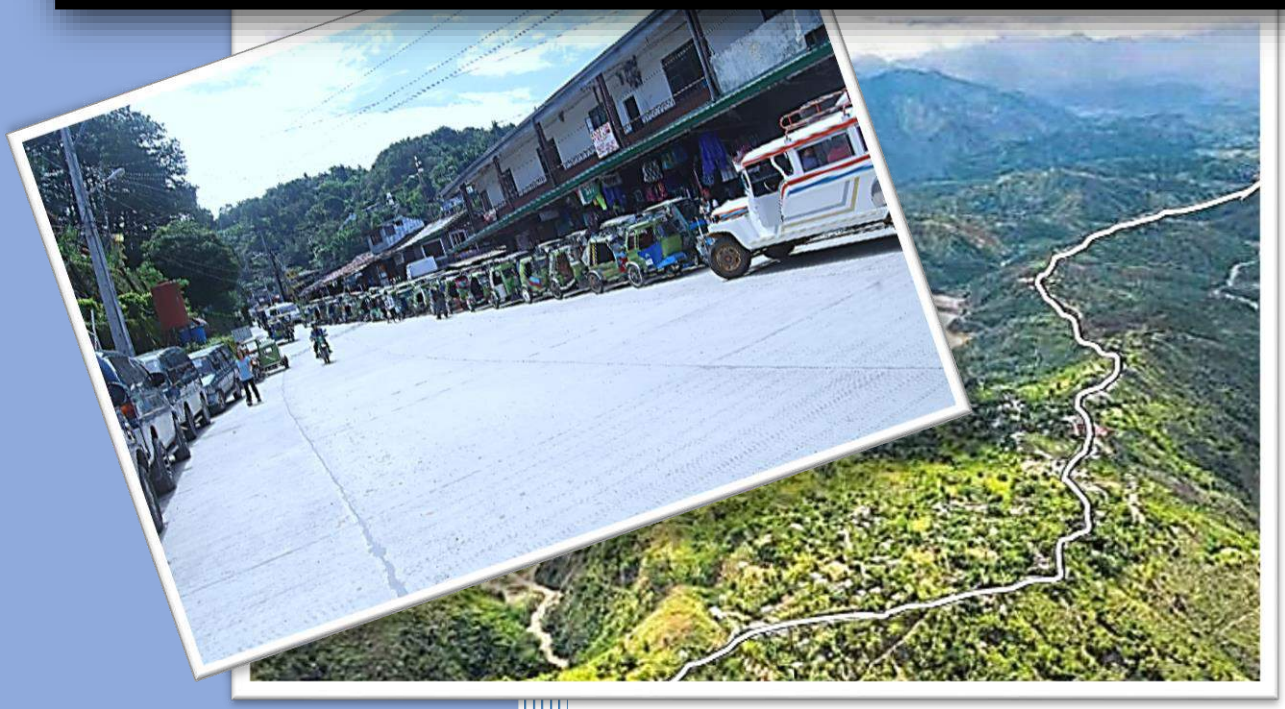
IMPACT EVALUATION of the CERVANTES-MANKAYAN-ABATAN ROAD PROJECT



MNadunop Development Studies
La Trinidad, Benguet

National Economic & Development Authority
Cordillera Administrative Region

December 2017

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1
EVALUATION FRAMEWORK

1.1 Project Overview

1.1.1 Development Context

The Cervantes-Mankayan-Abatan Road Project was contextualized within the development design under the Medium Term Philippine Development Plan (MTPDP) for 2001-2004. The plan emphasized the goal of supporting the country's socio-economic development through the provision of safe and reliable transport services that would support the modernization of the agriculture sector, tourism and the decongestion of Metro Manila. This was directed towards supporting the private sector and facilitating inter- and intra-island travel via networks of roads, bridges, railways, sea and air lanes. Transport development priorities were set on improving the quality of existing infrastructure rather than increasing the quantity of the roads by building new ones. Investments for national roads system then followed this hierarchy: (a) rehabilitation of damaged sections; (b) improvement and widening of heavily travelled roads; and (c) construction of new roads especially developmental roads and missing links in the road network. The plan targeted paved roads at 90 percent of the total national arterial roads existing at that time (16,799 km), from the 70 percent recorded at the beginning of the plan period. The plan scheduled the rehabilitation of the Suyo-Cervantes-Mankayan-Abatan Arterial Road[1] within the period 2001-2008.

The MTPDP for 2004-2010 coincided with the global financial crisis in late 2008, which necessitated a definite government response to mitigate ill effects on the Philippine economy. The plan, referred to as the Economic Resiliency Plan (ERP), aimed to address the threats and opportunities posed by the crisis as well as prepare the country for the global economic rebound. An investment-enhancing strategy was adopted that involved the regrouping of the country's geographic regions into "super-regions" with the aim of spreading development in the countryside. Through the super-regions, investment priorities to boost economic and market opportunities were focused on areas where the Philippines can bank on economies of scale that could maximize resource potentials. The enhancement of functional linkages was taken as a twin goal, seen as a way of spreading development opportunities to the rural areas. Infrastructure investments within the context of the super-regions were then designed to integrate growth centers with the countryside through the expansion of roads, airports and seaports. The North Luzon Agribusiness Quadrangle, in which CAR is included, is among the identified super-regions. Boosting investment climate in this super-region centered on agriculture and mariculture development, and functional linkages to be achieved by reducing the cost of transporting goods and addressing social development concerns.

The MTPDP for 2011-2016 underscored the attainment of inclusive growth and poverty reduction. It was also within this plan period that resilience to climate change and natural disasters as well as environmental quality were given importance as a major development sector. Under infrastructure development, the plan identified these critical performance outcomes: a) improved performance of tourism, agriculture, and industries; b) improved access to goods and services; c) improved environmental quality; and d) increased resilience to climate change and natural disasters. Subsequently, the Government of the Philippines embarked on strengthening the major road network in the country including secondary and tertiary roads in view of their importance to countrywide socio-economic development. The Arterial Road Links Project was a part of this major road development program. This project involved the paving of arterial roads as well as the expansion and improvement

[1] Arterial National Roads refer to national roads that are the backbone of passenger and freight traffic, in this case the Halsema Highway in CAR. Secondary arterial roads refer to national roads connecting arterial national roads and each city/town/village, of which the Abatan-Mankayan-Cervantes Road and the Tagudin-Suyo-Cervantes-Sabangan Road are categorized

of road networks. Thus, in addition to the north-south major road system in the country, arterial roads connecting in an east-west direction gave assurance to a geographically balanced development.

At the regional level, physical integration has been a continuing goal in the regional development plans (RDP) of the CAR. Physical integration involves the development of an efficient and reliable transportation and communication network to interconnect provincial capitals and major growth centers and build up the economic backbone of the region. Along this line, the Cordillera Roads Improvement Project (CRIP) became the highest priority infrastructure project of the region and seen as the major requisite and impetus to progressive and sustainable development in this landlocked and mountainous region. The CRIP involves the development of a north-to-south trunkline road, lateral roads connecting Regions I (Ilocos) and II (Cagayan Valley) through CAR and other vital alternate inter-provincial roads. The CRIP primarily aims to accelerate the socio-economic development of the region through the provisions of an efficient transport backbone to facilitate inter and intra movement of good, people and ideas within the region and between regions.

1.1.2 The Cervantes-Mankayan-Abatan Road Project

The Cervantes-Mankayan-Abatan Road is a 31.302 kilometer inter-regional road that links the provinces of Ilocos Sur and Benguet. The road project, under Contract Package 5 (Php 747.5 M) of the Arterial Road Links Development Project (ARLDP) - Phase V, was funded under the Japan Bank for International Cooperation (JBIC) Loan No. PH-P217.

The Cervantes-Mankayan-Abatan Road is a segment of the 92.61 kilometer west lateral component of the CRIP, particularly the Tagudin-Suyo-Cervantes-Mankayan-Abatan Road that connects the Manila North Road (MNR) in Ilocos and the Halsema Highway (Baguio-Bontoc Road) in the CAR. The road directly links east central Ilocos Sur and northern Benguet.

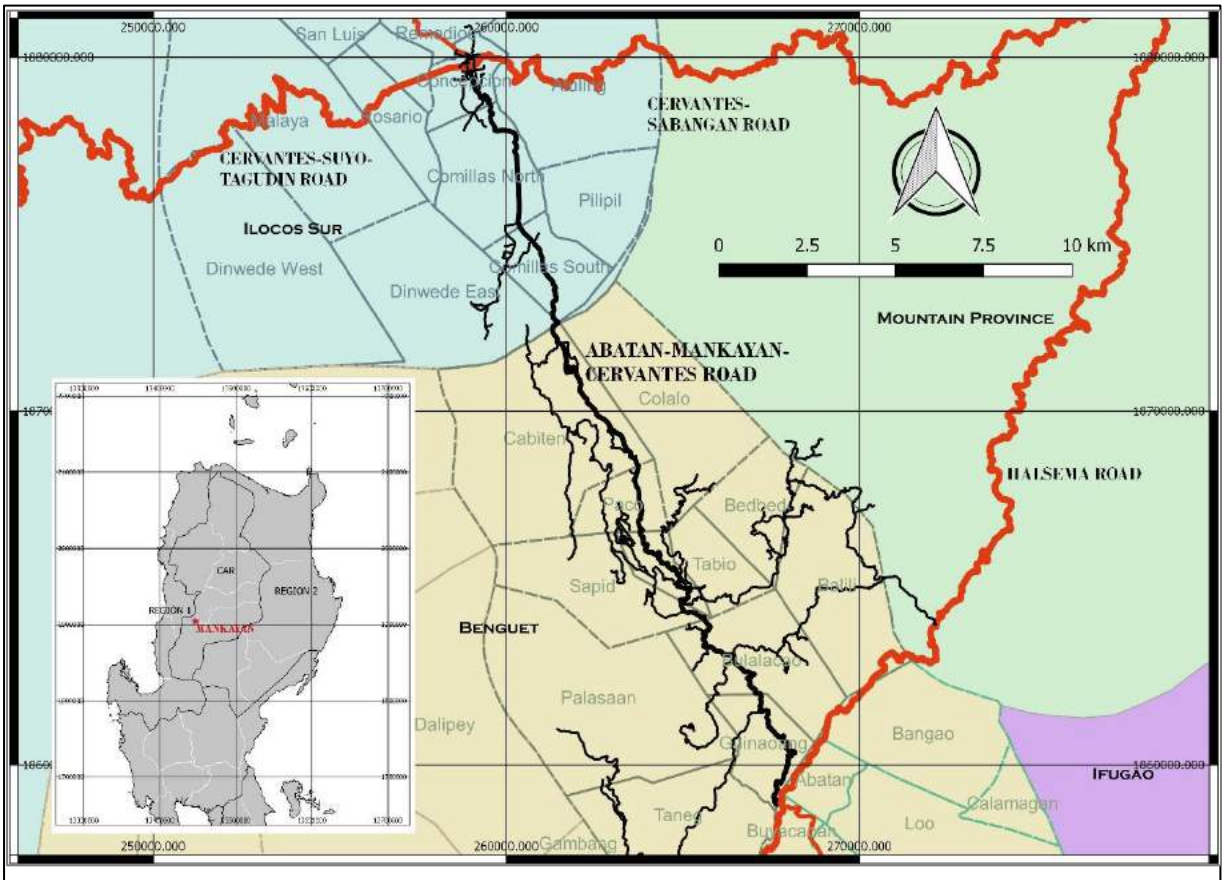


Figure 1.1. **Location map: Cervantes-Mankayan-Abatan Road**

The Cervantes-Mankayan-Abatan road starts at the end of Tagudin-Suyo-Cervantes Road (61.07 km from MNR) at the town proper of Cervantes, Ilocos Sur and passes through rolling and mountainous terrain, and ends at the intersection of Halsema Highway in Abatan, Buguias, Benguet. The road traverses the historic Bessang Pass in Cervantes, the mining areas of the Lepanto Mining Corporation in Mankayan, Benguet and vast vegetable farms in Buguias. The project was implemented from February 2008 to October 2010 by the DPWH Central Office through a project management office (PMO) with the China Harbor Engineering Company as contractor. The 54.07 km Suyo-Cervates Road Improvement Project, Contract Package 4A (ARLDP V) was implemented from June 2006 to August 2009 with a project cost of Php 1.16 B by the contractor Italian-Thai Development Public Company.

Table 1.1. **Project Description: Cervantes-Mankayan-Abatan Road Project**	
Project Name	**REHABILITATION / IMPROVEMENT OF CERVANTES-MANKAYAN-ABATAN ROAD PROJECT**
Project Location	Provinces of Benguet (CAR) and Ilocos Sur (Region 1)
Project Objectives	The proposed road rehabilitation/improvement is expected to: a) Provide a more efficient, faster, safer, and reliable means of transportation in the rural areas; b) Enhance the socio-economic activities within the municipalities of Mankayan, Benguet and Cervantes, Ilocos Sur; c) Benefit vehicle operating cost generated by traffic; d) Benefit in maintenance cost savings of transportation equipment; and e) Easy transport of agricultural products.
Project Components	Widening of existing gravel road from 5.3m wide to a two-lane 5.5 to 6.10m with one-meter wide shoulders on both sides, provision for additional drainage facilities, riprapping, slope protection, improvement of grades, and other miscellaneous works
Project Cost	Ninety-one Million Pesos (Php 91,000,000.00)
Loan Agreement Signing Date	May 2001 with Japan Official Development Assistance (ODA)
Final Disbursement Date	September 2010
Borrower	The Government of the Philippines
Executing Agency	Department of Public Works and Highways (DPWH)
Main Contractor	China Harbour Engineering Company Limited (China)
Main Consultant	Katahira & Engineers International (Japan) and Pacific Consultants International (Japan)
Road Alignment	• Starting at Abatan Junction Km. 333 in Buguias, Province of Benguet (267789.6801, 1859098.9214) and terminating at Cervantes Junction, Province of Ilocos Sur (258948.8967, 1879747.7164) • East-west link between the mountainous areas in Region 1, Ilocos Sur and Cordillera Administrative Region • Traverses seven (7) barangays: Guinaong, Bulalakao, Sapig, Poblacion Mankayan, Tabio, Paco and Kulalo • Total length of 33.34 km
Implementation Period	Commenced February 2008 Completed October 2010

1.2 Objectives of the Impact Study

The impact evaluation aims to assess the road's contribution in the attainment of the CAR's RDP development goal on Physical Integration. The project study is funded under the NEDA Monitoring and Evaluation (M&E) Fund.

The impact evaluation study of is intended to determine the effectiveness, efficiency and sustainability of the project, including good practices or lessons learned that may be applied in future similar projects in the region. The findings are organized to answer the following questions:

1) Project effectiveness: Up to what extent did the project attain its intended impacts?
2) Project efficiency: Granted that the project attained its intended impacts, are these at the level of best possible outcomes given cost and other constraints?
3) Project sustainability: How many years should the road last with proper maintenance? What decisions and arrangements did the government take to guarantee this?
4) The road project and sustainable development: What changes in the bio-physical environment of the road ZOI transpired after road improvement that can be directly or indirectly attributable to the road project?

The study assessed the road project along three general components: a) summative evaluation of project outputs and transportation outcomes; b) evaluation of socio-economic impacts; and c) evaluation of environmental impacts.

1) As a summative evaluation of project outputs and transportation outcomes, the assessment intended to:
    a. examine existing highway and traffic conditions
    b. determine whether new developments generated by increases in heavy commercial vehicle traffic have adverse impacts on pavements
    c. describe the road project and its relationship with the surrounding road network in terms mainly of traffic generation and its distribution throughout the road network.
    d. undertake traffic operation assessment to address the following:
        - quantification of the impact of additional traffic on traffic operations where a development was projected to generate significant increases in vehicle traffic;
        - how the nature and timing of road construction were compared with the required maintenance works based on projections of future traffic volumes
        - considerations in setting of design horizon for traffic operation assessment
2) On socio-economic impacts, the assessment aimed to:
    a. provide convincing proofs of quantifiable and non-quantifiable outcomes because there was a road development rather than not having one at all.
    b. establish a credible story line and/or documentation of the trickle down effect of road development as perceived by the: a) households; b) the local government units; c) the business sectors; and d) social and private institutions.
    c. identify the social and political process that complemented the intervention (i.e. road development) to achieve intended results and/or outcomes.
3) On environmental impact, the evaluation will be conducted considering cause and effect interactions within the context of a broad scale. Specifically, the evaluation endeavored to:
    a. determine the impacts of the road against the bio-physical environment to where it was constructed
    b. better understand the impacts of the road on the relationship of the people/community to the environment
    c. examine the level of relationship between environmental impacts and socio-economic change

This impact study will help the Cordillera Regional Development Council (CAR-RDC) plan the development of east lateral road linkages to Region 2, specifically the following:

- continuation of the connecting road to the east lateral Baguio-Aritao Road via the 56.24 km Abatan-Kabayan-Gurel (Bokod) Road;
- 36.51 km Cervantes-Sabangan Road, which intersects the Halsema Highway at Sabangan, Mountain Province; and
- 111.87 km Bontoc (Talubin)-Barlig-Natonin-Paracelis-Roxas Road, the interregional lateral road which links Eastern Mountain Province to Isabela in Region 2.

1.3 Analytical Framework

The study findings were organized following the analytical framework in figure 1.2. The impacts were analyzed as a hierarchy of effects arising from a set of project outputs, i.e., the road and all its features as constructed. The transportation outcomes are the first level effects—the direct results of the implementation of the road project. These transport outcomes can influence behaviors/actions that have immediate consequences to socio-economic conditions. These are the second level effects. The changes in the socio-economic behaviors/actions and conditions, in turn, can affect the quality of the environment, together with any changes in the bio-physical environment that directly resulted from the road project itself. These are the third level effects. The second and third level effects are the indirect impacts of the road project.

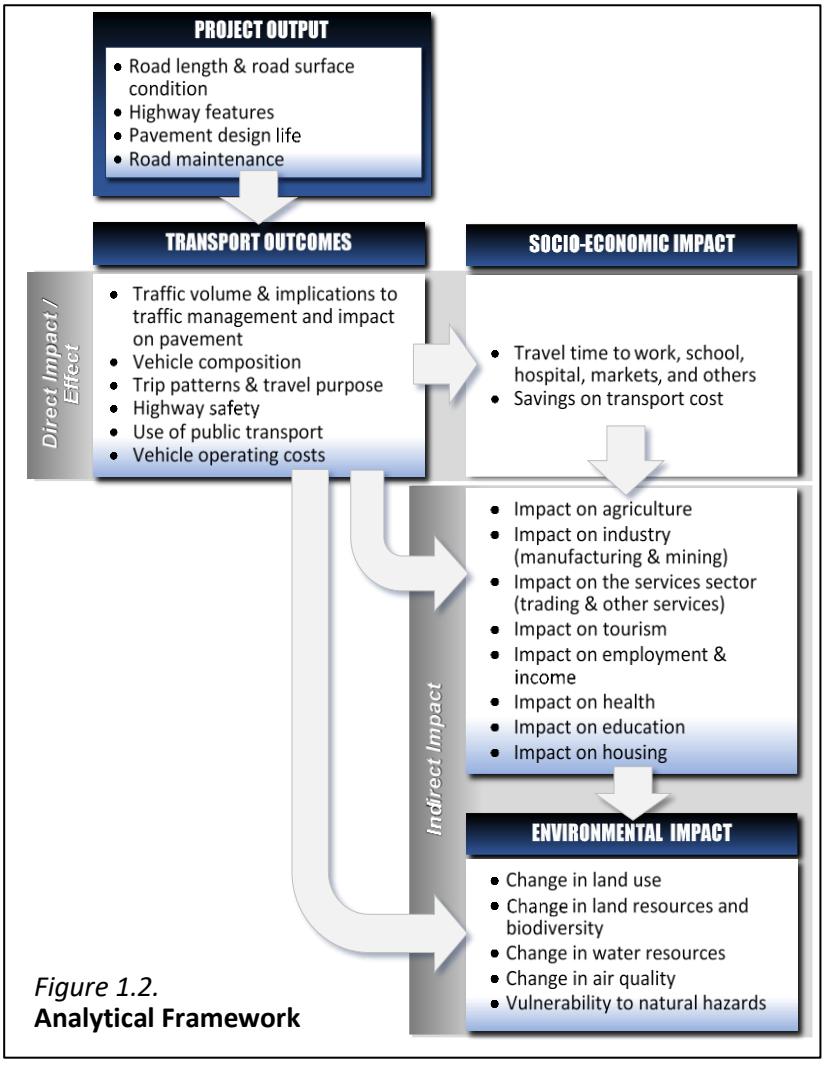


Figure 1.2.
Analytical Framework

The indirect impacts are far more difficult to measure than the direct impacts. Indirect impacts are normally influenced by complex interactions of various factors. The difficulty lies in isolating and measuring that part of the impact that can be attributed significantly to the project. This study is challenged by the inadequacy of baseline data and counter-factual information to measure the net impact of the project before and after implementation and in the with- and without-project scenario. These data limitations were addressed by drawing upon information generated through qualitative means (focus group discussions and key informant interviews) to triangulate the results of the surveys, site observations and available secondary data. The qualitative data provided insights into changes that could have occurred as a result of the improvement of the road that helped to explain snapshot data gathered from various sources.

