SOCIAL IMPACT BENEFITS OF ROAD REHABILITATION PROJECTS IN SIX PROVINCES IN PAPUA NEW GUINEA, SOUTH PACIFIC

S. JUSI,
Finnish Overseas Consultants (FinnOC) Ltd.
Finland
sari.jusi@uta.fi
W. ASIGAU
Department of Works (DOW)
Papua New Guinea
wilasi@datec.net.pg
N.LAATUNEN
CPCSTranscom Ltd
Canada
nlaatunen@cpcstrans.com

ABSTRACT

The Department of Works of Papua New Guinea launched the first ever Socio-Economic Impact Study (SIS) of road projects in 2004. The Study is funded by the World Bank and implemented jointly by Finnroad Ltd. and SMEC.

There are excellent examples in provinces of roads improving access for women to markets promoting gender equity in increased household income. Household income for those villages adjacent to the completed road is consistently pointing to higher incomes in a country with a low per capita income. Interestingly, the finished roads have directly led to village economic development with new agricultural products being grown and marketed such as vanilla and all spice. Environmental awareness has improved with communities being contracted for small-scale road maintenance contracts.

The economic growth of income in very poor villages with the newly constructed roads is not to be understated. There is a direct link between road improvements and poverty reduction. New roads have improved the economic circumstances and quality of life of rural communities.

1. INTRODUCTION

In a developing country such as Papua New Guinea there is always a need to provide a basic level of access to all rural areas in order to be able to provide basic administrative, social and health services. In general, PNG has sufficient transport infrastructure to service the main urban centres and the large export-oriented industries, which are connected by road, sea, or air links. The main urban centres are all serviced with gravel and sealed roads.

In rural areas, too many communities still do not have reliable access to main road networks or motorized access in PNG. Rural people are handicapped by limited access to motorised -and sometimes even non-motorised- transport, inadequate community roads, poor condition of footpaths, tracks and footbridges. This leads to serious difficulties in having access to markets, agriculture inputs, production fields, employment opportunities, and social services and facilities like health centres, schools, etc. Poor rural people,

particularly women can spend much of their time and effort to provide for their daily subsistence needs, which can restrict their ability to engage in economic activities and hence start to find their way out of poverty. Transport is more costly and more time consuming than it would be with a properly maintained road network, and in many parts of PNG some road connections have ceased to exist as the roads are no longer accessible.

The provision of an efficient road network is at the core of the poverty reduction strategy and enhancing rural incomes. Well-developed road infrastructure benefits the poor in many ways. It opens villages to other villages and to market centres and reduces transport costs and if the market is competitive, increases the income they get from their produce. It also improves traders' access to villages making the market competitive. Good road infrastructure improves farmers' access to information and new ideas.

Roads with good condition will always enable the rural people to access basic services like safe water, education, health, security and agricultural extension, as well as agricultural inputs.

In summary, the objectives of improvement and maintenance of rural roads are to:

- Reduce transport cost and raise the reliability of vehicular access (reduce the risk of impassability) and thereby to expand market for agricultural and non-farm products and social services.
- Integrate poorly accessible zones with regional economic centres.
- Improve transport conditions in rural villages.
- Generate employment through the rehabilitation and maintenance of rural roads to mitigate rural poverty. [2, 3, 7, 9, 12]

