB4 in Battambang

1. International roughness index of those roads.
   - Their IRI before improvement was considered 12.
2. Approximate travel speeds of major travel modes of motorcycle, bicycle, *tuk-tuk* and car.
   - Average travel speeds of the locally available modes are as below:

	Walk	Bicycle	*Tuk-tuk*	Motorcycle/ Vehicle
Before	5 km/h	15 km/h	16 km/h	20 km/h
After	5 km/h	10 km/h	30 km/h	40 km/h

Appendix 5. Interview with a Project Officer in the Japan International Cooperation Agency on the Health Sector in Cambodia

Date: October 27, 2017 (14:00-15:00)

Present Healthcare Systems of Cambodia

- The country aims at operationalizing a universal healthcare system in future, and at present implements the following three:
  - Health Equity Fund (HEF): The responsible agency is the Ministry of Health. The HEF covers approximately 20% of people assessed "poor." Those people are exempted from the payment of health-related expenditures and, if considered appropriate, travel costs to a public health service facility, either health center or referral hospital. At public health centers and referral hospitals, staff are stationed to administer their expenditures. Fund resources for the HEF are loans and grants from international financial institutes and tax revenues of the country.
  - Community-based Health Insurance: The responsible agency is commune or district. The system is for residents in a concerned administrative locality. The participation is voluntary. The participants are obliged to pay the determined amount of money to the locality, and the collected money is pooled and distributed to who need for paying health expenditures. This system has been criticized due to its complexity to operate, and its equality is questioned on the distributions among the participants. Hence, the system is not nationwide implemented.
  - National Social Security Fund: The responsible agency is the Ministry of Labour and Vocational Training. The system is principally a healthcare system for employees of a private company, which was based on occupational injury insurances. Recently, the number of companies introducing the insurance system has increased.
- Aside from the above three, the two systems are under consideration to be implemented particularly for those who do not participate in any of the above systems, but the decision to implement may be subject to the results of the national election of 2018.
  - Healthcare system for public officers (at present, only pension systems exist.)
  - Healthcare system for people who have not yet participated in any system: Japan International Cooperation Agency (JICA) has been providing a technical assistance to designing the systems (the project is named "the Project for Development of Social Health Insurance for the Informal Sector"). To ensure the equality among people in the country on the access, the system is suggested as involuntary for those people.
- The three systems are administered by different agencies, and their insurance collection and pooling systems of collected funds are also varied. The country aims at unifying those systems like present healthcare systems of Vietnam and Philippines.

Impacts of road constructions and rehabilitations on people's accessibility to medical services

- In the conceptual framework of Universal Health Coverage (UHC), the three types of barriers

(monetary/financial, physical, and social/cultural) are considered to affect people's accessibility to medical services. The HEF in Cambodia would contribute to relaxing the monetary/financial barrier, but would not necessarily ease the other two barriers.

- Increases in deliveries attended by midwives and/or obstetricians at public health service facilities have been noted, approximately 80% of the total at present. The increase may be because of incentive systems where expenditures involved at a delivery are refunded to expectant mothers or rewards are offered to midwives and obstetricians when attending to help a delivery. Recent roads improvements are also one considerable reason.
- In Ghana, there was a case observed of sharing modes among population in a commune for visiting health service facilities.
- The JICA-financed study, Multi-Sectoral Approach for Maternal and Child Health, carried out an extensive review on influences on the maternal and child health sector of factors related to people's quality of life, such as lifeline infrastructure and education.

Other observations in healthcare systems in Cambodia

- Though the referral system exists in Cambodia, a patient is allowed to visit either a health center or a referral hospital for initial consultation. The consultation fees are different between those two facilities, which however would not affect people's preference to visit a referral hospital. Such preference could be because hospitals are better staffed and equipped than health centers. Another reason could be that functions of health centers are more for preventions, such as vaccinations to children or regulation check-up to expectant mothers. The situations have overcrowded those hospitals and disrupted their operations. The current referral system of Vietnam is more rigid, directing patients to a health center for his/her initial consultation.
- Some people prefer consulting private health service facilities, like privately-operated hospitals or traditional therapists. There are two reasons behind their preference: their limited affordability to pay for service fees fixed by the governments; and unfriendly attitudes of medical practitioners/assistants and nurses working at public facilities. The issue related to such staff's attitudes has been recognized by the government and warned during training programs, but may not been addressed in practice.