1.4 Methodological Approach

1.4.1 The Road Zone of Influence (ZOI)

The Cervantes-Mankayan-Abatan road traverses the municipalities of Buguias and Mankayan in the province of Benguet and the municipality of Cervantes in Ilocos Sur. The Philippine Statistics Authority (PSA) classified Buguias as a medium, rural town. Mankayan, meanwhile, is a medium town with two of its barangays falling under Category 1 urban classification. Cervantes is categorized as a small town, rural.

Table 1.2. **Land Area & Population: Buguias, Mankayan & Cervantes**

Town	Land Area (sq.km.)	2015 Population	Description
Buguias	175.88	43,627	Medium town, rural
Mankayan	130.48	35,953	Medium town with Barangays Balili and Paco classified as Category 1 urban barangays*
Cervantes	234.70	17,211	Small town, rural

Source: Philippine Statistics Authority, 2010 Census

The road zone of influence (ZOI) set the general boundary for assessing the impact of the road project. A 5-km road ZOI from the road centerline was assessed as the impact catchment zone. This is further divided the following three sub-zones to account for differences in the level of impact that may be associated with distance/adjacency to the road: 1) Immediate/within 100 meters from the road centerline; 2) Within 2-km from the road centerline; and 3) Within 5-km from the road centerline.

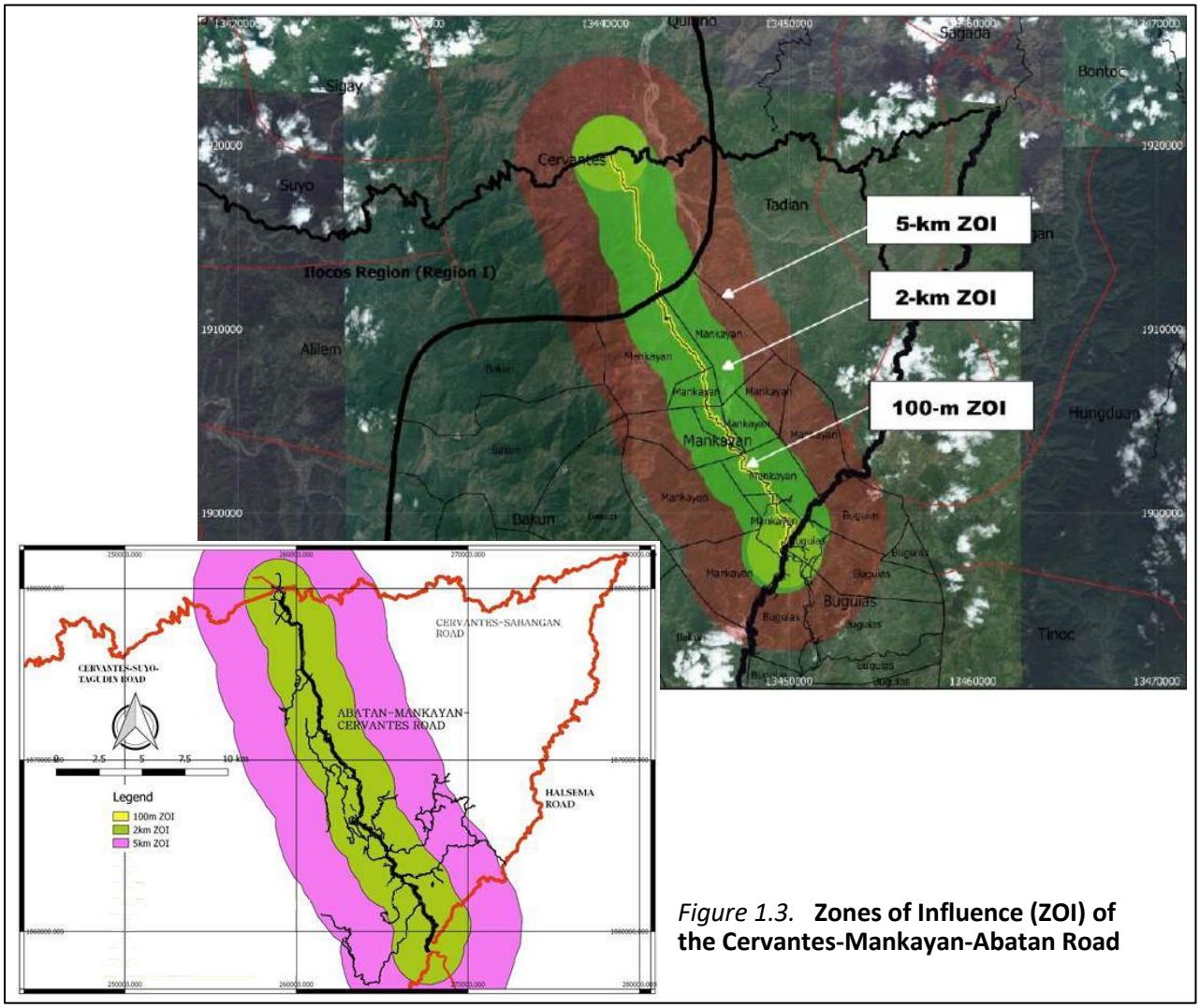


Figure 1.3. **Zones of Influence (ZOI) of the Cervantes-Mankayan-Abatan Road**

1.4.2 Summative Evaluation of Project Outputs and Transportation Outcomes

The data used to analyze the project outputs and transportation outcomes were generated using the following methods:

1) 12-hour traffic volume survey
2) Origin-destination survey using the license plate method
3) Site observation of road safety
4) Passengers, drivers, and operator's perception survey

12-hour traffic volume survey. Traffic volume Traffic volume survey, using tally sheets to record the number of vehicles, was conducted on July 2017 on major intersections particularly Abatan, Mankayan, and Cervantes. The survey is a 12-hour count carried out from 7 AM to 7 PM. Vehicle were counted, both those going to and coming from counting stations between each intersection.

The main objective of the traffic count is to gather information to support/complement the historical data on Average Annual Daily Traffic (AADT) obtained from the DPWH for purposes of analyzing the present condition of the road. This provided the basis in assessing: a) future traffic and its implications to traffic operations; b) impact on pavement; and, c) road maintenance requirements.

Origin-destination survey using the license plate method. The license plate method provides an accurate method in analyzing the volume of vehicles that passed by the vicinity of each midblock intersection. The license plate survey was conducted last July 2017 on a 12-hr count from 7 AM to 7 PM in each intersection approach. The method basically consists of observing and recording license plates of vehicles and time of arrivals at two points or more on the road where the vehicles are expected to pass. Each intersection is monitored by surveyors tallying the plate number. The plate numbers are then matched manually, or encoded in the computer for automatic processing. Within each interval the license plates of vehicles passing the point of observation are recorded.

The data generated by this survey provided the basis in analyzing the trip pattern of vehicles and in assessing the relationship of the road project with its surrounding road network.

Site observation of road safety. Assessment of road safety was based primarily on observations that have been documented by photographs and observation notes. Various observation points were selected within two sections of the road, namely, Abatan to Mankayan route, and Mankayan to Cervantes route.

Passengers, drivers, and operators perception survey. This survey was administered using a structured survey instrument to determine perceptions concerning changes in the following transport attributes: a) quality of travel; b) savings in transportation cost; c) travel time after completion of road; d) access to public transport; and, c) highway safety after completion of road. The survey respondents comprised of 30 drivers/operators randomly selected within the road ZOI and 30 randomly selected commuting passengers from the three localities within the road ZOI. The data lent added basis to generate conclusions on project effectiveness, transport efficiency and travel convenience.

1.4.3 Evaluation of Socio-Economic Impacts

The following data gathering methodologies were used in this part of the study:

1) Household Survey
2) Key informant interviews
3) Community and market survey
4) Focus group discussion
5) Archival references

Household survey. The survey instrument is structured into 11 parts: 1) household roster; 2) employment and job search; 3) questions on the importance of the road; 4) housing, amenities and transport usage; 5) livelihood activities; 6) electricity; 7) water; 8) education and road use; 9) health and road use; 10) migration and road use; 11) participation in community affairs.

A total of 280 respondents were interviewed. They are distributed as follows:

Area	Number of respondents in the Zone of Influence (ZOI)		
	100 meters	2.5 kilometers	5 kilometers
Abatan	40	0	0
Mankayan	40	40	40
Cervantes	40	40	40

The 40 respondents per ZOI were divided equally into: 1) those within the road vein and 2) those not within the road vein. For example, the 40 respondents with the 100 meters are randomly chosen, starting from the cross road of Mankayan and Cervantes. From the cross roads, the surveyors picked up 10 respondents gradually radiating to 2.5 kilometers up to 5 kilometers.

For Abatan, only those within the 100 meters of the ZOI were included in the survey. Using the crossroads in Abatan as reference for the ZOI, ZOIs further than the 100 meters is not within Cervantes-Mankayan-Abatan loop, but are within the Buguias-Kabayan-Gurel and Halsema road loops.

There are areas that are not always populated by households because these are forested areas, rivers, gardens and rice fields. Adjustments were made within four kilometers in these cases.

Key informant interviews. This was carried out using a structured KI questionnaire to obtain information about people's recollection of what was life like without and with a good road, the importance of the road, and the changes in the key indicators because there is now a good road. Three KIs were interviewed, ages between 50-60, 40-49, 25-39, and who have live in the community at least for 25 years.

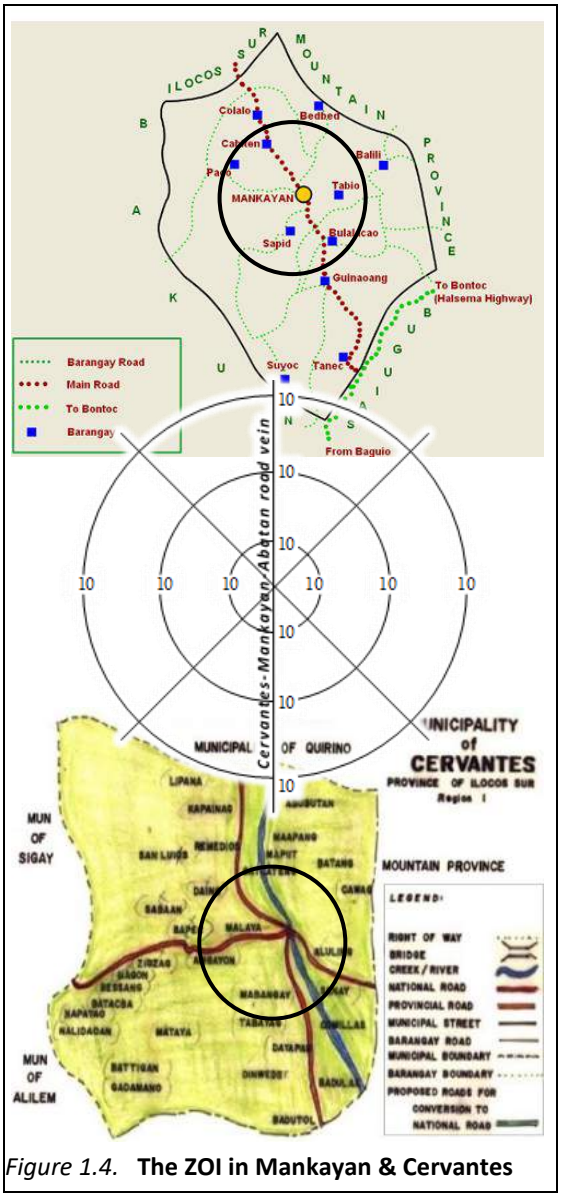


Figure 1.4. **The ZOI in Mankayan & Cervantes**

Focus group discussion. The FDG engaged the participation of 8 to 10 discussants each from Abatan, Mankayan and Cervanted, representing various sectors and groups in these localities. The FGD was conducted for the main purpose of complementing the household surveys and in-depth interviews. Group discussions were organized using time line analysis, transect analysis and spot and road mapping.

Community and market survey. This was administered to obtain pertinent data that are not found in the CLUP and the community profile. Three key informants were selected from among the barangay captain, an Municipal Local Government officer, or the barangay secretary. In instances when the selected key informant was not able to give the information, the interviewer consulted the official/personnel from the agency/organization concerned (school principal, barangay health worker) who are familiar with the facilities.

Archival references. Most of the archival sources are referenced to the work of Lewis (1991), who made a very detailed account of the political and socio-economic life of the people of Buguias. Maps are lifted from his book as he is the first writer to make a sketch of the trade routes of Buguias, which of course, affects Mankayan and Cervantes.

The analysis of the survey triangulates the three survey instruments, the household survey, community survey, and the structured key informant survey, to sketch a seamless analysis of the impact of road to the households and to the community. The analysis combines a qualitative and quantitative approach, the former to describe the variables and the latter to measure the variables and to develop objective discussion on the causal relations developed from theoretical models.

The evaluation design combines quantitative-qualitative approach. Descriptive statistics such as averages measures the variables that are needed to understand extent of impact. For inferential statistical techniques, Propensity Scores Method (PSM) was used to randomize observed changes in the three areas in the absence of baseline data. The quantitative measures were given deeper meaning by using qualitative approach to describe how the changes were experienced by the households and the community.

1.4.4 Evaluation of Environmental Impacts

The following data gathering methodologies were used in this part of the study:

1) Focus group discussion
2) Key informant interviews
3) Reconnaissance Survey
4) Walk-through surveys

Focus group discussion. The primary purpose of the environmental component of the FGD was to provide a venue for selected stakeholders to come together in a small and safe group setting to discuss and clarify initial thoughts or insights regarding environmental issues before, during, and after the road construction. This was conducted together with the FGD on the socio-economic component as discussed above.

Key informant interviews. The KI survey proceeded with the use of structured interview guide to surface clear recollection of what the environment was like before, during, and after the road. The interview instrument endeavored to measure the perceived environmental changes and the locations of the changes before and after the road. This was administered to a total of 18 selected key informants, broken down as follows:

- 6 KIs residing within the 100-meter ZOI
- 6 KIs residing within the 2-km ZOI
- 6 KIs residing within the 5-km ZOI

Reconnaissance Survey. This was conducted preparatory to the walk-through survey. This step served as an initial "spot check" to determine the general characteristics of the study area leading to the selection of representative sites used as transect in the walk-through survey. The number and

placement of the transect points were determined at this stage based on the study area's environmental characteristics.

The reconnaissance survey was conducted on June 1, 2017 where road intersections and possible representative sites were visited. Photographs and geographic locations were gathered. The transect points are shown in Figure 1.5.

Walk-through surveys. The walk-through surveys were conducted in July 27 and 28, 2017 and August 27 and 28, 2017. The locations visited during the Reconnaissance Survey served as the initial points for the transect but additional sites were also gathered along the Cervantes-Mankayan-Abatan Road and barangay roads in order to cover the different environments/ecologies existent along the road (Figure 1.6). The points also served as the reckoning points for the establishment of the ZOI.

Seven belt transects, each starting from the Cervantes-Mankayan-Abatan Road centerline at intersection points and going out towards the three Zones of Influence following the barangay roads were set up (Figure 1.7). A walk-through therefore started at the national road and walking out following the barangay roads and stopping within a 100-meter zone, 2-kilometer zone, and 5-kilometer zone. Environmental characteristics that were encountered were gathered through photography and mapping.

The environmental impacts were assessed against the bio-physical environment to where it is situated considering associations and interactions of people/community to the environment and the corresponding socio-economic change.

Of specific concern in this study is the environmental context in which the Cervantes-Mankayan-Abatan Road project is situated: a mountainous region of the CAR which demonstrates a different bio-physical, climatic, and cultural landscape to that of the rest of the country. These characteristics pose a challenge to conventional road construction and maintenance practices especially when considered against an objective of environmental conservation.

Some issues were taken into consideration during the conduct of this study which had an effect on the tools and methodology employed, namely:

1. Scientific consensus on the techniques on gathering indicators, quantifying environmental impacts, as well as predicting future effects is still gradually emerging; and
2. Every community has different needs and expectations on projects and the environment has different ways of adapting or resisting anthropogenic changes.

To address the above-stated issues, a triangulation approach in data gathering is adapted which is composed of secondary data, community consultations, and walk-through surveys. This procedure was established in order to straightforwardly capture and validate the gathered information which was eventually analyzed in this study.