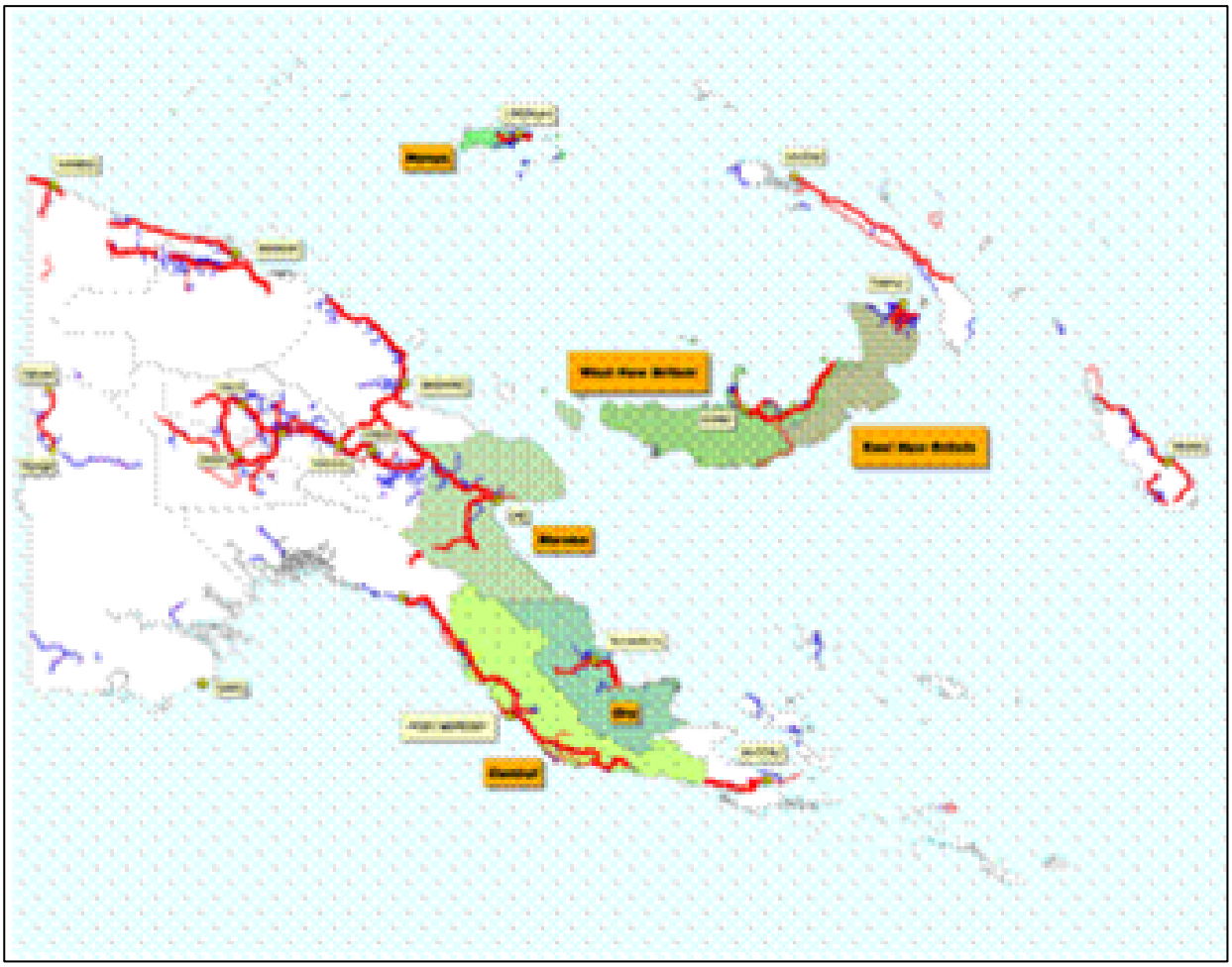
Road Maintenance and Rehabilitation Project (RMRP) is implementing road improvements Projects in Papua New Guinea. Project started in year 2004 and it will continue till 2009. The Project is improving roads in six provinces of PNG. These are Manus, East and West New Britain, Central, Oro and Morobe. The road maintenance and rehabilitation works of the RMRP include annual routine maintenance on about 2,200 km and restoration of about 440 km of national roads. Maintenance and rehabilitation of provincial roads comprises annual routine maintenance on about 900 km and restoration of about 200 km of provincial roads. The Project includes also the rehabilitation of 90 bridges and the procurement of additional emergency bridges. [11].

2. COUNTRY BACKGROUND

With a population of 5,130,365 in 2000 [1, 5], and an average growth of 2.7 % from 1994 to 2000, PNG has shown only moderate population growth in comparison to other Pacific island economies, where population growth rates of three to four percent are normal. PNG has especially low social indicators when compared with its neighbors in the South Pacific. In the year 2003, PNG ranks 132 out of 175 counties in United Nations Development Programme (UNDP); Human Development Index with 43% of women illiterate; the fertility rate in 2000 was high at 4.4; and life expectancy at birth is only 57 years. The Government is aware of these issues and has agreed to focus on improving the situation of its population. Improved transportation, especially to rural and remote areas, will go a long way to supporting and improving social indicators and the quality of life for men, women, and children.