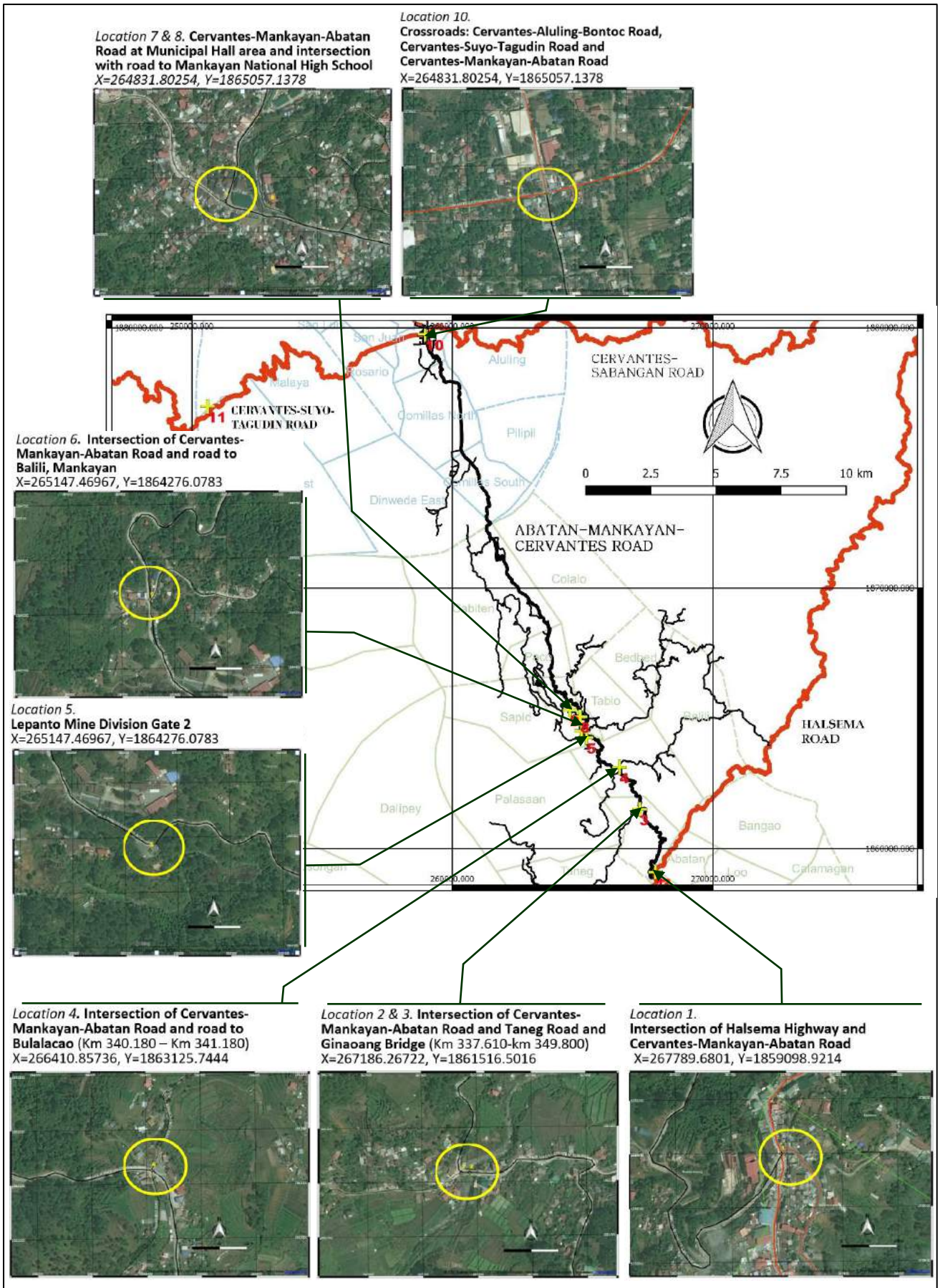


Figure 1.5. **Plot of locations visited during reconnaissance survey which initially served as points for transect**

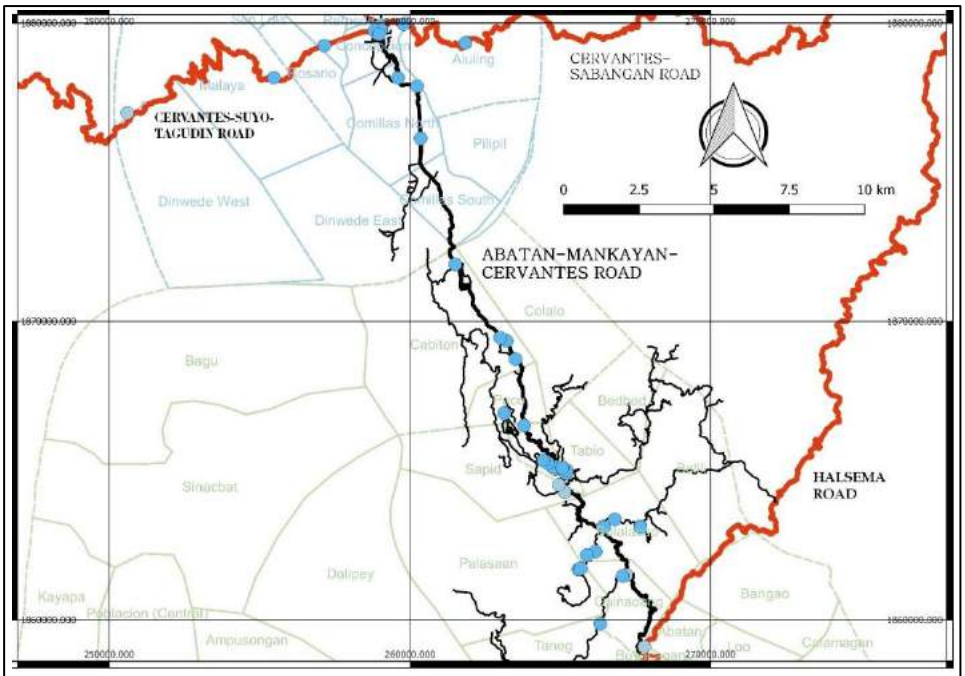


Figure 1.6. **Plot of Locations Visited during the Walk-Through Survey which served as points for transect.**

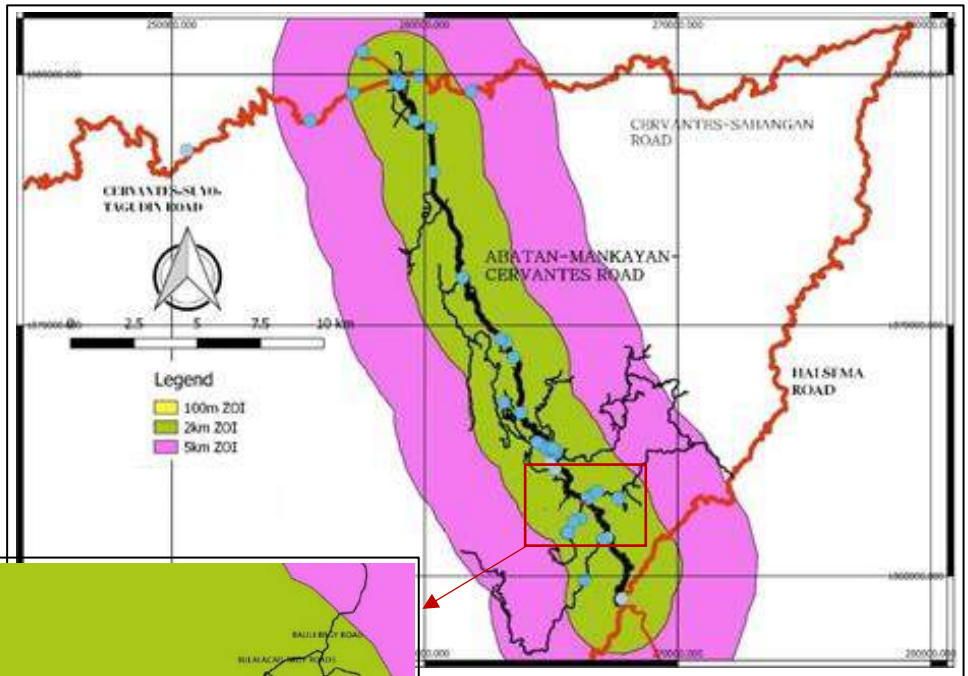


Figure 1.7. **Road ZOI and Walk-thru Plot Locations**

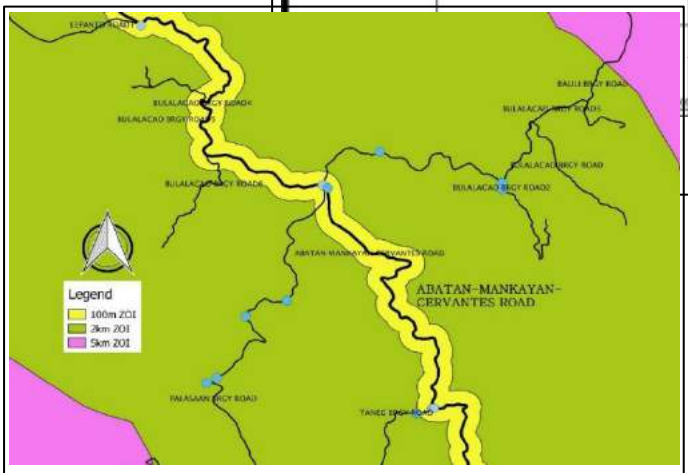


Figure 1.7. **A defined belt transect from the centerline of the Cervantes-Mankayan-Abatan Road at intersections and moving out following barangay roads**

Chapter 2
SUMMATIVE EVALUATION OF PROJECT OUTPUTS AND FINDINGS ON TRANSPORTATION OUTCOMES

2.1. Road Features

The Cervantes-Mankayan-Abatan road traverses the provinces of Ilocos Sur and part of Benguet. This road connects at the end of Suyo-Cervantes road at the town proper of Cervantes, Ilocos Sur passing through rolling and mountainous terrain and ends at the intersection of Halsema Highway in Abatan town proper. It has a total aggregate length of 31.55 kilometers.

The road is constructed with a two-lane traveled way with width ranging from 5.0 to 6.10 meters plus the improvement of shoulder on both sides (width varies 0.5 to 1.0 meter) with provisions of AC surfacing if gradient exceeds 5 percent. The pavement length is broken down into 7.63 kilometers by 6.10 meters width of PCC pavement (t=0.23 meters) kilometers by 6.10 meters width of AC pavement (t=0.10 meters). It also involves the rehabilitation/improvement of six existing bridges and construction of miscellaneous drainage and slope protection structures.

Table 2.1. **Road Surface Condition of the Cervantes-Mankayan-Abatan Road: 2011**

Existing Road Type	Physical Condition	Length (KM)
Concrete	Fair	21.35
Asphalt	Fair	9.15

Source: MPDO, Engineering Office

Table 2.2. **Existing Bridges: Cervantes-Mankayan-Abatan Road: 2011**

Bridge ID	Bridge Name	Bridge Type		Overall Condition	Length(KM)
B02413LZ	Sinedab Bridge	Permanent	Concrete	Good	30.70
B02414LZ	Comillas Bridge	Permanent	Concrete	Fair	60.00
B02415LZ	Libeg Bridge	Permanent	Steel	Good	122.00
B03270LZ	Baguyos Bridge	Permanent	Concrete	Fair	27.60
B02160LZ	Tubo Bridge	Permanent	Concrete	Fair	19.40
B02159LZ	Guinaong Bridge	Permanent	Concrete	Fair	19.50

Source: DPWH-CAR

The highway features for the Cervantes-Mankayan-Abatan Road are as described in the table below.

Table 2.3. **Highway Features of the Cervantes-Mankayan-Abatan Road**

Feature	Description
Carriage width	6.10 Meters (Two-Lane Two Way)
Right of Way width	1 to 1.5 Meters
Vertical grades along the highway	0 to 18%
Horizontal alignment along the highway	-8% to +8%
Design Speed/ Posted speed limit	30 kph
Traffic Control Type	
Traffic Operation signage	
Guardrails	Steel guardrail/ concrete parapet/ stone masonry/ concrete barrier
Current pavement design life	20 years
Current pavement age	8 years

Source: DPWH-CAR

The Cervantes-Mankayan-Abatan road was constructed to enhance the agricultural productivity, increase mining outputs along the main roads of Benguet and Mountain Province and to boost tourism in the area of influence. The road is being used by the trucks hauling ores from Lepanto Mines, the bus commuting public from Lepanto in Mankayan, and travels from Cervantes, Quirino, Ilocos Sur. Likewise, this will provide more access to the nearby provinces of Ilocos Sur, Abra, Benguet and Mountain Province. It is expected that the road constructed will reduce the vehicle operation cost as well as the travel time while improving riding comfort.

The Cervantes-Mankayan-Abatan Road has been used in the past as an alternate road to Baguio via Candon, Ilocos Sur when the Halsema Road closed due to landslides. The frequency of vehicles using the road is busiest during 4:00 A.M to 8:00 PM. However, the above mentioned purpose of the road, together with its identified advantages seemed to have fallen short. The road having a mountainous topography is prone to landslide and other natural disasters or hazards.

Other hazards with natural causes include earthquake, typhoons and drought. It can be noted that most portion of the area are characterized by rugged terrain, high hills and inland valleys. At present, some portions of the built structures and agriculture areas have sinkhole cracks. These events were reported to Lepanto Mining Company and their findings were fault line as declared by their Geologist.

Considering the topography and slope, low lying areas are perennially subjected to flooding during periods of heavy downpour. The lack of drainage systems is one factor contributing to the flood problem. Additionally, continuous heavy rain causes landslides along Tagudin-Cervantes road and Cervantes-Baguio road, and it normally takes approximately one week to clear the road. It is believed that denudation of the mountains caused some landslides which in turn bring inconveniences to commuters and motorists.

2.2 Road Maintenance

Monitoring data from NEDA-CAR provided information on the existing road and bridges with present conditions as shown in Tables 2.4 and 2.5.

Table 2.4. **Current Condition and Maintenance of the Cervantes-Mankayan-Abatan Road**

Existing Road Type	Length (Km)	Carriage Width (Meters)	Thickness (Meters)	Proposed Improvement
PCC Pavement	5.902	6.10	0.23	No Improvement
Gravel/ Earth Pavement	7.63	6.10	0.23	PCC Pavement
Gravel/ Earth Pavement	17.77	6.10	0.10	Asphalt Concrete Pavement

Source: NEDA-CAR

Table 2.5. **Current Condition and Maintenance of Bridges, Cervantes-Mankayan-Abatan Road**

Existing Bridge	Proposed Improvement
Sinedab Bridge (Bailey)	New Bridge
Comillas Bridge	Repair/ Rehabilitation
Libeg Bridge (RCDG)	Repair/ Rehabilitation
Baguyos Bridge(RCDG)	Repair/ Rehabilitation
Tubo Bridge (SCIS)	Repair/ Rehabilitation
Guinaong Bridge	Repair/ Rehabilitation

Source: NEDA-CAR

The current cost of road maintenance for the Cervantes-Mankayan-Abatan Road is estimated at Php 11,155,409 per kilometer per lane (Table 2.6). Maintenance works cover reblocking and thermoplastic pavement markings.

If there are no damages to the pavement, then the allotted fund indicated in table 2.6 will be returned to the DPWH. This is like an emergency fund for rehabilitation for instance when landslides occur. The fund allotment for routine maintenance is in anticipation of any damages to the road. The budget of Php 11.11 million is the estimated cost for repair that may happen in a one-kilometer road stretch. In 2016, concrete maintenance increased to Php 14,396,116.01 per km. The 4.5 km stretch fund allocation is assessed more than enough in case there will be structural damages to the pavement.

Table 2.6. **Current Cost of Routine Maintenance, Cervantes-Mankayan-Abatan Road**

Road Section	Scope of Work	Appropriation (Php)	Length (Km)	Cost per Km (Php)
Regular Infrastructure	Reblocking	50,000,000.00	4.5	11,111,111.11
Maintenance Project	Thermoplastic Pavement Markings	398,681.28	9	44,297.92
			Total	**11,155,409.3**

Source: DPWH-CAR

2.3 Traffic Conditions

There were two types of traffic data that were gathered for this study: 1) the Annual Average Daily Traffic (AADT) from DPWH-CAR; and, 2) 12-hour traffic volume data gathered through traffic count done in July of 2017. These sets data were used to analyze changes in highway and traffic conditions.

2.3.1 Average Annual Daily Traffic

The Cervantes-Mankayan-Abatan Road started fully operating in year 2011[2]. Figure 2.1 shows that the highest average annual daily traffic recorded before the project went into full operation was at 1,028 vehicles per day which was in 2010. The AADT before project started construction can be averaged at 766 vehicles from 2007 to 2010. After construction, from 2011 to 2015, AADT reached an average of 1294 vehicles. This is an increase of about 69 percent from the before-project to the after-project. Recorded traffic is highest in 2015 when it reached 1,646 vehicles per day. This level is 60 percent higher than the highest recorded AADT before project operation, i.e., in 2010.

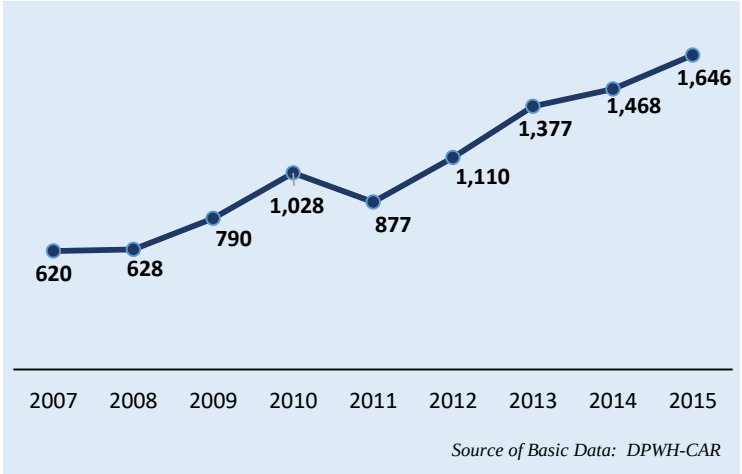
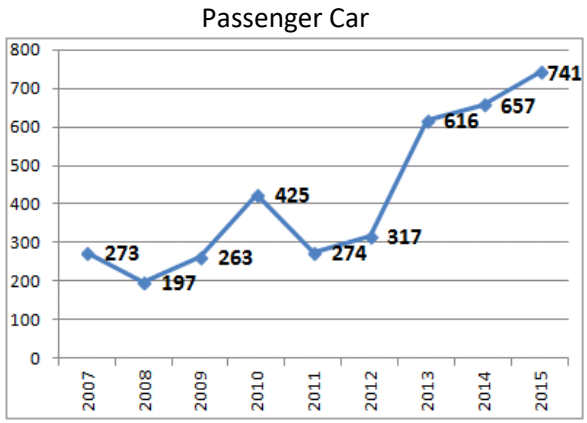


Figure 2.1. **Annual Average Daily Traffic, Cervantes-Mankayan-Abatan Road: 2007 to 2015 (number of vehicles)**

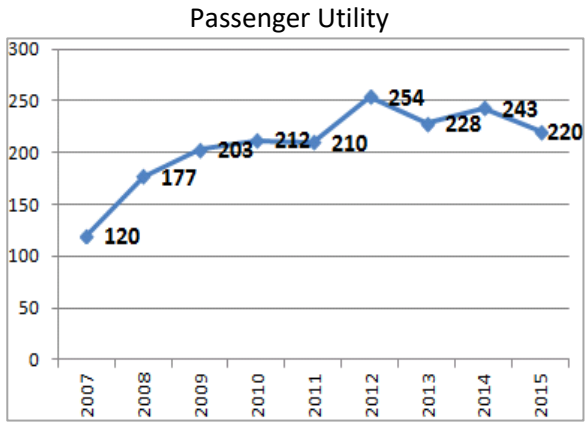
Passenger cars have been increasing by an annual average of 22 percent from 2011 to 2015 (Figure 2.2), reaching a total of 741 vehicles per day in 2015. Meanwhile, the passenger utility vehicles (Figure 2.3) remained almost unchanged (increasing by only 1% annually) fluctuating around an average of 225 passengers per day.

[2] Project completion was expected end of 2010. Road rehabilitation, however, extended to 2011 which accounted for the AADT dip in the year as some road sections were only one-way opened.



Source: DPWH-CAR

Figure 2.2. **AADT for Passenger Car, Cervantes-Mankayan-Abatan Road**



Source: DPWH-CAR

Figure 2.3. **AADT for Passenger Utility, Cervantes-Mankayan-Abatan Road**

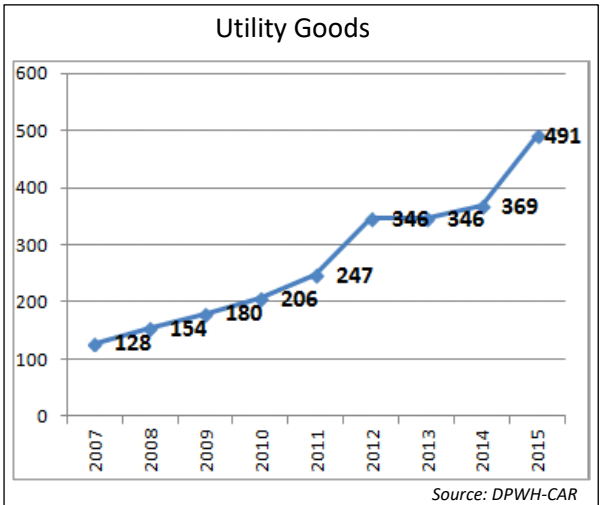
In terms of logistic support for business activities in the area, the use of utility vehicles for goods in 2015 more than doubled that in 2010 and nearly four times the number in 2007 before the road project started construction (Figure 2.4). Table 2.7 shows that the AADT for utility goods increased much faster (annual average of 19 percent from 2011 to 2015) compared to the build-up in AADT for passenger utility and passenger car taken together (9% average annual increase for the same period). This would suggest that the Cervantes-Mankayan-Abatan road project is increasingly used more for the transportation of goods than for the transportation of passengers, which appears to lend primacy to the economic importance of the road.

Table 2.7. **AADT for Passengers and Goods, Cervantes-Mankayan-Abatan Road: 2007, 2010, 2015**

	AADT (Number of Vehicles)			Ave Annual Increase	
	2007	**2010**	**2015**	**2007-2010**	**2010-2015**
Passengers	393	637	961	17%	9%
Goods	135	215	518	17%	19%

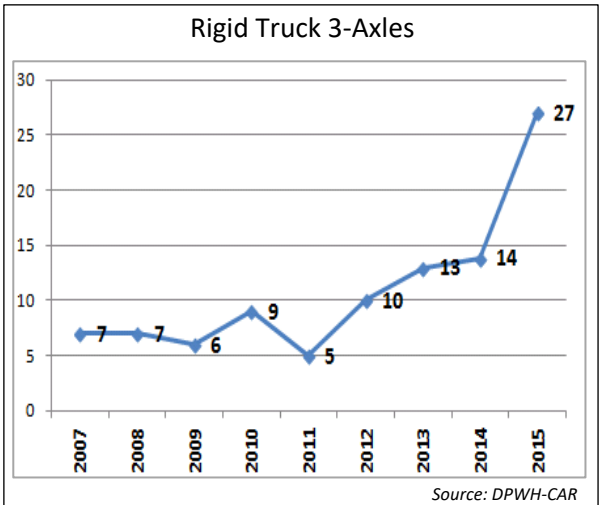
Source of basic data: DPWH

Daily traffic for 3-axle trucks likewise steeply rose since the road was improved (Figure 2.5). In 2015, an average of 27 units of 3-axle trucks were plying the road on a daily basis. This is nearly four times the annual average from 2007 to 2010.



Source: DPWH-CAR

Figure 2.4. **AADT for Utility Goods, Cervantes-Mankayan-Abatan Road**



Source: DPWH-CAR

Figure 2.5. **AADT Rigid Truck 3-Axles, Cervantes-Mankayan-Abatan Road**

2.3.2 Hourly Traffic Volume

This part further describes traffic volume in terms of specific hours of the day at specific major points using data gathered through a traffic volume survey conducted on July 2017 at three major road intersections--in Abatan, Mankayan, and Cervantes. The survey was a 12-hour count conducted from 7:00 AM to 7:00 PM covering vehicles going to and from the counting stations between each intersection.

Figure 2.6 shows that the largest volume of vehicles, entering and exiting combined, is recorded along the Cervantes intersection towards Mankayan with peak-hour occurring between 7:00 to 8:00 AM. Overall vehicle count in Cervantes is 37 percent higher than in Mankayan, and the latter only two percent higher than in Abatan. Consider, however, that a bulk of the vehicles counted in Cervantes and Mankayan are tricycles/motorcycles. When excluding tricycles/motorcycles, as of 2017, the biggest vehicle volume is in Abatan (1,536 vehicles/day), next is Mankayan (1,010 vehicles/day), and the least is in Cervantes (758 vehicles/day).

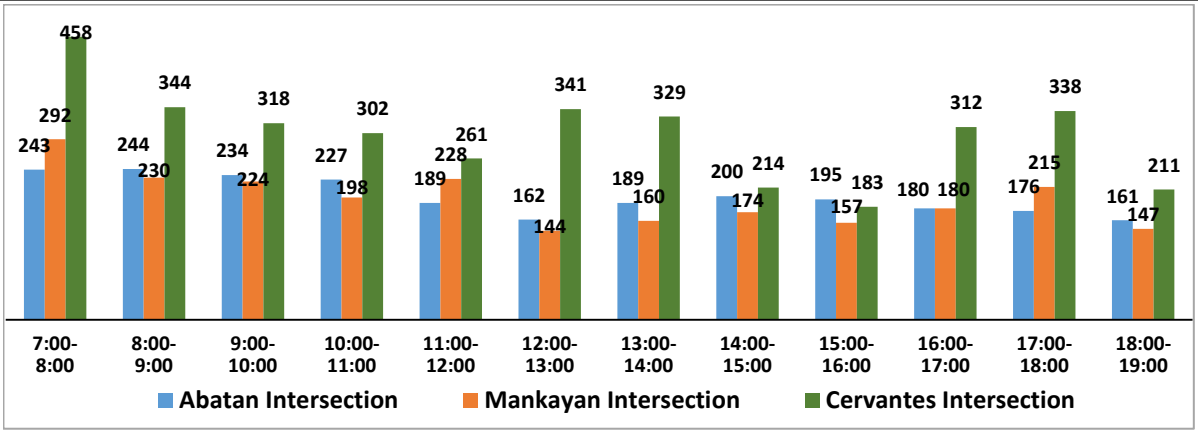


Figure 2.6. **Hourly Traffic Volume Count, 12 hours, Cervantes-Mankayan-Abatan Road: 2017**

Figure 2.7 show that vehicles going to Abatan intersection peaked at 7:00 to 9:00 AM with 137 and 139 vehicles per hour. At the Mankayan intersection, vehicles going to Abatan peaked between 7:00 to 8:00 AM at 166 vehicles per hour. Travel activity at noon is normally low but in the case of Mankayan intersection, the volume is high between 11:00 to 12:00 noon at 154 vehicles per hour. This is an indication that there is much travel activity between Abatan and Mankayan intersection. Travel activity between Mankayan and Cervantes is also high even during non-peak hours.

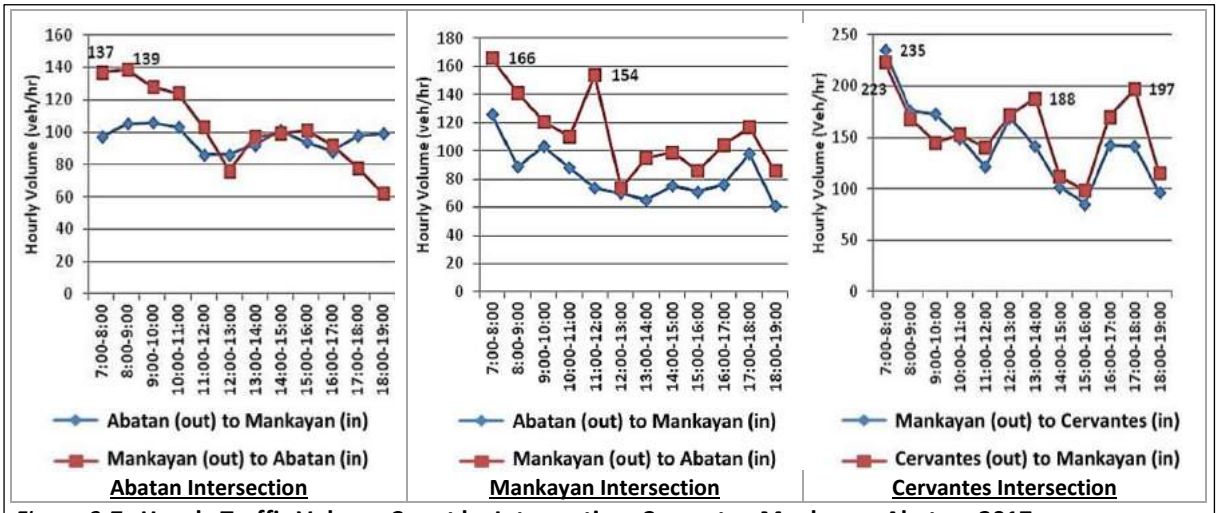


Figure 3.7. **Hourly Traffic Volume Count by Intersection, Cervantes-Mankayan-Abatan: 2017**

2.3.2 Mode of Choice: Vehicle Composition

Comparing motorist's preference between the use of private and public transport, the results are shown in Figures 2.8 and 2.9. There was a notable shift from passenger utility vehicles to passenger car before the road fully operated (2010-2011) and during full operation (2012-2015). In 2010 when the road was still under construction, passenger car comprised 41 percent of the total vehicle fleet. This went down to 31 percent in 2011 and further to 29 percent in 2012. Starting 2013 until 2015, however, this rose to 45 percent of the number of vehicles which was accompanied by a significant drop in the number of passenger utility vehicle, from 23 percent in 2010 drastically plunging to 13 percent in 2015.

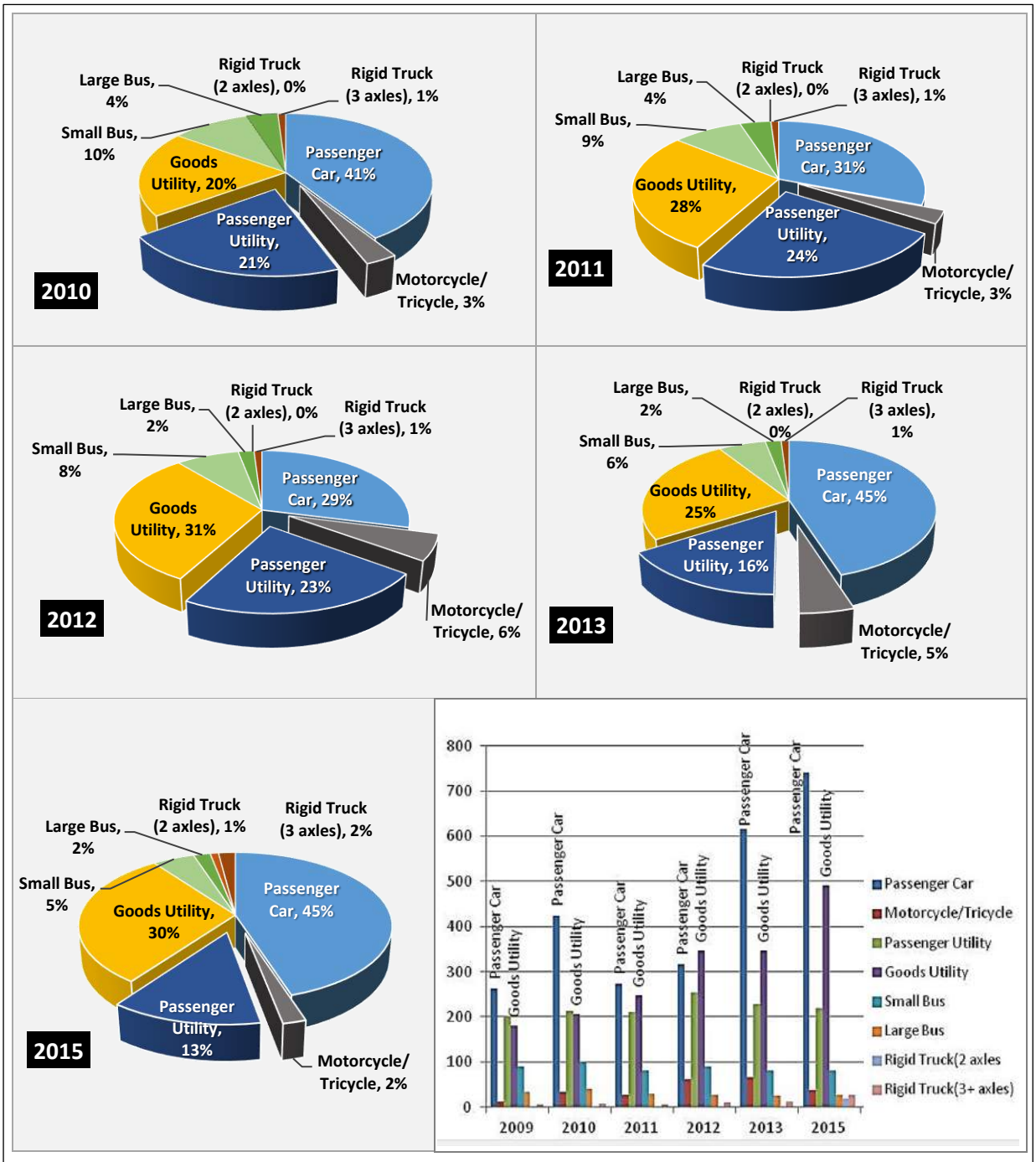


Figure 2.8. **AADT by Vehicle Composition, Cervantes-Mankayan-Abatan Road, 2010-2015**
Source: DPWH-CAR

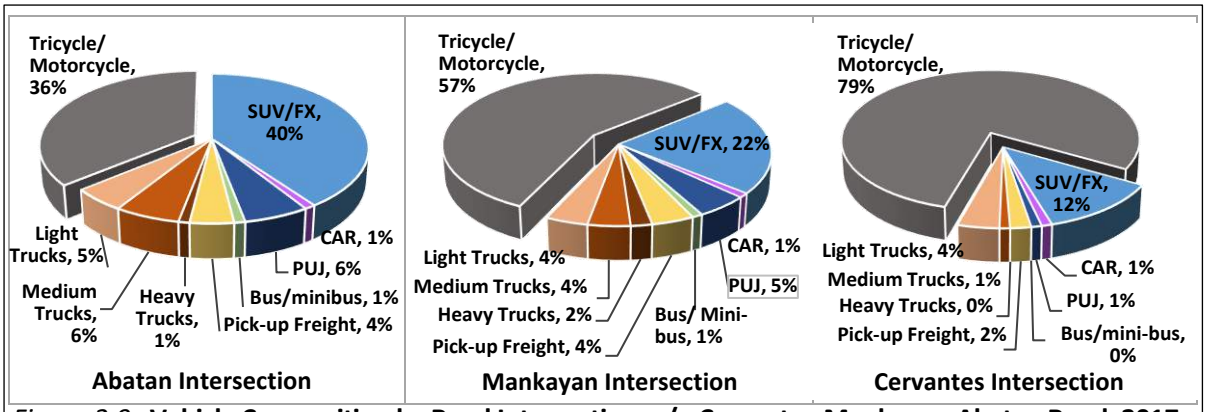


Figure 2.9. **Vehicle Composition by Road Intersection w/n Cervantes-Mankayan-Abatan Road, 2017**
Data gathered thru 12-hr vehicle count conducted July 2017

The data gathered through 12-hour vehicle count in July 2017 showed a very steep rise in the number of motorcycles/tricycles plying the Cervantes-Mankayan-Abatan road. This vehicle mode comprised but three percent of the vehicle fleet in 2010 before the road went into full operation. This dropped to two percent in 2015. It then rapidly soared two years later to as high as 79 percent in Cervantes and lowest at 39 percent in Abatan. The rise in the volume of tricycles reflects the increase in the demand of passengers for short-distance travels and the probable increase in the feeder roads from the main road artery leading to the different communities within the road zone of influence. These feeder transport modes operate within a very localized route, i.e., barangays near the town center, and are not used for travel further to other towns.

Passenger demand for inter-town travels (i.e., outside of their respective municipalities) through public utility mode is observed to be generally low. PUJ is the sole means of public transport from one town to the next along the Cervantes-Mankayan-Abatan road. (The buses/mini-buses recorded in the 12-hour count are most likely tourist buses). In 2017, this mode of travel composed only six percent of the vehicle count in Abatan, five percent in Mankayan and one percent in Cervantes. Aggregately, this is more or less equal to the 13 percent count of DPWH-CAR in 2015 when including as well the FX mode of public transport to Baguio from Cervantes and Mankayan.

The SUV/FX vehicles comes as the overall second in terms of transport mode in 2017. This is particularly more prominent in Abatan where SUV/FX, more than tricycles/motorcycles, is the primary transport vehicle, accounting for 40 percent of the 2017 traffic count in that area. Most of these vehicles are for private transport being used as well, if not mostly, for the transport of goods.

In general, data on traffic count suggest that the construction of the road caused a shift of mode preference from public transport to private transport. The composition of public transport along the road project dropped by more than half within a span of two years during full operation--from 31 percent in 2015 to 14 percent in 2017, and concurrently raised the composition of private vehicles from 69 percent to 86 percent in the respective years. It would appear that Cervantes may have experienced the biggest shift from public to private passenger transport mode as a result of the road project.

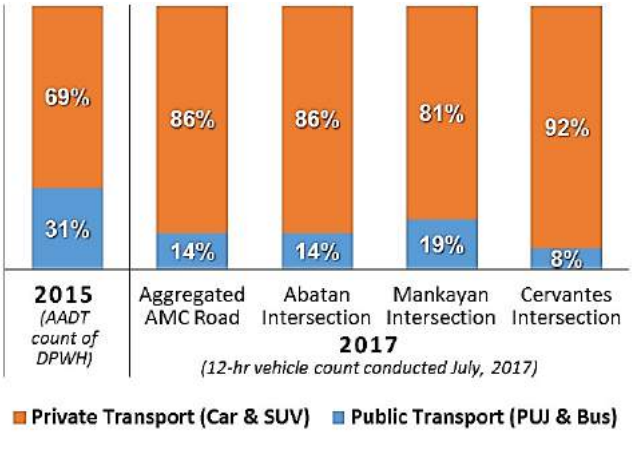


Figure 2.10. **Passenger Mode Split, Cervantes-Mankayan-Abatan Road: 2015 & 2017**

2.4 Future Traffic Forecasts and Implications to Traffic Operations

The AADT is forecasted to year 2030 and 2050 to assess the Level of Service (LOS) of the facility based on future traffic volume. The method used for the forecast is linear regression. Figure 2.11 shows the equation used to forecast the AADT by 2030. The R^2 coefficient shows a value of 0.9404 indicating that it is close to 1.0. Thus, the linear equation y=131.33x – 263051 is the best fit or best model to predict the AADT. Figure 2.12 shows that by 2030, the AADT will reach 3,549 vehicles per day.

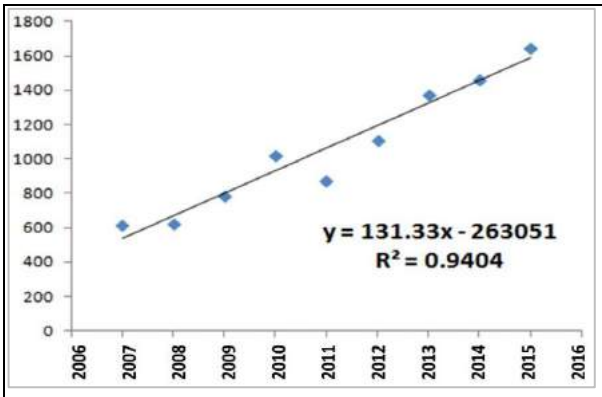


Figure 2.11. **Regression Equation from the AADT Data**

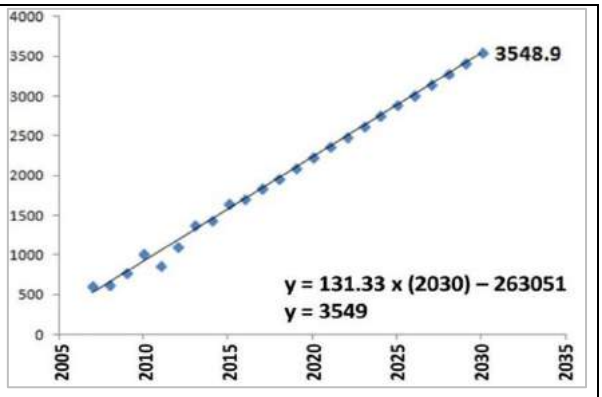


Figure 2.12. **Forecasted AADT by 2030**

The forecasted AADT of 3,549 vehicles in year 2030 converts to 4,540 PCU (Passenger Car Unit) per day. The design hourly volume is computed as DHV (Design Hourly Volume) = AADT x K factor (0.10). The K factor Design Hourly Volume is equal to 454 PCU per hour. The capacity for a 6.1 meter carriage width is 1900 vehicles per hour. Thus, DHV divided by capacity (454/1900) equals 0.239. This value falls within level of service (LOS) B.