Poverty in PNG is overwhelmingly rural, and urban-rural income disparities are widening, as are disparities between communities within and outside enclave resource projects. Poverty is about three times more severe in rural than in urban areas, varies in severity across rural regions, with about 75 percent of the poor living in the Sepik and Highlands [Ibid]. Between 1996 and 2003, the number of Papua New Guineans living below US$1 per day is estimated to have doubled (from 1.1 to 2.2 million). The poverty headcount index, for the US$1/day poverty line, was about 39.4 percent in 2003, up from 24.6 percent in 1996. An estimated 70 percent of the population now live on less than US$2 per day, up from 54 percent in 1996. The key factor underlying this increase in poverty has been the continued failure of growth, coupled with 2.7 percent annual growth. The coverage provided by formal social safety nets is very limited. In addition, there is emerging evidence of the traditional safety net (wantok system) breaking down in urban areas [10].

Figure 1 - Project Provinces in Papua New Guinea



2.1. Project Provinces

The provincial environmental descriptions are mainly based on Papua New Guinea Rural Development Handbook, the 2000 Census information and Papua New Guinea Human Development Report 1998.

East New Britain includes roughly 15 100 km^2 of the island of New Britain, in the northeast of PNG with the estimated rural population of 247 000 in the year 2000. The provincial

rural population growth rate is a very high 4.2 percent per year. The highest population densities are on the volcanic hills and plains of the Gazelle Peninsula, in the Duke of York Islands, with and average of 220 person/km^2. There is a significant in-migration in the northeast of Gazelle Peninsula, with people from many parts of PNG seeking better access to services, more productive environments and wage employment opportunities provided by the towns and plantations.

The northeast of the Gazelle Peninsula has an extensive network of sealed roads. There are few roads in the south of the province. Outboard motor boat and canoe travel are common in coastal areas. People in the northeast of the Gazelle Peninsula require less than one hours' travel to reach Kokopo, while those in the west Baining Mountains, in the Duke of York Islands and Watom Island require less than four hours travel..

West New Britain occupies 20 800 km^2 of New Britain Island in the northeast of PNG. This area has been densely settled since the early 1970s through formal settlement schemes based on oil palm production. The estimated rural population of West New Britain in the year 2000 was 99 000, which is 2.5 percent of the national rural population. West New Britain is one of the three provinces with the largest urban centers, where net migration in concentrated due to commercial activities of oil palm. The provincial rural population growth rate is high at 3.3 percent per annum.

The northeast coastal plains from Talasea to Sule have extensive network of good roads that service the oil palm settlement schemes. West New Britain is one of the three provinces (besides of Central and New Ireland) where the lengths of road per head of population are the greatest. There are numerous logging roads in the south coast valleys, inland of Kandrian, and around Cape Gloucester. These roads, and in particular the bridges, are short-term constructions that deteriorate when maintenance stops. Outboard motor boat and canoe travel are common in coastal areas.

Surrounding the National Capital District is Central Province, a narrow coastal strip, which rises to the 4000 m high Owen Stanley Ranges which form its northern border and divides and isolates the Province from the north. The National Capital of Port Moresby has a powerful influence on the economy and the movement of people in this province. Good roads allow people to commune long distances to work in Port Moresby from coastal villages that have among the highest housing standards in the country, and also have electricity supplies and running water. The peri-urban areas around the city are densely settled with people from all over the country. The estimated rural population of Central Province in the year 2000 was 167 000, which is four percent of the national rural population.

The coastal areas of the province have network of good roads, although some are in poor condition and thus are inhibiting the transportation of the market produce and cash crops to the markets (for example rubber can not be transported to the market due to no road access). Logging activities have impacted the some of the roads negatively and deteriorated them.

Morobe Province occupies 33 525 km^2 in the central north of PNG and curves around the waters of the Huon Gulf. The capital city of Lae, known as the "Garden City", with its 80 000 inhabitants, is the second largest city in Papua New Guinea. The estimated rural population of Morobe in the year 2000 was 307 000, which is 7.6 percent of the national rural population. Population densities are highest on Malai and Tuam islands, near Umboi Island, with 400 person/km^2.

Despite its large size and mountainous terrain, there is a good road network in Morobe Province and access to services is generally good. A network of roads (The Highlands Highway) connects Lae with Madang to the northwest, through the Markham Valley to the Highlands in the west and south to the Highland areas around Wau and Bulolo..