Capacity is defined as the maximum hourly volume at which persons or vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given time period under prevailing roadway, traffic, and control conditions. On the other hand, level of service (LOS) is a qualitative description of how a facility is performing. Capacity and level of service analysis determine the width and number of lanes when planning for new facilities or when expanding existing facilities that are already experiencing congestion problems (Sigua, 2008).

Table 2.8. **Level of Service of Cervantes-Mankayan-Abatan Road for year 2015 and 2030**

Year	AADT (Annual Average Daily Traffic) PCU/day	DHV PCU/hr	Capacity PCU/hr	V/C Ratio	Level of Service
2015	2106	189.54	1900	0.0998	**LOS A**
2030	4540	408.6	1900	0.215	**LOS B**
2050	6175.5	555.8	1900	0.30	**LOS B**

Source of Basic data; DPWH

Table 2.9. **Level of Service Description**

Year	LOS	Type of Flow	Description
2015	A	Free flow	Traffic flows at or above the posted speed limit and motorists have complete mobility between lanes. The average spacing between vehicles is about 550 ft(167 m) or 27 car lengths. Motorists have a high level of physical and psychological comfort. The effects of incidents or point breakdowns are easily absorbed. LOS A generally occurs late at night in urban areas and frequently in rural areas.
2030 and 2050	B	Reasonably Free Flow	LOS A speeds are maintained, maneuverability within the traffic stream is slightly restricted. The lowest average vehicle spacing is about 330 ft(100 m) or 16 car lengths. Motorists still have a high level of physical and psychological comfort

The Level of Service that resulted from the traffic forecast is LOS B (Table 2.8). This indicates that there will be no traffic congestion along the Cervantes-Mankayan-Abatan Road until year 2030 and further on to year 2050. With a Level of Service B, the degree of comfort and convenience is somewhat less than LOS A but the zone is still in a stable flow and drivers have reasonable freedom to select their own speed. Even in the year 2050, there is still

reasonably free flow indicating minimized traffic congestion. The designed carriage width at two-lane, two way is still sufficient to carry the projected AADT in 2050. Thus, a "Do Nothing" Scenario for traffic management is the appropriate solution at present.

Attention will be needed mostly in managing the road-right-of-way (RROW) that are now prone to obstruction with increased vehicular traffic particularly in urban/urbanizing areas traversed by the Cervantes-Mankayan-Abatan road. The Mankayan intersection shown in Figure 2.13 taken in 2014 was utilized by passengers going to Cervantes, Lepanto, Abatan, and other destinations. The PUJs and tricycles occupied half of the left lane which violates the right of way. There are no open spaces allotted for PUJ and tricycle terminal.

Figure 2.13. **Mankayan Staging Area for PUVs (2014)**

Figure 2.14. **Mankayan Staging Area for PUVs (2017)**

Figure 2.15. **Mankayan Intersection going to Abatan (2017)**

Figure 2.14 showed improvement in the staging area in 2017 by arranging the PUJs in parallel parking position as compared to diagonal parking position in 2014. The encircled right most portion of Figure 2.15 shows Mankayan intersection going to Abatan that indicates some improvements on the RROW as compared to the situation in 2014. In the present staging area for PUJs and tricycles, obstruction of road-right-of-way is now reduced. RROW obstructions will however remain a challenge with the inadequacy of terminals for public transport vehicles.

At the at the road's Abatan entry point from Halsema Highway, Figures 2.16 and 2.17 below show that there is no public transport terminal for PUJs bound for Mankayan. The PUJs currently use a staging area at the side of the curb to wait for passengers.

Figure 2.16. **Abatan Road Entry Point from Halsema Highway to Mankayan**

Figure 2.17. **Abatan Road Entry Point Staging area**

2.5 Impact of Commercial Vehicle Traffic on Pavement

The design parameters provided by DPWH-CAR for the PCC design are as follows:

- Performance Period , N = 20 years
- Design Reliability, R = 85%
- Standard Deviation, So = 0.35
- Design Serviceability Loss = 2.5
- Modulus of Rupture, S'c = 722 psi
- Modulus of Elasticity, Ec = 3,400,000 psi
- Sub-grade, Design CBR = 6
- Effective Roadbed Resilient Modulus, M_R = 9,000 psi
- Sub-base thickness as computed, D = 8 inches (200 mm)
- Drainage Coefficient , Cd = 1.0
- Load Transfer Coefficient, J = 3.6
- Rigid Truck 2-Axles = 1.38
- Rigid Truck 3-Axles = 6.89

Annual Average Daily Traffic for 2015 Rigid Trucks 2-Axles = 18 vehicles per day
Annual Average Daily Traffic for 2015 Rigid Trucks 3-Axles = 27 vehicles per day[3]
Solving for W18 = [1.38(18) + 6.89(27)] x 365 days x **20 years** = **1,539,351** (18 Kip-ESAL)

Using AASHTO rigid pavement design equation, the thickness of the slab D = 7 inches is feasible but D = 8 inches is the minimum thickness.

Assuming a slab thickness of D=8 inches (200 mm) and using the data provided by DPWH and the rigid pavement equation, the result indicates that the road pavement is sufficient to carry loads from trucks. DPWH adopted a thickness of 230 mm which is above the minimum computed thickness of 8 inches.

Inset Box 2.1.

AASHTO 1993 Rigid Pavement Thickness Design

ZR =	-1.036			
So=	0.35			
delta PSI=	2.5	ZR*So-0.06=		-0.4226
TSI=	2	7.35[log(D+1)]=		7.013682
S'c=	722	log[apsi/3.0]=	-0.079181246	
Cd=	1	1+[1.624x10^7/D+1^8.46=	1.137307543	-0.06962
J=	3.6	S'cCd[D^0.75-1.132]=	2617.126148	
Ec=	3400000	D^0.75-[18.42/(Ec/k)^0.25	2527.229043	0.01518
k=	150		0.054344589	
D=	8			6.575805
		Actual Evaluation log (W18)=	6.187337658	0.388468
w18=	1539351	DPWH data: log (W18)=	6.491361694	0.084444

$$\log_{10}(W_{18}) = Z_R \times S_o + 7.35\times\log_{10}(D+1) - 0.06 + \frac{\log_{10}\left(\frac{\Delta PSI}{4.5-1.5}\right)}{1+\frac{1.624\times10^7}{(D+1)^{8.46}}} + (4.22-0.32p_t)\times\log_{10}\left[\frac{(S_c')(C_d)(D^{0.75})-1.132}{215.63(J)\left(D^{0.75}-\frac{18.42}{\left(E_c/k\right)^{0.25}}\right)}\right]$$

To achieve a lifespan of 20 years, a yearly maintenance of the wearing surface is recommended. The yearly routine maintenance budget of DPWH indicated in Table 2.6 did not mention of wearing surface maintenance of the pavement, and DPWH must take this into account. Major road rehabilitation would most likely be entailed mainly in such events as major landslides occurring along the road.

The DPWH data on the volume of 3-axle rigid trucks include those from Lepanto Mines. Hence, even with the mine truck fleet plying the road, not much structural damage to the pavement is expected for 20 years. Moreover, since loading more tonnage to a truck might damage the axles and suspension of the truck, it is not very likely that the mine's truck capacity will be exceeded to the point of causing damage to road pavement.

[3] These include trucks from Lepanto Mines which are all 3-axles

3.6 Relationship of the Road Project with the Surrounding Road Network

This section describes the road project in terms mainly of traffic generation and its distribution throughout the road network. This uses the data gathered from the 12-hour license plate survey conducted on July 2017. The method basically consists of observing and recording license plates of vehicles and time of arrivals at two points or more on the road where the vehicles are expected to pass. This provides information on general trip patterns, whether a vehicle traversed certain major intersections or stopped at any point in between, and what the patterns suggests as they relate with the road networks that intersect or connect with the Cervantes-Mankayan-Abatan road.

The license plate survey result is summarized in Table 2.10 and Figure 2.18. Of the total 2,978 vehicle-plate counted over 12 hours along the Cervantes-Mankayan-Abatan road, 51 percent go westward, from the intersection in Halsema Highway in Abatan towards Cervantes. Forty nine percent (49%) go the other direction, from Cervantes towards Abatan.

Table 2.10. **License Plate Survey Summary: Vehicles Passing Through and Stopping Per Route Within the Cervantes-Mankayan-Abatan Road: 2017**

Route	Passed the Route		Stopped within Route		Total		%	%
	No. of Vehicles	%	No. of Vehicles	%	No. of Vehicles	%	Passed	Stopped
Abatan to Mankayan	353	*23%*	409	*28%*	762	*26%*	12%	14%
Mankayan to Abatan	549	*36%*	364	*25%*	913	*31%*	18%	12%
Mankayan to Cervantes	141	*9%*	526	*28%*	949	*28%*	5%	18%
Abatan to Cervantes	282	*18%*					9%	
Cervantes to Mankayan	188	*12%*	153	*28%*	354	*28%*	6%	5%
Cervantes to Abatan	13	*1%*					1%	
TOTAL	**1526**	***100%***	**1452**	***100%***	**2,978**	***100%***	51%	49%
							100%	

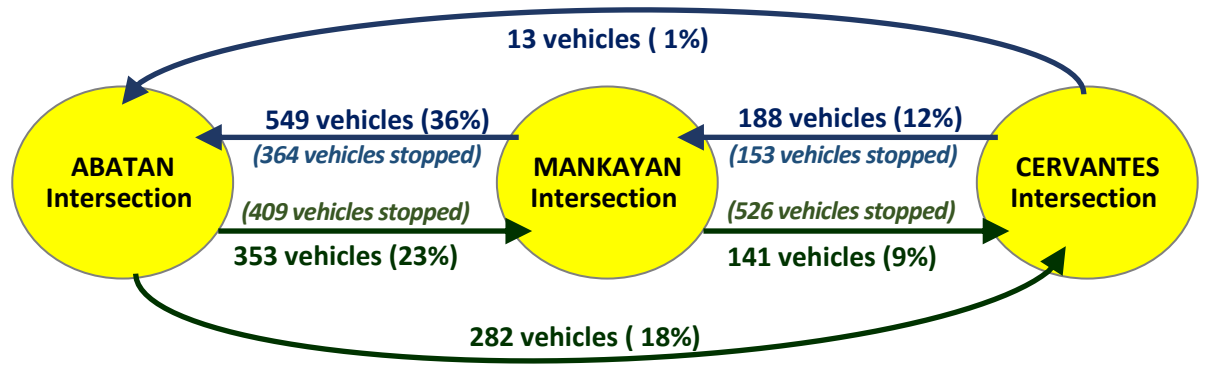


Figure 2.18. **License Plate Survey Vehicle Count, Cervantes-Mankayan-Abatan Road: 2017**

Within the road ZOI, table 2.11 shows that Abatan attracted the most trips. This is tied to its robust commerce, being a trading hub, and the presence of social facilities and services that serve also its neighboring towns. Mankayan, meanwhile, generated the highest volume of trips. This can be associated with the relatively high income of households in this area. The least in terms of both trip generation and attraction is Cervantes. It is notable that Cervantes, by itself, is more of a trip attraction than generation route.

Table 2.11. **Trip Generation & Trip Attraction by Intersection, Cervantes-Mankayan-Abatan Road: 2017**

	Trip Generation		Trip Attraction		Total	
	No. of Vehicles	%	No. of Vehicles	%	No. of Vehicles	%
Abatan	635	42%	562	37%	1197	39%
Mankayan	690	45%	541	35%	1231	40%
Cervantes	193	13%	423	28%	616	20%
Total	1518	100%	1526	100%	3044	100%

Cervantes attracts traders that pick up rice and livestock to be brought to the market. Not too many farmers from the place travel to outside markets to sell their produce.

The trip patterns are related to the trip purpose. The household survey conducted for this study generated the following data on the purpose of travel for the people within the road ZOI.

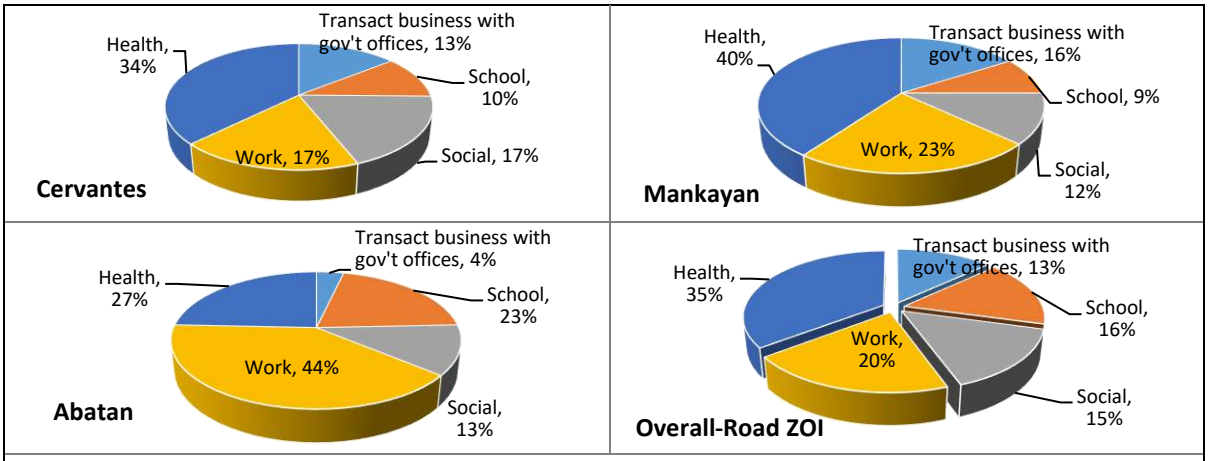


Figure 2.19. **Trip Purpose, Cervantes-Mankayan-Abatan Road: 2017**

The leading purpose of travel among many of the population within the road ZOI are health- and work-related. This could significantly explain the high traffic going to Abatan, attracting about 562 per day in 2017, the highest among the three areas within the road ZOI. Abatan has two big hospitals, i.e., the Abatan Emergency Hospital and Lutheran Hospital, that offer tertiary health services to a catchment area that includes Mankayan and Cervantes. Abatan is also a strategic trading area that attracts merchants from far and near, including those from Mankayan and Cervantes where trading is among the major economic activities. Abatan notably has the least proportion of its population whose purpose of travel is health-related, presumably because many need not travel outside the municipality to access health services. In this area, the biggest trip purpose is work-related. Abatan has the biggest proportion of its employed population whose place of work is outside of the municipality.

For motorists outside of the ZOI, it can be deduced that the purpose of travel along the Cervantes-Mankayan-Abatan road is mostly business-related. This surfaced during the focus group discussions and from the household survey. Cervantes is now attracting business with travelling merchants that go to the municipality to trade, mostly to pick up agricultural produce like rice and livestock and bring these to the markets. Most of the merchants appear to exit to Ilocos or Mt. Province, thus, the lower volume of vehicles going the Cervantes-Abatan direction. The road continues to function as a traditional trading route between Benguet and the Ilocos region and a major exit of the Cordillera to the Ilocos Region.

One of the objectives of the study is to determine whether the Cervantes-Mankayan-Abatan route is used as an alternate route from Benguet to Ilocos Sur and vice-versa. One notable finding from Table 2.10 is that Abatan to Cervantes route is utilized well as an alternate route at 18 percent of all vehicles passing through the Abatan-Mankayan-Cervantes road. The Cervantes to Abatan direction, however, is not as frequently traveled, suggesting that not too many passengers from Ilocos or Mt. Province use the road as a route going to Benguet.

There are more trips directly to Cervantes from Abatan at 282 vehicles as compared to trips directly from Cervantes to Abatan at 13 vehicles. This is an indication that many motorists use the road to get to Suyo and Sabangan areas through the roads that intersect with the Cervantes-Mankayan-Abatan road at the latter's end in Cervantes (Figure 2.20).

The pattern of trips that resulted from the license plate survey indicates that the Cervantes-Mankayan-Abatan road is a transit route to other destinations, particularly further up north to Mt. Province or westward towards Ilocos. Data shows that less vehicles go back the same route, i.e., from Cervantes to Abatan. This suggests that many of the trip destination are way farther from the road ZOI which makes taking another route to their point of origin a rational decision. This can be expected from among travelling merchants that usually move from one commercial center to the next following an optimal travel itinerary.

The road project also opened-up connectivity with shorter travel time to the southwestern part of Mt. Province. A secondary national road from the Cervantes-Mankayan-Abatan road in Poblacion, Mankayan towards the municipalities of Tadian and Bauko in Mt. Province is presently being concreted (Figure 2.21). This road will substantially shorten the existing travel time to Tadian, Mt. Province from the Halsema Highway junction in Abatan. The existing travel time on this route is more than one hour following the Cervantes-Mankayan-Abatan road and on to the Cervantes-Sabangan road. This will drop to about 30 minutes via the secondary national road from Mankayan.