Oro Province occupies 43 700 km^2 on the north coast of the mainland of PNG with the estimated rural population of 110 000 in the year 2000. The volcanic plains and fans have moderate population densities of 36 persons/km^2 and are used extensively for plantation and smallholder oil palm production. Areas around the provincial capital of Popondetta have significant in-migration.

There are road links between Popondetta, Tufi, Ioma, Kira, Kokoda and Afore with PMV buses travelling regularly between the district. Outboard motor boat and canoe travel are common in the coastal areas and on the northern floodplains.

Manus is Papua New Guinea's smallest province, both in terms of population and land area, but has a vast sea area. The province consists of a group of islands, known as the Admiralty Islands and a scattering of low-lying atolls, mostly uninhabited with the northern border reaching the equator. The estimated rural population of Manus in the year 2000 was 37 000, which is one percent of the national rural population.

The islands are connected by a bridge crossing the Loniu Passage. The airport is at Momote on Los Negros Island. There is a good quality road from Momote airport to Lombrum and Lorengau. However, outboard motor boats and canoes are the most common means of transport in the province. 55 percent of Manus population had access to roads in year 1995.

3. SOCIO-ECONOMIC STUDY (SIS)

To evaluate the impacts of RMRP to socio-economic environment, The Department of Works of Papua New Guinea launched the first ever Socio-Economic Impact Study (SIS) of road projects in 2005. The Study is funded by the World Bank and implemented by Finnroad Ltd. in association with SMEC PNG Ltd.

The interactions between transport and socio-economic development are complex, including both direct and indirect impacts. Direct effects are reduced travel time to markets, work, health center, school, etc. and savings in fuel and other direct transport costs. The composition and distribution of the direct effects depends on the composition of users and the structure of the transport market. The indirect effects consist of increases in income and other dimensions of well-being (education, health, social interaction and political participation) brought about by the infrastructure. The roads may increase job opportunities and open up new resources of revenue, leading to a more diversified income structure, which can reduce household vulnerability to economic shocks. SIS Project identified all of these impacts of RMRP Project in these six provinces. Data collection was organized before the implementation of the road project (2005) and then after (2006) the implementation of the construction of a road, when the road had been serving the community over a certain period already and the impacts could be identified.

Figure 2 - Road Construction Works in Progress in Papua New Guinea.

The indicators that were considered from the instruments are characteristics that show poverty rates. These are standard international indicators and are: income and food security. In the case of income there are several questions in different sections of the household questionnaire to validate the income response towards the end of the questionnaire. These extra checks on income are a well-known tool in order to ensure accurate results. Another key indicator is the examination of food security and whether there are any food shortages.

The following table presents the indicators, which have been used in the SIS Project:

- Road Transport Overview. Including time required to reach the nearest road, frequency of travel to the nearest market, PMV fares, and number of trips made by PMV
- Income Pattern. Including household incomes, average household expenditure, food security (the amount of food a household has in reserve and the number of families having food shortage), trade store prices
- Access to Social Services. Including: distance and time to nearest school and health facility, causes of visiting health centre by men and women, awareness of HIV/AIDS
- Environmental Issues. Including: noise and dust level of the road, road side water quality, loss of agricultural produce due to bad road conditions, increased gardening/farming activities due to road

In this paper most significant results are presented province by province and then village by village (to see the differences between sample and control villages). The following indicators have been collected in a study.

- Travel time to nearest road which can be used by vehicle
- Frequency of road use, why
- PMV fares, and number of trips made by PMV

- Travel to market, how often
- Income, divided for five categories
- Expenditures: divided for five categories
- Trade store prices
- Average market income
- Families below and above of poverty line
- Travel to health centres, how often, how long it will take
- Travel time to nearest school
- Information of accidents on the road
- Farming
- Food situation
- Environmental indicators: road side water quality, noise, dust, loss of animals/vegetation, increase in clearing the bush, impacts on gardening; and
- Benefits of the road improvement.

To collect the data, the formal household interviews utilized structured questionnaires as the main tool to collect data. In addition sketch maps for the sampled villages along with village profiles were completed.