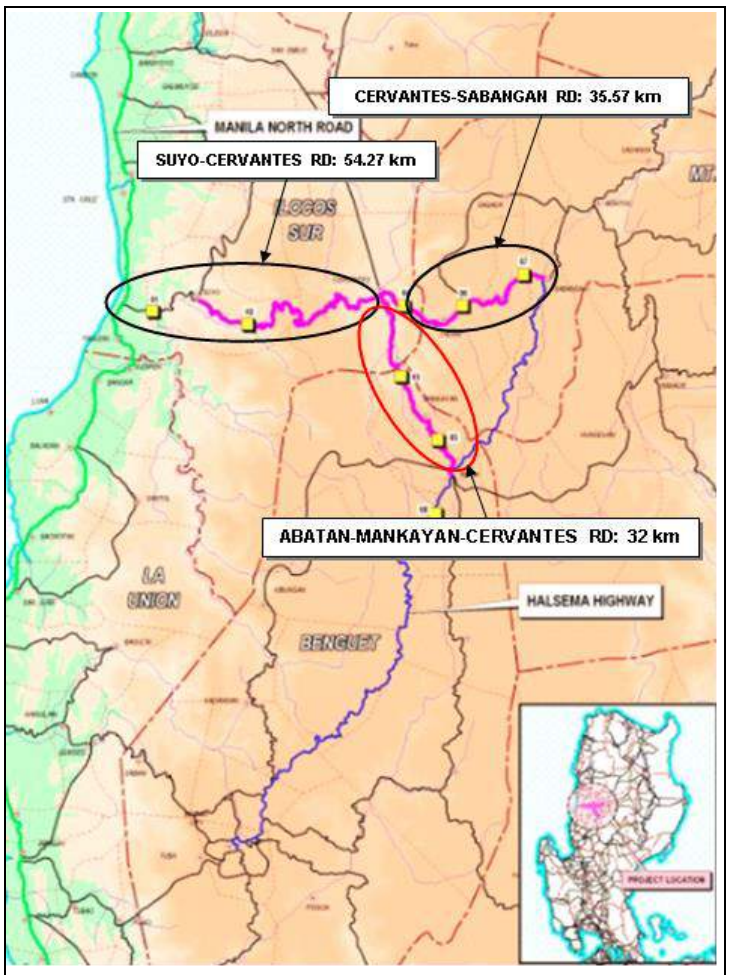


Figure 2.20. **Surrounding Road Network to the Cervantes-Mankayan-Abatan Road**

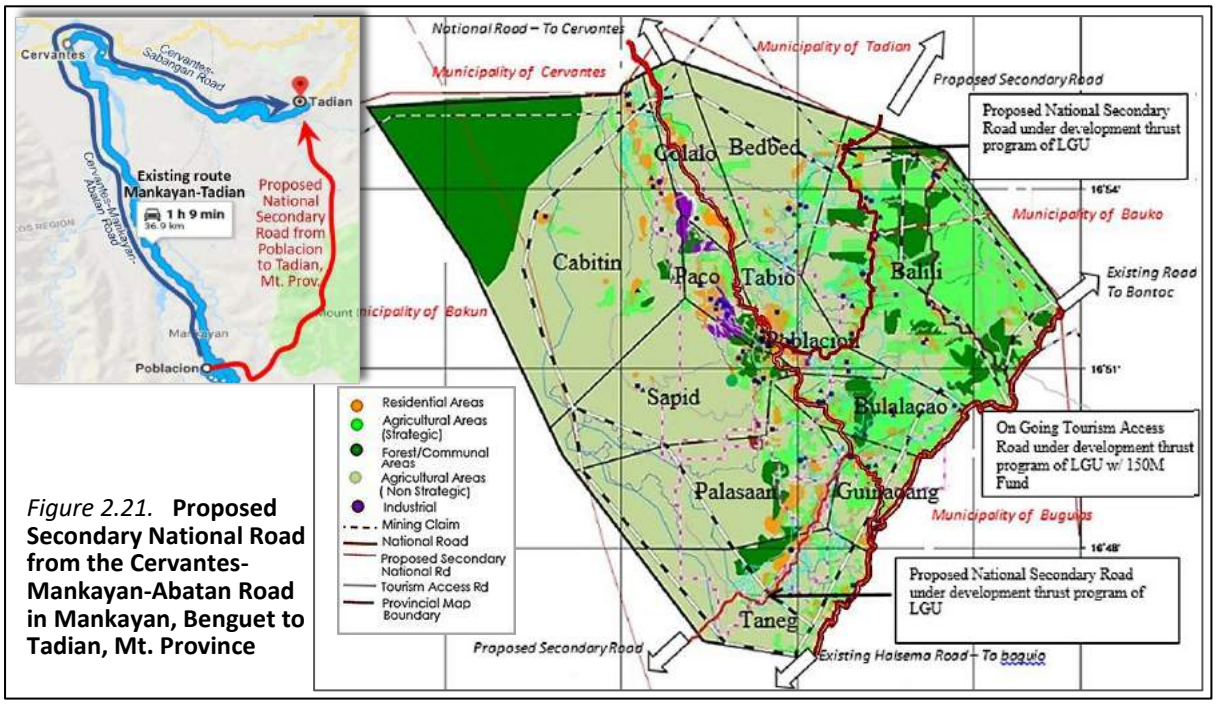


Figure 2.21. **Proposed Secondary National Road from the Cervantes-Mankayan-Abatan Road in Mankayan, Benguet to Tadian, Mt. Province**

It is also believed that some residents from Abra use the Cervantes-Mankayan-Abatan route to reach Baguio or La Trinidad in Benguet. Travel time from Abra to La Trinidad, Benguet is seven hours and 49 minutes via the Cervantes-Mankayan-Abatan route (Figure 2.22). Meanwhile, it takes a shorter time, at five hours and 54 minutes, via La Union up Naguilian Road to Baguio City. It is then not likely that many would prefer the former route to reach Baguio or La Trinidad. Travelers from Abra would very likely take the Cervantes-Mankayan-Abatan route if the destination is Abatan or Buguias or further up north. At present, the license plate survey shows that this does not happen as frequently as the opposite direction.

Figure 2.22. **Routes and Travel Time from Abra to La Trinidad, Benguet**

2.7 Highway Safety

Records of the Philippine National Police show that there is an increase in road accidents in the past three years. Among the causes of these road accidents are human errors, machine malfunction and unsafe or slippery road caused by heavy rains and landslide and/or poor weather conditions. Because of these instances, only few vehicles are passing the Cervantes-Mankayan-Abatan road making the constructed road a little less than optimal.

The photos in this section illustrate the major safety hazards that currently confront the motorists plying the Cervantes-Mankayan-Abatan road. These hazards include the absence of retaining walls on slopes that are prone to landslide, inadequacies in traffic control devices, lack of sidewalks, and road obstructions.

Figure 2.23 is a photo of a damaged portion of the emergency bay area with no retaining walls. It can also be noted that there are no pavement markings nor raised pavement markers (Cat's eye) along the road.

Figure 2.23. **Damaged emergency bay area** (x=267,635 m=1,859,513 m, elevation = 1712m)

The section of the road shown in Figure 2.24 is prone to landslide. A retaining wall was not constructed on the left side. Guardrails were also missing as well as basic traffic control devices like pavement markers.

Figure 2.24. **Landslide prone road section** (x=267,635 m, y=1,859,513 m, elevation = 1712 m)

Figure 2.25 shows a road section where a landslide occurred. No repairs are going on to fix the damaged portion, thus, the capacity of the road was reduced to one lane. No warning signage was installed to alert drivers on the damaged portion of the highway for highway safety. Moreover, increasing urbanization especially along the 100-meter ZOI of the road near the town centers, makes the road vulnerable to waste management issues. During the transect survey, a solid waste transit station along the road in Mankayan was observed during the transect survey.

Figure 2.26 shows inconsistency of guardrail design on this section of the road. Note, too, that the old parapet wall is below the standard height of two feet (0.61 m).

A chevron arrow sign was installed on the road section shown in figure 2.27 but it's not too visible. A red barrier was installed made of G.I. corrugated sheets which may not be visible at night and could even be hazardous for motorists.

Part of highway safety is the removal of obstructions. Figure 2.28 shows a boulder on the road that compelled a vehicle to steer away from the obstruction. This can potentially result to probable collision with opposing vehicles.

Figure 2.25. **Landslide occurrence & solid waste transit station at the RROW** *(x=264,465 m, y=1,865,683 m, elevation = 1230 m)*

Figure 2.26. **Inconsistency of guardrail designs** (x=267,980 m, y=1,860,229 m, elevation = 1625 m)

Figure 2.28. **A boulder obstructing part of the emergency bay** (x=267,973 m, y=1,860,036 m, elevation = 1,652 m)

Figure 2.27. **Barriers with no reflective materials** (x=264,304 m, y=1,865,868 m, elevation = 1204 m)

Sidewalks are very inadequate. Figure 2.29 shows how this situation exposes pedestrians and motorists to vehicular accidents, more so along sections approaching a sharp curb.

Figure 2.29. **Abatan Road section with no sidewalks**

The intersection shown in Figure 2.30 is unsignalized. Traffic control devices such as stop or yield sign have been installed to regulate traffic flow.

Figure 2.30. **Unsignalized Cervantes intersection**

Notwithstanding the safety hazards resulting from inadequacies in safety control devices, road obstructions, inadequacy of sidewalks and RROW enforcement, many of the passengers generally find travelling along the Cervantes-Mankayan-Abatan road to be a lot safer than before the road was improved. Notably though, not everyone perceived road safety to have largely improved after completion of road with a number stating landslide occurrences needing to be addressed especially at vulnerable portions of the road.

Safety of travel all the way to Baguio City was generally perceived to have not changed for those coming from Mankayan, and improved for those from Cervantes. These perception are more likely because of the safety conditions along the Halsema road rather than the Abatan-Cervantes-Mankayan Road on its own. This still does not put to rest the need to improve safety conditions along the latter to lower risks of any future road-related accidents from happening.

Compared to the 2013 JICA findings on convenience and safety of travel along the Suyo-Cervantes-Mankayan-Abatan Road and the Cervantes-Sabangan Road, the perception of residents notably improved at present for the Cervantes-Mankayan-Abatan Road. The moderate percentage of improvement in the safety of the highway in 2013 was due to the vulnerability of the road to landslides and falling rocks. Note, however, that the JICA study covered the entire road stretch from Cervantes to Suyo. It can be noted during the site observations that vulnerability to landslides and falling rocks is particularly high along the Bessang Pass traversed by the road section from Cervantes to Suyo. Other than the shorter travel time, the safety risks due to these factors makes the Cervantes-

Mankayan-Abatan road the preferred route to Baguio City than going down through Suyo route for those from Cervantes.

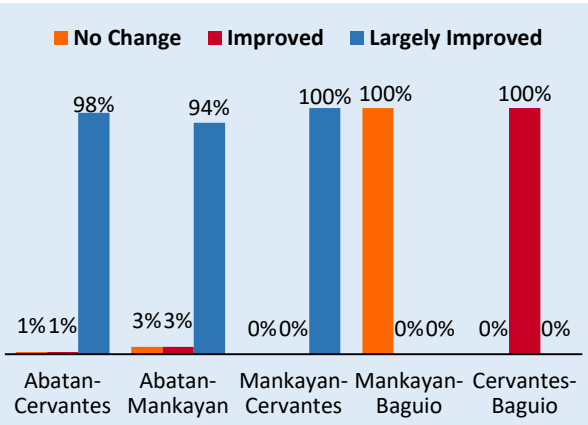


Figure 2.31. **Passengers' Perception About Highway Safety After Road Completion, Cervantes-Mankayan-Abatan Road: 2017**

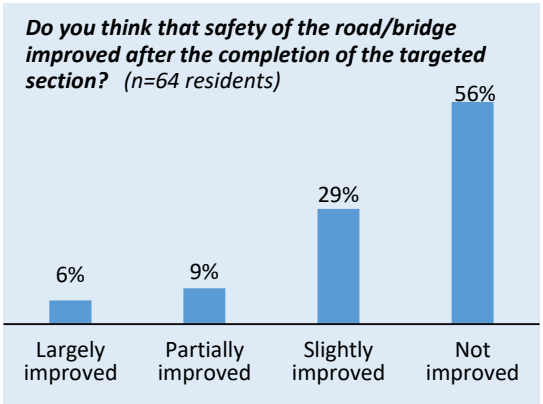


Figure 2.32. **2013 results of a JICA survey on safety of travel through the Suyo-Cervantes-Mankayan-Abatan Road and the Cervantes-Sabangan Road.** *(JICA, 2013)*

2.8 Travel Time Saved

The average travel time from Abatan to Cervantes is now two hours by public utility vehicle. (This can be shorter if using private vehicles). It used to be two hours and 45 minutes before the road was improved. Travel time saved can then be estimated at 45 minutes over the whole stretch of the Cervantes-Mankayan-Abatan road. Savings on travel time is relatively highest from Mankayan to Cervantes. These have implications to the socio-economic conditions within the road ZOI, discussed in the next chapter.

Table 2.12. **Travel Time Before and After Road Improvement**

	Abatan-Mankayan	Mankayan-Cervantes	Abatan-Cervantes
Before Road Improvement (2010)			
Mode of Transport	*Tricycle, FX*	*Tricycle, FX, motor*	*Tricycle, FX, motor*
Travel Time (hrs)	0.75	2	2.75
After Road Improvement (2017)			
Mode of Transport	*Jeepney*	*Jeepney, UV Express*	*Jeepney, UV Express*
Travel Time (hrs)	0.5	1.5	2
Savings on Travel Time (hrs)	**0.25**	**0.5**	**0.75**

Note: Trips using UV express are all bound for Baguio City. These are also being used for short trips, particularly for passengers bound between Mankayan and Cervantes that missed the jeepney trips.

2.9 Use of Public Transportation

The result of the passenger survey conducted in July 2017 is summarized in Table 2.13 that pertain only to matters on public transport from one locality to the next via the main road (which therefore excludes tricycles which are used mainly for short distances and along feeder roads). PUJs and AUVs/Vans are the main mode of public transportation for communities within the road zone of influence. PUJs are used for travel between municipalities while AUVs/Vans are used for longer distances, mainly to Baguio City.

Table 2.13. **Use of Public Transport by Travel Route: 2017**					
	Abatan to Cervantes	**Abatan to Mankayan**	**Mankayan to Cervantes**	**Baguio to Mankayan**	**Baguio to Cervantes**
Route Length	32 km	16 km	16 km	105 km	123 km
Mode	PUJ	PUJ	PUJ	AUV(Van)	AUV (Van)
Average Number of Trips per Day (round trip)	1	6	1	1	1
Number of days of operation per unit per week	6	6	6	4	5
Time of operation	9 hrs	3 hrs	4 hrs	n/a	n/a
Average Travel Time	2 hrs	0.5 hr	1.5 hrs	3.67 hrs	4 hrs
Fare/passenger(One-way)	Php 120	Php 30	Php 90	Php 150	Php 200

The Abatan-Mankayan route has the most number of trips for public transportation. This is consistent with the findings of the license plate survey that trip generation and attraction occurs mostly from Abatan to Mankayan and vice versa. On the other hand, the routes to and from Cervantes are served by relatively limited trips: one daily PUJ round-trip from Abatan and another from Mankayan. In spite of these, the improved connectivity with Cervantes due to the development of the Cervantes-Mankayan-Abatan road was recognized as among the major benefits during a focus group discussion with people from Cervantes, citing that the public transport before road construction was very difficult with infrequent trips using mostly rundown vehicles.

Table 2.14. **Perception on the Use of Public Transport by Travel Route: 2017**					
	Abatan to Cervantes	**Abatan to Mankayan**	**Mankayan To Cervantes**	**Baguio to Mankayan**	**Baguio to Cervantes**
Access to Public Transport	Largely Improved	Largely Improved	Largely Improved	Improved	Improved
Quality of Travel (comfort level)				Improved	Improved
Travel time after road completion				No Change	Improved

In general, the construction of the Cervantes-Mankayan-Abatan road has been perceived to have led to large improvements in public transportation services in terms of access, comfort level, and travel time for commuting passengers within the road zone of influence (Table 2.14). The travel time saved was 45 minutes, on the average, after the concreting of the road. Travel fare was reduced to about half after the concreting of the road.

Perception on improvement of public transportation services from these areas to Baguio City is not as high as in the other shorter routes but this is most likely more because of factors along the Halsema Highway than those within the Cervantes-Mankayan-Abatan road.

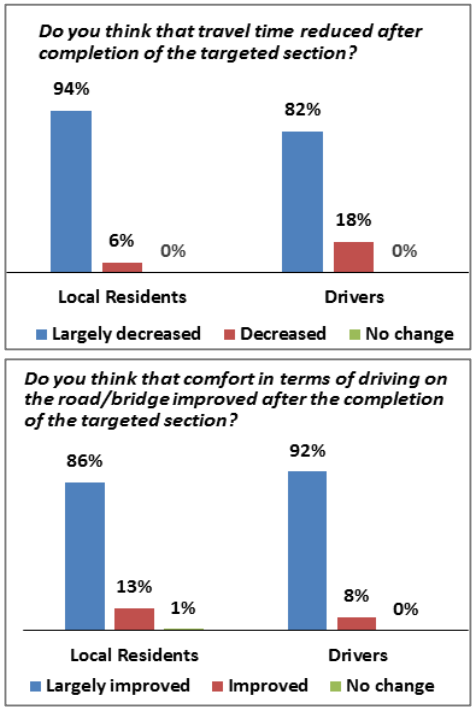


Figure 2.33. **2013 results of a JICA survey on convenience and safety of travel thru' the Suyo-Cervantes-Mankayan-Abatan Road and the Cervantes-Sabangan Road** (*n=64 residents and 50 drivers.* JICA, 2013)

People also now assessed better the comfort and travel time conditions after road construction compared to the JICA findings in its 2013 study (Figure 2.33). A notable number of the respondents in the 2013 JICA study perceived that travel time has decreased and comfort has improved, but not on a largely scale.

2.10 Vehicle Operating Cost

This section covers the vehicle operating cost (VOC) of PUJs using data gathered from interviews with selected drivers and operators from within the Cervantes-Mankayan-Abatan road ZOI. The cost estimates were based on the vehicle operating characteristics for each route.

The drivers and operators within the road ZOI generally find the savings on transportation cost to have largely improved. They assessed this to be a bit lower in scale travelling from/to Baguio City, but overall, the perception is generally a positive change after road construction.

Table 2.15. **Drivers' & Operators' Perception About Savings in Transportation Costs**

Road Section	Overall Perception About Savings on Transport Costs
Abatan to Cervantes	Largely Improved
Abatan to Mankayan	Largely Improved
Mankayan to Cervantes	Largely Improved
Baguio to Mankayan	No change
Baguio to Cervantes	Improved

From the estimated average figures for the three major route segments within the road ZOI in Table 2.16, the PUJ operators incur higher VOC when compared to the Mega Manila VOC average for the same transport mode estimated by the National Center for Transportation Studies or NCTS (2012). Specifically, overhead and vehicle maintenance cost for the PUJs plying the Cervantes-Mankayan-Abatan road are much higher than the NCTS estimates for Mega Manila. PUJs for the Abatan-Mankayan route, particularly, have the highest cost of vehicle maintenance and, in general, has the highest average VOC per kilometer among the three routes. This is mainly because the PUJs plying this route are more frequently used, which translates into longer mileage, than those in the other two routes.

Table 2.16. **2017 Estimates of Annual Vehicle Operating Cost for PUJ Operators per Travel Route Within the Cervantes-Mankayan-Abatan Road & Comparison with the National Average VOC Estimates, Per unit of PUJ**

Particulars	Abatan to Mankayan		Mankayan to Cervantes		Abatan to Cervantes		Average Cost for the whole stretch of the Road Proj.		Mega-Manila Ave VOC per PUJ (NCTS, 2012)	
	Php	%	Php	%	Php	%	Php	%	Php	%
Overhead Cost	**12,500**	*8%*	**17,000**	*11%*	**17,000**	*7%*	**15,500**	*8%*	**7,268**	*6%*
Annual Insurance	2,200		1,000		1,000					
Annual vehicle registration	2,140		2,500		2,500					
Franchising Supervision Fee	1,000		5,000		5,000					
Annual Report Fee	600		3,500		3,500					
Franchise Application Fee	3,500		5,000		5,000					
Taxes	3,060 *(255/mo)*									
Annual Vehicle Maintenance Cost	**55,200**	*34%*	**10,000**	*7%*	**10,000**	*4%*	**21,300**	*11%*	**9,690**	*8%*
Fuel Cost *(312 days operation/ year)*	**93,600**	*58%*	**124,800**	*82%*	**218,400**	*89%*	**163,800**	*82%*	**104,173**	*86%*
Fuel Costs per day	*300*		*400*		*700*					
Total Annual Vehicle Operating Cost	**161,300**	*100%*	**151,800**	*100%*	**245,400**	*100%*	**200,600**	*100%*	**121,131**	*100%*
Ave. Annual VOC per Kilometer	**10,081**		**9,488**		**7,669**		**8,727**			

Vehicle Operating Characteristics			
Route Length	*16 km*	*16 km*	*32 km*
No. of days of operation per unit per week	*6 days*	*6 days*	*6 days*
Time of operation (hrs)	*9*	*3*	*4*
Ave. round Trip per day	*1*	*6*	*1*

Note: Average cost per route for annual vehicle maintenance and vehicle operating cost is weighted based on the route length.

There are no counter-factual data by which to arrive at estimates on VOC savings for PUJs plying the road project. The survey among drivers and operators, however, included a question about their view on transport cost savings before and after the road project. As a general indication on changes in VOC, the respondents generally find the savings on transport cost to have largely improved after the construction of the road project. Saving on transport cost all the way to Baguio City from the road ZOI is perceived a notch lower but, again, this can be attributed more to the conditions of the Halsema Highway than the Cervantes-Mankayan-Abatan road.

As a proxy to savings on vehicle operating cost, the analysis centered on the income from operating a PUJ net of the VOC and compare this with the applicable minimum wage. The difference provides an indication of the net incremental benefit of the road project arising from reduction in vehicle operating costs. From the estimates shown in Table 2.17, a PUJ driver can take home a daily earning of more than Php 500 for those plying the Abatan-Mankayan route, more than Php 600 for those at the Mankayan-Cervantes route, and more than Php 700 for those at the Abatan-Cervantes route. Measured against the daily minimum wage of Php 280 for Abatan and Mankayan, the resulting incremental net income for PUJ drivers within the road ZOI ranges from around Php250 to Php450 per day.