Survey instruments used for the socio-economic impact study (SIS) included:

- Household questionnaires
- Questionnaire for trade store owners
- Questionnaire for public motor vehicle operators
- Village profile form

In a project total of 1167 households were interviewed in six project provinces (Central, Manus, East New Britain, West New Britain, Morobe and Oro) in each phase of the data collection. In each province, four villages were selected for the Study (two sample and two control villages). In addition to the collected household questionnaires, information from trade store owners if located in one of the villages and the PMV operators (transport operators like minivan drivers) was also collected in each province. Village profiles were also completed during the after the implementation of the project data collection phase.

4. RESULTS

4.1. Poverty

During the before project survey in year 2005 the average amount of families living below the poverty line was 33 %. Highest proportion of poor families was in Oro (71 %) and in Morobe (40 %). Concerning poverty the best situation was in the West and East New Britain, where respectively 90 percent of the surveyed households live above poverty line. After the implementation of the project in year 2006 only 8 % of the surveyed families were living below poverty line. In Central, East and West New Britain there were only a few families living below the poverty line. However, when evaluating the income levels it can be clearly seen that the incomes are wider spread to families and amount of the families who were previously in below 100 K monthly income are now in the category of 101-300 kina per month. In Oro (20 % living below the poverty line), in Manus (13 % of families living below the poverty line) and in Morobe (7 % living below the poverty line) the progress is very good. Also in these three provinces there was substantial amount of

families, who were living below the poverty line during previous study and are now having income more than 100 kina per month.

Table 1 - Percentages of Survey Households Living Above and Below Poverty Line. Before Road Improvement/ After Road Improvement

Poverty Line	% of HH in Oro	% of HH in Manus	% of HH in Morobe	% of HH in Central	% of HH in ENB	% of HH in WNB
% of HH below poverty line	71/20	53/13	40/7	16/2	11/2	8/1
% of HH above poverty line	29/80	47/87	60/93	84/98	89/98	92/99

($1=K2.94, 30 days x K2.94 = monthly poverty line K88,2 in 2006, K94 in year 2005)

When evaluating the results in village level, the difference between villages near the road (sample village) and far away from road (control village) can be seen. Concerning incomes there are more significant improvements in those villages living near the road.

In Table 2 results of East New Britain are presented by different village types.

Table 2 - Households Living below the Poverty Line. Before/After Road Improvement. East New Britain

Poverty	% of HH in ENB			
	sample	sample	control	control
	Turagunan	Napanar 3	Liaga	Gunanur
% of HH below poverty line	5/0	0/3	24/6	16/0
% of HH above poverty line	95/100	100/97	76/94	84/100

The following table shows the average number of households with inadequate food in the project villages and average food reserves

Table 3 - Average Number of Families with Inadequate Food Estimated by Surveyed Households per Provinces. Before/After Road Improvement

Food security	Oro	Manus	Morobe	Central	ENB	WNB
Amount of families with inadequate food (% from total)	1/1.4	2/21	0/1.3	0.6/18	3/1	6/0

In 2005 the food security situation in all sample and control villages was generally good. The number of households with inadequate food in the village estimated by the surveyed households was highest in West New Britain (6) and lowest in Morobe (0). After improvement of the road survey results revealed that the average number of households with inadequate food has increased in all of the provinces except in East and West New Britain. Manus (21) and Central (18) are having highest numbers of household without sufficient food. There were only very minor differences for the Base-Line-Mid-Term survey results in Oro and East East New Britain. When a comparison is done between sample and control villages, it was very clear that situation is worst in the sample villages.

In 2005 people in surveyed villages had enough food in reserve for one week to six months. The largest food reserves of households were in Oro and Morobe (6 months), where most of the people are subsistence farmers. Overall, families reported to have enough food in reserve for a long time in control villages, whereas the situation in the sample villages was a bit weaker. This is probably due to the fact that people in more remote (control) villages have more land and opportunities for gardening and farming comparing to sample villages, where people have more often jobs and monthly salary incomes. This probably explains also the higher number of families living with inadequate food reserves in West and East New Britain.

In 2006 the situation has changed, there were more families not having adequate food available. In Central (86 % of these families having food reserves over three months period), in Manus (91 %) and in Oro (99 %) and almost all of those families had enough food for at least a three month period. In Morobe this was 21 %, in ENB 14 % and in WNB 54 %.

4. 2. Economic Information

4.2.1. Employment

Of the households surveyed, 90 percent reported to be subsistence farmers. About 10 percent of the respondents reported working in non-agricultural sector, mainly working as a teacher, pastor or an entrepreneur. There are less people who do gardening in the surveyed households in East New Britain (82 %) and Manus (83 %) comparing to other provinces due to higher employment rate of people. The number of people working outside agriculture was highest in project villages in Morobe, Oro and West New Britain. Evidently, family economic conditions improve when adult family members have regular work and income. Access to work areas can be impeded by poor road access. Better roads provide easier access to work opportunities both locally and at more distant locations.

4.2.2. Household Incomes and Expenditure

Farming and fishing are predominantly the most important source of income for households within the survey sample. The main household incomes come from selling cash crops along with handicrafts at the market in all of the selected project villages. The following tables 4 and 5 present the different levels of household income for the before project study and for after the project study periods. As it can be seen there is a substantial increase in household incomes after implementation of the road project .

Table 4 - Household Income. Before/After Road Improvement

Monthly Income	% of HH in Oro	% of HH in Manus	% of HH in Morobe	% of HH in Central	% of HH in ENB	% of HH in WNB
Over 2001	0/1	0/1	0/2	4/1	7/3	2/4
K1001 - 2000	4/2	1/1	2/16	17/4	12/18	6/11
K501 - 1000	13/33	7/13	3/18	15/26	29/41	37/33
K301- 500	6/15	10/16	11/33	7/38	26/21	31/27
K101-300	6/26	29/14	44/29	39/28	15/13	16/23
K100 or less	71/23	53/27	40/13	18/2	11/3	8/1
Total	100 %	100 %	100 %	100 %	100 %	100 %
Average monthly income	187	167	197	703	769	570

In 2005 the average income in these six provinces was 432 kina and in year 2006 it was 527 kina per month. Therefore, the annual average increase is 22 %.

Comparing provincial differences it can be seen the increase in four (Oro, Manus, Morobe and West New Britain) provinces and decrease of monthly income in two (Central and East New Britain) provinces. As presented, the average increase has been 22 %, however, when calculating only those four provinces, where income increased, the average increase is 72 %. So in these four provinces progress of income accretion is very rapid. In West New Britain the situation was fair, but in Central the situation was not very good. There was a 32 % decrease in average monthly income, which is not promising.

The differences between sample and control villages in Oro Province are very significant. The average income in year 2005 was 187 kina and in 2006 was 396 kina, which shows an annual increase of 112 %. In Oro, the average increase from 2006 income compared to 2005 income was 112 %. When comparing this between sample and control villages, it can be seen that with the group of the poorest population (income K100 or less) the incomes have been growing more rapidly in sample villages (especially in sample village Ombisusu).

Table 5 - Household Income. Before / After Road Improvement. Oro Province

Monthly Income	% of HH in Oro			
	Sample	sample	control	Control
	Eroro	Ombisusu	Kopure	Evasusu
Over 2001	0/2	2/0	0/0	0/0
K1001-2000	3/2	8/4	10/0	0/0
K501-1000	5/9	26/67	5/6	12/47
K301-500	11/24	8/4	11/32	15/4
K101-300	33/33	8/21	42/36	40/24
K100 or less	48/30	48/4	32/26	33/25

In Oro, the average increase from 2006 income compared to 2005 income was 112 %. When comparing this between sample and control villages, it can be seen that with the group of the poorest population (income K100 or less) the incomes have been growing more rapidly in sample villages (especially in sample village Ombisusu).

4.3. Travel and Transportation

The most frequently used mode of transport for the survey respondents was walking (63 %). 37 percent of the respondents said that they used motorized transport for moving. Sea transport was also a vital mode of transport to some people in villages in West New Britain (Baia) and Central Province (Doramoku). The following table presents the average percentages of people traveling by walking and motorized transport:

Table 6 - Modes of Transport in Baseline Survey

Modes of travel	% of HH in Oro	% of HH in Manus	% of HH in Morobe	% of HH in Central	% of HH in ENB	% of HH in WNB
Walking	84	64	78	58	59	26
Motorized transport	16	34	22	41	41	61
Sea transport	0	0	0	1	0	13

Motorised transport was most frequently mode used by respondents in Provinces of West New Britain (61 %) and Central (41 %). Walking was most dominant mode of travel in Oro, where 84 percent of the respondents travel by foot. People travel by walking more often in control villages due to weaker PMV operating services and bad road conditions.