Table 2.17. **2017 Estimates of Incremental Net Income of PUJ Drivers and Operators**

Particulars	Abatan to Mankayan	Mankayan to Cervantes	Abatan to Cervantes
One-way Fare per Passenger (Php)	*30*	*90*	*120*
No. of Round-trips per PUJ per Day	*3*	*1*	*1*
Estimated Gross Revenue per day (PHP)	***2,300***	***2,500***	***3,200***
Number of days operation per pear	*312*	*312*	*312*
Gross Revenue per Annum (Php)	717,600	780,000	998,400
Less: Annual Operating Cost (Php)	161,300	151,800	245,400
Net Revenue per Annum (Php)	556,300	628,200	753,000
Average Net Revenue Per Day (Php)	**1,783**	**2,013**	**2,413**
Average Daily Net Income of Operators (Php) *(70% share of the net revenue)*	**1,248**	**1,409**	**1,689**
Average Daily Net Income of Drivers (Php) *(30% share/commission of the net revenue)*	**535**	**604**	**724**
Daily incremental net income to PUJ drivers due to the road project (Php) *(Daily net income less Php 280 daily minimum wage for the road ZOI)*	**255**	**342**	**444**

3.11 Summary of Findings

Assessment of the project design. Setting the lifespan of the pavement to 20 years, a slab thickness equals 7"(178 mm) was computed using the AASHTO 1993 Rigid pavement design equation. However, the minimum thickness as per AASHTO provision is 8" (200 mm). The DPWH-CAR adopted a thickness of 230 mm for the Cervantes-Mankayan-Abatan road. The DPWH increased the standard of pavement thickness in 2015 when then Department Secretary Rogelio Singson proposed for concrete pavements to have a minimum thickness of 280 millimeters (11.02 inches), thicker than the average 250-mm (9.84-inch) thickness of arterial and secondary roads. The Cervantes-Mankayan-Abatan road project was constructed before this time hence the standard applied was below 280 millimeters, but the design as constructed is still within the safe range.

Changes in highway and traffic conditions after road construction. The following findings are highlighted:

- Vehicular traffic rose about 69 percent when comparing the AADT for the five years prior to road improvement and fiver years after. AADT was recorded at 1,646 as of 2015, about 60 percent more than the highest AADT recorded before project operation.

- Since the road fully opened in 2011, passenger utility vehicles have increased at a faster pace (22% average per annum), whereas passenger utility vehicles remained nearly unchanged.
- While vehicles for passengers (both utility and car) still comprise the bulk of the vehicle fleet, the volume of vehicles for the transportation of goods has been increasing at a much rapid rate (19% per year from 2010 to 2011 as against 9% for passengers). This implies that the road's economic use is increasing.
- Since the road was constructed, the large share of privately-owned vehicles has further increased into the years after road construction. From 69 percent in 2015, private transport accounts for 92 percent of vehicle traffic in 2017.
- The upsurge in the volume of tricycles in 2017 reflects the increase in the demand of passengers for short-distance travels and the probable increase in the feeder roads from the main road artery leading to the different communities within the road zone of influence. Tricycles/motorcycles which comprise the bulk of vehicle fleet in Abatan and also in Mankayan. In Abatan, tricycles/motorcycles come second to SUV/FX as the leading vehicle mode.
- Daily traffic for 3-axle trucks likewise steeply rose, by five times, since the road started operating in 2011, reaching 27 units average per day in 2015.

Future traffic and implications to traffic operations. There will be no traffic congestion along the Cervantes-Mankayan-Abatan road until year 2050. Driving comfort and convenience will remain relatively good. Traffic will be in a stable flow and drivers still have reasonable freedom to select their own speed. The road's designed carriage width at two-lane, two way is still sufficient to carry the projected AADT up to 2050. Thus, a "Do Nothing" strategy for traffic management is the appropriate solution at present.

Impact on pavement. The DPWH adopted a 230 mm thickness, above the 200 mm minimum, which is over the design life of 20 years. The volume of 2-axle and 3-axle trucks projected over the next 20 years, including those from Lepanto mines, will not be heavy enough to cause serious structural damage on pavements even until 2050.

Required road maintenance works. To achieve a lifespan of 20 years, a yearly maintenance of the wearing surface is needed. The yearly routine maintenance budget of DPWH did not mention of wearing surface maintenance of the pavement, and DPWH must take this into account since there is no major rehabilitation required and less maintenance cost can be achieved. Major road rehabilitation would most likely be entailed mainly in such events as major landslides occurring along the road.

Relationship of the road project with the surrounding road Network. The Cervantes-Mankayan-Abatan road is a transit route to other destinations, particularly further up north to Mt. Province or westward towards Ilocos. The volume of vehicles from Abatan to Cervantes is not as substantial as in the opposite direction, which means that there are less vehicles that go back the same route towards Abatan. This suggests that many of the trip destinations are way farther from the road ZOI which makes taking another route to their point of origin a rational decision. This can be expected from among travelling merchants that usually move from one commercial center to the next following an optimal travel itinerary, with the road serving more as an exit to the Ilocos region from the Cordilleras.

Most of the travel activities take place within the Abatan-Mankayan-Cervantes loop with a bulk of trips stopping at any point with the road project, mostly along the Abatan-Mankayan section. Among the three areas within the road ZOI, Abatan attracted the most trips and this most likely relates with its status as a major trading and commercial center in that part of Benguet. Mankayan, meanwhile, generated the highest volume of trips that can be associated with the relatively high incomes generated by the residents in that locality. The least in terms of both trip generation and attraction

is Cervantes, and it is notable that Cervantes, by itself, is more of a trip attraction than generation route.

Purpose of Trips. Within the road ZOI, the leading purpose of travel are health- and work-related. This could explain the high traffic towards Abatan where major health facilities and business establishments are located. For motorists outside of the ZOI, most of them ply the Cervantes-Mankayan-Abatan road for trading purposes with the road continuing its traditional function as a trading route between Benguet and the Ilocos region.

Highway safety. The relatively low traffic along the Cervantes-Mankayan-Abatan road can partly be attributed to the inadequacy of traffic control devices and other safety concerns along the road that increases safety-risks for motorists. These safety issues can be summarized as follows:

- There were missing and faded pavement markings such as center lines, edge lines, and double solid yellow lines.
- Raised Pavement Markers (Cat's eye) and reflective delineators were also missing on some parts of the road section.
- Sidewalks for pedestrians along the route were not provided. Some sidewalks approaching commercial centers are occupied by residences and stalls violating right-of-way provisions.
- Guardrails were not constructed/installed on majority of the road section particularly on sharp curves and there were inconsistent height of guardrails
- Terminals are not located on designated areas and road sections are used instead that may be vulnerable to pedestrian accidents boarding and unloading from Public Utility Vehicles. Moreover, it causes traffic congestion occupying part of the travel lane
- Some parts of the route are vulnerable to landslide occurrence. Some sections have no drainage facilities which contributes to the deterioration of the pavement

Notwithstanding the safety hazards resulting from inadequacies in safety control devices, road alignment designs, sidewalks and RROW enforcement, many of the passengers generally find travelling along the Abatan-Mankayan-Cervantes road to be a lot safer than before the road was improved. This still does not put to rest the need to improve safety conditions to lower risks of any future road-related accidents from happening.

Use of public transport. PUJs and AUVs/Vans are the main mode of public transportation for inter-locality travel by communities within the road zone of influence. PUJs are used for travel between municipalities while AUVs/Vans are used for longer distances, mainly to Baguio City. The Abatan-Mankayan route has the most number of trips for public transportation. Meanwhile, the routes to and from Cervantes are served by relatively limited trips: one daily PUJ round-trip from Abatan and another from Mankayan. In general, the construction of the Abatan-Mankayan-Cervantes road has been perceived to have led to large improvements in public transportation services in terms of access, comfort level, and travel time for commuting passengers within the road zone of influence. The travel time saved was 45 minutes, on the average, after the concreting of the road. Travel fare was reduced to about half after the concreting of the road.

Vehicle Operating Cost. The drivers and operators within the road ZOI generally find the savings on transportation cost to have largely improved. Measuring the vehicle operating cost against the daily minimum wage yields an incremental net income of about Php250 to Php450 per day for PUJ drivers within the road ZOI.

Chapter 3
FINDINGS ON THE SOCIO-ECONOMIC IMPACTS

Roads are access to important economic activities. Trading is a major economic activity that is dependent on a road network. Here, the analysis of the household survey starts with a history of the road network of the Cervantes-Mankayan-Abatan road. The history of the road was drawn from three sources, namely: 1) Key informant interviews; 2) focus group discussions, and 3) archival references. Most of the archival sources are referenced to the work of Lewis (1991), who made a very detailed account of the political and socio-economic life of the people of Buguias. Maps are lifted from his book as he is the first writer to make a sketch of the trade routes of Buguias, which of course, affects Mankayan and Cervantes.

The analysis of the survey triangulates the three survey instruments, the household survey, community survey, and the structured key informant survey, to sketch a seamless analysis of the impact of road to the households and to the community. The analysis combines a qualitative and quantitative approach, the former to describe the variables and the latter to measure the variables and to develop objective discussion on the causal relations developed from theoretical models.

The objective of the socio-economic impact study is to assess the magnitude of the direct and indirect impact of having the road, among households and communities along the stretch of the Cervantes-Mankayan-Abatan Road, including its radial zone of influence at 100 meters, two-and-a-half (2.5) kilometers and five kilometers. The study follows the measurements of impact as suggested by Grootaert (2008).

The study measured the impacts of the road in terms of:

1) Direct effects: Transportation cost and time measured by reduced travel time to work, school, hospital, market, among others;

2) Indirect effects such as, income and measures of well-being such as health education and social interaction.

The distribution of the direct impact of the road project depends on the composition of the users and the transport market (Grootaert, 2008). The composition of the users was gathered from the household survey. The beneficiaries of the road are described through their socio-economic profile, the changes they have experienced in terms of changes in income, production, employment opportunities, and their access to social services such as education, health, water, electricity, and social security.

A brief history of the Cervantes-Mankayan-Abatan road prefaces the analysis of the socio-economic impacts to the road ZOI. This traces how the old trading route had changed since the pre-war period until the present time. The discussion of the present time expounds further on the socio-economic profile of the households and, in this context, how they perceive the importance of road development. This flows into the analysis of the direct impact of the road in terms of the value of time and opportunity costs based on changes in travel time and transport costs that resulted from the road project. This is the starting point in determining the impact of the road project on the economic and social development conditions within the road ZOI.

3.1 The Political, Historical, and Socio-economic Context of the Cervantes-Mankayan-Cervantes Road

The Cervantes-Mankayan-Abatan road project traverses two regions, the CAR and Region 1 (The Ilocos Region). These two contiguous regions have a long history of trading relationships through the Spanish Trail that snakes through the rugged mountain ridges and peaks of the Cordillera region. *The Spanish Trail was the gateway of the Ilocos Region to the Cordilleras*.

> *The Spanish Trail has a historical significance as it was the escape routes of great men, Gen. Emilio Aguinaldo via the Tirad Pass and General Yamashita via the Bessang Pass*

As road development began in the Ilocos Region, the municipalities of Cervantes, Quirino and San Emilio, were left out from the major road network due to their geographic location. Isolated from a good road network to and from the Ilocos Region, these three municipalities traded heavily with the Cordilleras, via Mankayan. Cervantes, being the most developed among the three municipalities, became the center of trade for Quirino and San Emilio. The Spanish trail eventually widened into a dirt road with the establishment of Lepanto Mining Corporation. Although, there was trade, it was limited to essentials due to the difficulty of transporting via bad roads. Development was slow. The situation was literally described as: *'you've got bad roads, then you have a rotten economy'.*

> *The municipalities of Mankayan and Abatan were former settlements of Igorot, San Emilio was formerly part of the old mountain province during the Spanish regime, Quirino became a settlement to Igorots who opted to become lowlanders to escape labor of the Tirad Pass, and Cervantes used to be a small Igorot village. When the Spaniards came, accompanied by the Ilocanos, the Igorots were driven back to the mountains and hills.*

The Cervantes-Mankayan-Abatan road existed even before the prewar. Figure 3.1 shows the prewar trade routes tracing the historical trade relations among people of Abatan, Mankayan, and Cervantes. Historical account of booming trade between these three areas is largely fueled by two major economic activities: agriculture and livestock, and mining. Suyoc was an old mining site (as seen in Figure 3.2) before Mankayan became the seat of large scale commercial mining.

Trading during the pre-war was essentially through barter. As shown in the first panel of Figure 3.1, barter trading routes centered in Abatan, Buguias, and all road routes were merged at the cross roads of Abatan. The 150 kilometer Halsema Road was a prewar road whose construction started in 1922 and was finished in 1930 as a footrail (Sy, 2010). During the prewar period, livestock, salt, copper wares, root crops, rice, and vegetables were mostly traded (Lewis, 1991). Most Chinese traders traversed the Bagulin, La Union-Kapangan-Buguias trade route to barter goods.

The development of the Halsema Highway, the Nueva Vizcaya Road, and the Kennon Road, opened trading opportunities to La Trinidad and Baguio. Fueled by money and demand for highland vegetables by the Americans who settled in Baguio, the trading routes eventually shifted to Baguio City and La Trinidad (Figure 3.1), deflating trading activities from Abatan, Buguias.

Despite this setback, trading remains robust within the Cervantes-Mankayan-Abatan route. Mankayan was host to Lepanto Mining Corporation which was established in 1936 and attracted workers from the Mt. Province, Pangasinan, and the Ilocos Region. With cash from salaries and wages, trading prospered within these areas. Accounts from the key informants from Cervantes recalled that they (i.e. parents) would usually bring and sell their agricultural products in Mankayan because they can convert the goods to cash, which they in turn used to buy household needs such as cooking pots, textiles, and other supplies. Those from Cervantes would either go to Tagudin, Ilocos Sur or Abatan, Buguias, but they would always prefer to buy in Abatan, which is nearer than Tagudin.

The walks are long, it was three hours going up to Mankayan. A ride plies the area, but with bad roads, travelling would take two hours. The goods traded must be worth the travel otherwise it is a waste of time. Cattles, legumes, and vegetables were sold in Mankayan.

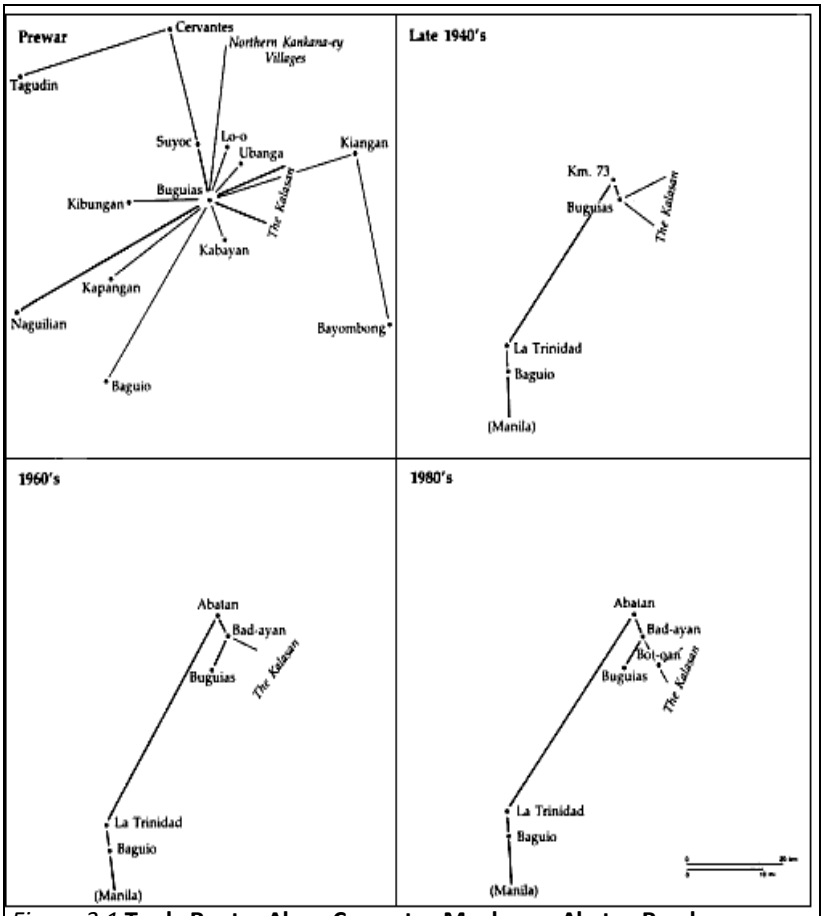


Figure 3.1 **Trade Routes Along Cervantes-Mankayan-Abatan Road**
*(*Source: Lewis, M.W (1991) *Wagering the Land: Ritual, Capital, and Environmental Degradation in the Cordillera of Northern Luzon 1900-1986.* University of California Press, Berkeley)

On one hand, a key informant from Abatan recalled that Mankayan is a vibrant trading area during market days. His family would sell potatoes, sweet yam, taro, and vegetables. Mankayan was the only place which has money. To him the Abatan-Mankayan route was an old road network even before WW II. It became even more important during the Japanese war. Copper was mined in Lepanto as a major material for the production of ammunitions. The Japanese operated Lepanto mine for this purpose. Trade continued even with an impending war.

Mankayan was the epicenter of migrant workers, whose only objective is to work in the mines. The ones who farmed were those from the outskirt villages of the mining area. Traders were usually from Cervantes and Abatan. With the mines, permanent stores were established by merchants, usually old families from Mankayan or Abatan.

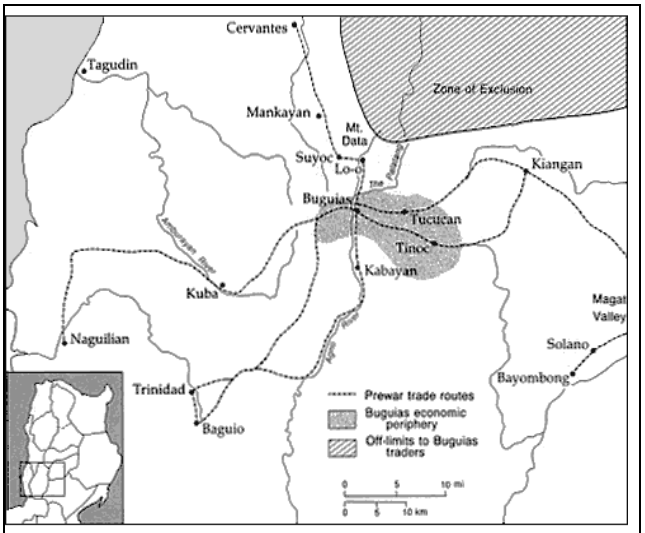


Figure 3.2. **Prewar Trade Route Along the Cervantes-Mankayan-Abatan Roa**d.
(Source: Lewis, M.W. 1991)

After the war, Mankayan (referring to Lepanto) was the center of economic activities. A handful of business boomed in the 1960s mostly catering to the needs of travelling merchants or sales agent. As Abatan was the major entry point to Mankayan and the Mt. provinces, Abatan regained its economic seat as a major trading hub. Travelling was still long and tiresome for the travelling merchants that Abatan became an important stop-over for travelers who would either go to Mankayan, Loo, and the Mt. provinces. Regaining its seat as the trading center, nearby villages from Kabayan, Ifugao, and Bauko, Mt.Province comes to Abatan to trade. Money flowed from the travelling merchants, the mining industries, and the *baknangs* of Buguias, who shifted from farming to business entrepreneurs.

Trade and education came hand in hand. In 1964, a group of priests reached Abatan, Buguias via the Kabayan route. At that time Loo was still the center of commerce, but with the development of the Halsema road, commerce grew in the Abatan loop (Figure 3.3). It may not be as it was during the prewar period as shown in Figure 4.8 but trade was growing vibrantly in the Abatan loop.