The average time to reach the nearest road before the road projects (2005) and after (2006) presented in following table 8.

Table 7 - Average Time to Reach the Nearest Road. Before/After Road Improvement

Time to reach the nearest road	% of HH in Oro	% of HH in Manus	% of HH in Morobe	% of HH in Central	% of HH in ENB	% of HH in WNB
Over an hour	12/43	5/0	44/2	29/30	29/12	44/8
45 - 60 min	10/7	7/2	36/2	12/1	19/13	10/18
44 - 30 min	23/2	9/48	1/0	10/4	27/15	5/25
15 - 29 min	2/2	10/1	0/12	3/1	7/22	5/9
0 - 14 min	53/46	69/49	19/84	46/62	18/38	36/40

The sample villages are located near the road and the time to reach the nearest road for transport is logically much shorter in sample villages comparing to control villages. Villagers reported that an improved road would make movement easier and faster. When comparing the situation between 2005 and 2006 it can be seen that the time to travel to the nearest road has decreased. The share of villagers reporting that they have immediate access to passable road has increased by 13 percent. In 2006 only 23 % of the surveyed households walked over 45 minutes to the nearest passable road. In year 2005 this figure was 43 %.

In Oro the amount of families, which are traveling more than 45 minutes to the nearest road, which can be used by a vehicle, has decreased by 28 percent. In Manus and Central the same trend can be seen and there the decrease has been 10 percent for both. The share of families, which had travel time of more than 45 minutes to the nearest road, has decreased from 80 % to 4 % in Morobe. In East and West New Britain these figures have decreased roughly by half as well.

The average frequency of travel to the nearest market place is shown in the next table.

Table 8 - Average Frequency of Travel to the Nearest Market Place. Before/ After Road Improvement

Frequency of market trips/month	% of HH in Oro	% of HH in Manus	% of HH in Morobe	% of HH in Central	% of HH in ENB	% of HH in WNB
5 times or more	24/1	24/21	25/27	37/17	30/11	6/2
3-4 times	32/0	56/53	33/39	18/35	33/41	16/3
1-2 times	44/98	14/11	42/30	45/46	32/40	67/91
0	0/1	5/15	0/4	0/2	5/8	11/3

Responses concerning travel to markets reflect their economic importance to survey households. Roads service rural communities whose livelihood is based on subsistence agriculture, with limited cash income derived from the sale of garden produce in markets and cash crops. When comparing before and after survey results the number of trips to market places per month has declined by provincial level. However, the difference is marginal. Respondents (27 %) in Morobe travel to a market place most often (5 times or more to the market per month) among the provinces in Mid-Term survey whereas people in Central Province (37 %) traveled to a market place most often in Base-Line survey. In 2006 survey the villagers of Oro and West New Britain are traveling least to markets.

The responses of surveyed households suggest that road improvements greatly enhance ease of travel especially for women and reduce travel time to destinations. An upgrading of road transport infrastructure can open up opportunities for the village people to sell garden crops at market more frequently.

The average travel time to school and health services were also studied. The results showed that people have benefited from social impacts of rural roads through access to social services in areas such as education. Improvements in access to health services for women and children in particular are especially important for poverty reduction. Road improvement generally leads to decline of time used for traveling to social services.

4.4. ENVIRONMENTAL ISSUES

Road and bridge construction, maintenance and rehabilitation projects of the RMRP have not led to substantive degradation of the environment or had tangibly negative effects on people living along the road. Maintenance and rehabilitation works have resulted, nevertheless, in frequent minor damage to existing conditions (e.g. tree-cutting, dust, landscape damage) at the length of the network. The impacts of the RMRP activities relate mainly to erosion, noise, dust, and contamination of waterways or gardens from construction activities and to some extent also loss of flora and fauna and littering along with waste management in all of the Provinces.

Evidently, dust, noise and water pollution have affected to sample villages, which are located along the RMRP road and are receiving road and bridge upgrading, maintenance and rehabilitation activities. When comparing the Mid-term noise results to previous year Base-line result, noise has been decreased in all most all the provinces, by mostly in Oro. The noise was felt to be biggest problem in Central and West New Britain, which is most probably related to higher traffic levels and road construction works. The road caused least noise contamination in East New Britain and Morobe. Dust pollution has also reduced through upgrading and sealing roads.

Similarly, the share of respondent experiencing water contamination has considerably decreased in all of the provinces except in Morobe comparing to Base-line results. For example, drainage repair and maintenance has generally a positive impact, which may be substantial in erosion-sensitive soils, like in East New Britain. Pollution of watercourses is also reduced through improved transverse drainage and turbid runoff. In Central and Morobe, the share of surveyed households worried about the water quality was highest. If the road is paved, some water pollution can occur from chemicals carried away in runoff (like exhaust emissions, pavement and tire wear and petroleum product drippage). Contamination of water was reported to be smallest in East New Britain.

The RMRP has also caused some positive impacts on the environment. Access to communities has improved. Naturally, the sample villages with road access have benefited from improved road and bridge condition by increasing their farming activities and by decreased losses of agricultural produce. Road and bridge improvement works under RMRP have positively impacted on gardening and farming activities comparing to the previous year household data results especially in Central and Manus. The number of respondents experiencing loss of agricultural produce due to bad road conditions has reduced quite significantly in Central and West New Britain, which indicate that the RMRP projects have improved the road conditions and enhanced the transportation of the agricultural produce to the markets. The percentage of people experiencing agricultural losses due to bad road conditions was highest in the surveyed households in East New Britain (73 %) and Morobe (39 %). Surveyed households in Manus experienced biggest losses of vegetation and animals due to road coming to the village area.

The following table summarizes some of the most important environment related issues, which were examined in Mid-Term and Base-Line Study Phases. Noise level, water quality, loss of agricultural produce and increased gardening activities are presented here on province level.

Table 9 - Noise Level, Water Quality, Loss of Agricultural Produce and Increased Gardening/Farming Activities due to Road in Provinces. Base-Line Study/Mid-Term Study

Environment Indicator	% of HH in Oro	% of HH in Manus	% of HH in Morobe	% of HH in Central	% of HH in ENB	% of HH in WNB
People experiencing high to moderate noise (%)	89/19	13/12	10/14	36/27	13/9	52/24
People experiencing contamination of roadside water quality (moderate to very contaminated)(%)	100/33	70/43	0/46	88/47	52/29	100/45
People experiencing loss of agricultural produce due to bad road conditions (%) (K)	14/23	9/19	12/39	72/1	84 /73	93/37
People experiencing increased gardening/farming activities due to road (%)	82/13	78/86	91/74	58/87	37/48	58/47

The following table provides a preliminary set of findings of main environmental impacts of the implementation of the RMRP activities and mainly used mitigation measures. The table is based on the study of Environment Mitigation and Management Plans (EMMPs), several consultations with various Project stakeholders, household and environmental surveys and it is not meant to be exhaustive and covering all possible issues.

Table 10 - Preliminary Findings of the Main Environmental Effects of the RMRP

Theme	Environmental Effect
Soil	Erosion, flooding, sedimentation
Air	Noise pollution, dust generation
Water	Disturbance of water flows, deterioration of water quality by sedimentation and erosion, disruption of drainage patterns
Flora and fauna	Removal of vegetation and loss of animals
Local population	Spread of diseases such as STD and HIV/AIDS, traffic safety issues

5. CONCLUSIONS

Of special attention and noteworthy interest is the clear link that is emerging that roads and bridges are bringing economic growth to the villages and the same households interviewed a year later. The growth in income due to rural infrastructure improvements is simple not to be understated. This has meant a difference in promoting poverty reduction and another year of data collection may continue to demonstrate and substantiate this very important finding in 2006.

What the ex-post evaluation has revealed is that the completed roads have been a major success factor in retaining teachers in more remote areas and ensuring equity of education opportunities with both girls and boys being able to access new transport providers. In health services, the immunization indicators are directly linked to transport in the six provinces. Mothers can transport their children to the clinics for immunization much easier with a completed road.

Road and bridge construction, maintenance and rehabilitation projects of the RMRP have not led to substantive degradation of the environment or had tangibly negative effects on people living along the road.

The RMRP has also caused some positive impacts on the environment. Access to communities has improved. Naturally, the sample villages with road access have benefited from improved road and bridge condition by increasing their farming activities and by decreased losses of agricultural produce

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