The growth of trading in the Abatan loop is interwoven with Cervantes growth of trading routes. Cervantes traded in Mankayan, and also Bauko, Mt. Province. Cervantes, located in the interiors of the Ilocos Region and Mt. Province, traded more in the Cordillera regions than in the Ilocos Regions. The key informant from Cervantes offered that it is a natural trade diaspora for them, as the population are 80 percent Kankana-eys and only 20 percent Ilocanos.

Figure 3.3. **The New Trading Routes of the Cervantes-Mankayan-Abatan s Road**
Source: Cordillera Road Improvement Program (CRIP)

The cementing of Halsema road, brought commerce and money: In the 1980's an auto supply was opened, and extended credit lines. And in 1990-1996 some migrant traders hit it big through a buy-cheap-sell-high strategy and eventually put up the largest building and auto supply goods, later hardware and farm equipment retail store. These are not remote stories as more migrants are seizing the opportunity of boom in the Abatan loop.

Along the road vein of the Cervantes-Mankayan-Abatan road, future trading roads and migration patterns can be predicted based on the development of the provincial roads, such as the Mankayan-Balili, Guinaoang-Suyoc-Gambang, Mankayan-Tadian, and Mankayan-Bedbed, which connects Mankayan to Mt. Province. Cervantes provides the major exit of the Cordillera to the Ilocos Region. The improvement of the Cervantes-Mankayan-Abatan road fully connects Cervantes to the Mt. Province via the newly constructed Aluling bridge, and Benguet.

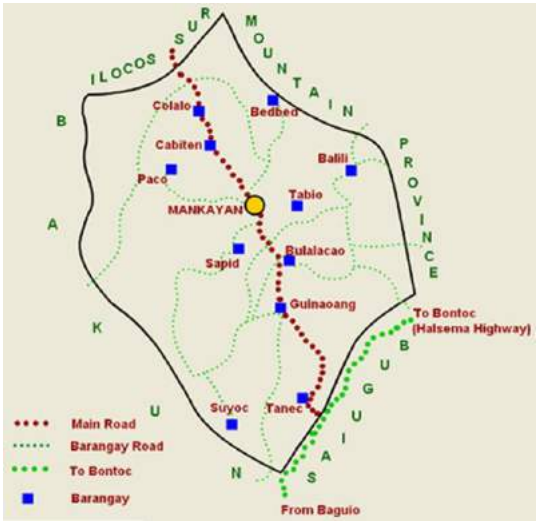


Figure 3.4. **Mankayan Road Map**

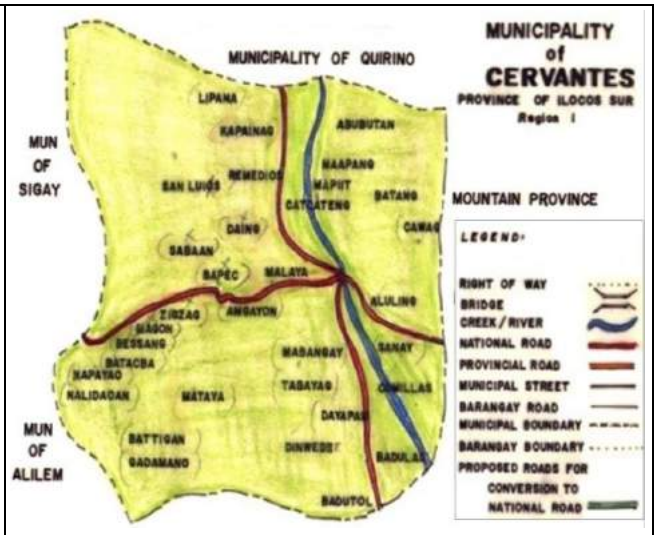


Figure 3.5. **Cervantes Road Map**

The road development of the Cervantes-Mankayan-Abatan develops new trade routes which ushers economic growth and development. Mt. Province which was excluded from the trade route during

the prewar period from the Cervantes-Mankayan-Abatan road (Figure 3.4 and 3.5), will benefit from the improved road as it provides arterial roads leading to the interior towns of Mt. Province. History surely predicts development, and this will come into reality via road development.

3.2 The Households' Socio-economic Profile and Perceptions of the Importance of Road Development

Roads connect isolated communities to the national road networks, allow people to travel and access labor and product markets, health care and education, and leads to over-all poverty reduction. The rehabilitation of the Cervantes-Mankayan-Abatan road is expected to bring these changes down to the level of the households. There were 280 households profiled, surveyed and interviewed.

Of the 280 respondents 62 percent(174 out of 280) were women with most of the men in the farm, mines, delivering vegetables in the city, and/or were in nearby municipalities working in the construction of roads and/or houses. Female respondents referred to themselves as household head, wife, or a female relative. While the husband remains to be the household head, of the 105 respondents who acknowledged their role as heads, 17 percent (18 out of 105) were women.

Among the three municipalities, household in Cervantes has the largest number of family members living in one house when compared to Abatan and Mankayan which mostly have three members and below living in one roof.

Table 3.1. **Family Size Per Municipality**

	3 members & below		4-7 members	
	N	%	N	%
Abatan	31	77.5%	9	22.5%
Mankayan	64	53.3%	56	46.7%
Cervantes	37	30.8%	83	69.2%

The responses can be associated with the number of family members living with the respondents, Tables 3.1 and 3.2 show that having an extended family is more pronounced in Cervantes and Mankayan than in Abatan. The year the family members were born provides the demographics of the household size. Grandparents, the nucleus family and, older children who generally do not stable work lives in the house. This would generally describe the households of Cervantes and Mankayan.

Table 3.2. **Year the Family Members were Born**

Year the family member was born	Frequency		
	Abatan	Mankayan	Cervantes
1927- 1936 (90-81 yrs. Old)	1	2	10
1937-1946 (80-71 yrs. Old)	3	16	97
1947-1956 (70-61 yrs. Old)	10	31	31
1957- 1966(60-51 yrs. Old)	11	33	24
1967-1976 (50-41 yrs. Old)	20	32	62
1977-1986 (40-31 yrs. Old)	16	60	57
1987-1996 (30-21 yrs. Old)	18	88	62
1997-2006 (20-11 yrs. Old)	17	55	124
2007-2017 (10-0 yrs. Old)	15	82	105

Educational attainment in the three areas is fairly high with most of the family members finishing high school and at least with some years in college. This observed patterns of educational attainment, in all subject areas, insinuates that pooled household income is most likely augmented by seasonal employment and sources of income from various employment, such as farming and mining. Very few college graduates stay with their parents, those who do are

Table 3.3. **Educational Attainment of the Respondents and the Family Members**

Years of schooling	Abatan	Mankayan	Cervantes
Elem Level (1-5 yrs)	16	48	110
Elem Graduate (6 yrs)	12	32	53
High school Level (7-9 yrs)	22	105	228
High school Grad (10 yrs)	22	65	72
College Level (11-13 yrs)	62	219	353
College Graduate (14 yrs)	21	71	70
Did not attend School	2	8	11

either looking for work, or have a work in the municipality college. Most of those who have finished college are in the city working.

In Abatan and Mankayan, farming, trading, and mining are considered as full time work owing to its scale of operation. The count of 126 means that at least there is one in every household who is employed. The context of "not employed" simply means that members of the household has no specific livelihood, they could be just farming a very small plot, taking care of one or two pigs, selling vegetables in the market and so forth. Each area has a different notion of 'not employed'. In Mankayan, not employed means they are not working in Lepanto, they are not working in small scale mining, and they are not also farming, but they are doing other things that earn them irregular amount of money. In Abatan, not employed means the household members do not earn as as much as the big time farmers. Household members consider also seasonal employment, such as working in the construction of road and houses, and in some cases, they supply bulk labor to some farming households in other areas.

Table 3.4. **Employment Status of the Respondents and Family Members**

Status	Abatan	Mankayan	Cervantes
Not employed	18	89	137
Seasonally employed	13	73	46
Employed	54	119	126

Of the three areas, there are more households in Cervantes who own farmlands than in Mankayan and Abatan.[4] All households own the lot where their house is built, those who do not own the house either rent or occuppy the house for free.

Inset Box 3.1.
AVERAGE SIZE OF LAND OWNED BY THE HOUSEHOLD

Farmland and house site had become smaller in Abatan over time. Space had become scarce. Almost all farm lands in Abatan are converted into trading spaces, or housing units for the service workers, and students who studies at the San Isidro Catholic High School.

Asset	Abatan	Mankayan	Cervantes
Farmland	1000 sq.m.	1323 sq.m.	6929 sq.m.
House Site	100 sq.m.	173 sq.m.	426 sq.m.

In Mankayan farm lands and housesits are relatively small compared to Cervantes. Farmers in Mankayan plants high value crops, while in Cervantes the major crop is rice, which explains the large farmland owned by the household.

Road connectivity provides household's access to social services that are mostly associated with poverty alleviations programs of the government such as education, health services, and improvement of welfare. Households perceptions on the importance of road is shown in Table 3.5. Of the three areas, Cervantes gave the highest mean an modal response. This indicates that Cervantes felt the most impact of road for every reason that it was built for – the flow of economic activities and welfare.

Table 3.5. **Households' Perceptions on the importance of Road[5]**

Category	Mean (Modal) Response		
	Abatan	Mankayan	Cervantes
Improvement of Welfare	4.32 (4)	4.40 (4)	4.58 (5)
Education	4.26 (4)	***4.46 (4)***	4.82 (5)
Work	4.37 (4)	4.38 (4)	4.76 (5)
Hospital	4.31 (4)	4.34 (4)	***5.00 (5)***
Purchasing Food	***4.42 (4)***	4.32 (4)	4.91 (5)
Selling Produce	4.33 (4)	4.39 (4)	4.91 (5)
Purchasing Non-food Items	4.28 (4)	4.43 (4)	4.89 (5)
Social Work/ Obligation	4.21 (4)	4.22 (4)	4.55 (5)

A straight forward narration of a key repondent expressed how every crop became valuable:

The development of road brought in cash, and every available crop is converted to cash no matter that this is 5 cans of legumes or a basket of fruits sold in Mankayan. The sale is sufficient to cover for their fare going back to Cervantes.

[4] Respondents from Abatan are those just within the 100 meters which means respondents were randomly picked up within the traders section of the Abatan. In Mankayan, from 100 meters up to 5 kilometers are within the operations of Lepanto.
[5] The mean of the Likert Scale was rounded off to the nearest ten.

Abatan which yielded the lowest mean, perceives the importance of road in terms of purchasing food, while Mankayan viewed it differently, that to them the road is important for access to better education (i.e. college education). On one hand, those from Cervante view the importance of the road in terms of how fast they can bring a sick family member and/or a relative to the hospital. Analyzing now the context of the household responses, of the three areas, Cervantes benefited most from the improvement of the Cervantes-Mankayan-Abatan road project.

Abatan was the among the first to benefit from the construction of the Halsema road, while Mankayan had always better access to roads due to the presence of Lepanto Consolidated Mining Company that had maintained the Cervantes-Mankayan-Abatan road ever since it renewed mining operation after the second world war.

No matter how the extent of importance of the road was perceived, in general, it had not only brought a steady flow of money, but the improvement of road made education and health services accessible. School children ride tricycle and jeepneys to go to school. School services are also available for school children with the improvement of road. Emergency cases are easily brought to the nearest hospital, mostly to the Lutheran Hospital in Abatan or to the Luis Hora Hospital in Bauko, Mt. Province.

Key informants admitted that trade became faster, households have more products to choose from, they don't feel as isolated as compared to the '50s until the early '90s. Yet they also feel that together with the gains of the road development, it has also its consequences. The once closely knit townspeople are feeling the dispersion of their family moving from one town then next to the city, while new settlers are also buying lands and have established businesses in the central part of the municipalities.

3.3. The Impact of the Road on the Value of Time and Opportunity Cost

With the construction of road, fares became cheaper. From the response of the key informants the calculation of fares and waiting time are shown in Table 3.6.

Table 3.6. **Comparative Fare in 1960s and 2017**

Year	Fare	Purchasing power	Equivalent today
Baguio – Abatan			
1960s	P 1.50	5c buys 5 pcs. nougat candy	30pcs of 5c*5pcs of nougat=150pcs
2017	P130.00	Per pc. of nougat is Php1.00	Php1*.150 pcs = Php150
Percentage decrease in fares			***16%***
Baguio – Mankayan			
1960s	P 2.50	5c buys 5 pcs. nougat candy	50pcs of 5c * 5pcs of nougat =250 pcs
2017	P160.00	Per pc. of nougat isPhp1.00	Php1*250pcs = Php250
Percentage decrease in fares			***56%***
Baguio – Cervantes			
1960s	P 3.00	5c buys 5 pcs. nougat candy	60pcs of 5c * 5 pcs of nougat =300 pcs
2017	P200.00	Per pc. of nougat isPhp1.00	Php1*300pcs = Php300
Percentage decrease in fares			***50%***

Using a simple formula of inflating the fares, the price in 2017 was held constant to convert the purchasing power of the peso in 1960, using a single product reference, i.e. nougat. All respondents used the nougat candy as a reference of the value of money in the 1960s. The table shows that with the concreting of the old trading routes, the fares decreased by 16 to as high as 56 percent. This calculations show that improved road generally lowers the cost of travel and transportation.

The improvement of road lowers repairs and maintenance of the operators. Rough, gravelly, and bumpy roads hastens the wear and tear of springs, tires, tyrod-ends, increases pressures on gas pedals, and engines, but with much improve road, spending on maintenance is reduced and prolongs the useful life of the asset, and may even have a higher resale value.

Another insight drawn from the study is to analyze its impact on the market. The improvement of the road reduces monopoly of transportation services and increases competition of alternative transportation. This makes it easier to impose caps on fare without so much opposition among operators. Improved roads levels off playing field among the transport providers through a graduated fare tariffs, which as a consequence improves transport services, allowing the market mechanism to determine equilibrium prices of differentiated transport services, and leave the choice to the transport users. Users do have not much of a choice of a transportation when the roads are really bad condition.

Comparative fare rates between 2010 and 2017 is also analyzed to evaluate the impact of the rehabilitation of the Cervantes-Mankayan-Abatan road. Using more recent fare rates, improved road did not result to excessive increase in fares as shown in Table 3.23. Using 2000 as the base year for the consumer price index for transport, the fare at constant prices was estimated. The estimates show that there has been a slow fare increase in a span of seven years. The constant price hardly varies, particularly in Abatan and Mankayan. A marked difference between 2010 and 2017 is observed in Cervantes relative to Abatan and Mankayan.

The rehabilitation of the road attracted investment in the transportation business owing to the demand for more public utility transportation. It was a cheap and self-liquidating investment, attracting farmers, miners, traders, and even employees who have excess funds to re-allocate to another business venture – transportation. With more suppliers of public utility transportation, supply was regulated through franchising, registration, rights of conveyance. Once registered vehicle owners much abide also to the regulated fares.

Table 3.7. **Comparative Fare in 2010 and 2017**

Year	Fare	Fare at constant prices	Percent changes in Prices
Baguio – Abatan Fares adjusted at 2000=100 base year			
2010	P120.00	P98.00	***Percentage decrease in fare 2%***
2017	P130.00	P96.00	
Baguio – Mankayan Fares adjusted to 2000=100 base year			
2010	P140.00	P114.00	***Percentage increase in fares 3.5%***
2017	P160.00	P118.00	
Baguio-Cervantes Fares adjusted to 2000=100 base year			
2010	P160.00	P130.00	***Percentage increase in fares 14%***
2017	P200.00	P148.00	

The regulation of fare impacts on the income of the operators and the drivers. However, with better road conditions this compensates the losses due to high repair and maintenance cost. Operator's major expense comes from increase in fuel, and repair and maintenance due to bad road conditions. With the improvement of road, in effect the government indirectly subsidizes transport operators with their capital by decreasing the cost of repair and maintenance, and prolonging the useful life of the vehicle. It can be said that better road conditions increases market competition and eliminates monopolistic and opportunistic market behavior.

Not only that the fares had decreased but the waiting time declined as well. What more, travelling today is worry-free. Short trips from Abatan to Mankayan, and Mankayan to Cervantes are available when one misses the direct trips plying the area. Table 3.8 shows the calculation of the key respondents of saved travel time and its monetary equivalent. The amount lost due to waiting time

is between Php1,000-1,500 as more or less the cost of waiting for 13.5 hours, the same can be said with walking when there is no transportation due to bad roads.

Table 3.8. **Comparative Travel Time in 1960s & 2017 from Baguio to Cervantes-Mankayan-Abatan Loop**				
Year	**Length of time**	**Time Saved**	**Total**	**Monetary Value**
Travel time in 1960s	4 – 6 hours	2 hours	13.5 hours	Php1,000-1,500 Value of clearing a farm from sunrise to sunset
Travel time 2017	2- 4 hours			
Waiting time: 1960s	Half day (12 hours)	11.5 hours		
Waiting time:2017	30 minutes			

Today, there are many types of transportation that traverse the Cervantes-Mankayan-Abatan road. The respondents have common stories of waiting for at least six hours for any type of transportation to pass, which unlike today, 30 minutes is already a long waiting time on a fair day. The Dangwa bus was the mode of transportation way back in the 1960s. One has to catch a very early trip to go to Baguio, then they will have to catch the only trip that goes back to their places.

Missing the only trip means additional cost because it means sleeping with relatives, or sleeping in the station to wait for the bus. Shopping is also done in two to three hours. There is no leisurely pace for shopping, only those that are essentials are purchased so as not to waste the fare in going to the city. Others, during those years, have never travel as far as Baguio at all. They travel only within the Abatan or Bauko loop.[6]

Along the Cervantes-Mankayan-Abatan loop, jeepneys, tricycles, and FX are available for short trips. The trip is about 20-30 minutes on a moderate speed (40 kph) from Abatan to Mankayan, longer for Mankayan to Cervantes. Jeepneys are cheaper than tricyle and FX. Effective travel time from Abatan to Mankayan (i.e. business center) may run up to 30 minutes, while effective travel time is one hour and thirty minutes from Mankayan to Cervantes (i.e. town center). Effective travel time includes dropping of passengers in their designation destination and picking them up in turning points or stations.

The next table shows that households in Abatan-Mankayan save between Php118.00-Ph192.00, while those in Mankayan-Cervantes save about PhpPhp199.00 – Php329.00. The amount is equivalent to a days work in the agricultural sector. The table implies that improved road increases productivity, while not having the road increases cost of agricultural output due to the cost of waiting. On the other hand, the amount saved from travel time is the value of the agricultural output because waiting time is converted into labor hours.

Table 3.9. **Estimated value of Opportunity Cost of Time: 1960 & 2017**			
Comparative Years	**Time spent to reach destination**	**Estimated cost of travelling (opportunity cost of time & actual fare)**	**Comparative cost**
Abatan – Mankayan, Estimated length: 12			
1960's	2 hours Walking	Php74.00 –Php 111.00/hour	Php148.00-Php222.00
2017	30 minutes ride	Php30.00	Php30.00
Amount Saved			***Php118 –Php192.00***
Mankayan-Cervantes, Estimated length: 20			
1960	3 ½ hours Walking	Php74.00 -Php111.00/hour	Php259.00-Php389.00
2017	1.5 hours	Php90.00	Php90.00
Amount Saved			***Php199-Php329***

The rehabilitation of the Cervantes-Mankayan-Abatan road resulted to cheaper fares which can be accounted by the increase in public utility transportation which can convey more people at one time, for example jeepneys. Before there were jeepneys, households have to rely on tricyle and motorcylces to travel within the loop of Cervantes-Mankayan-Abatan. Tricycles or motorcylces are hired at an

[6] There is also an Abatan in Bauko. It is the usual travelers stop over for warm meals and snacks, and a stop to the rest rooms.

exorbitant price of Php150.00 to Php200 per trip depending on the time of the day. Transportation cost becomes more expensive during the night.

Table 3.10 shows the comparative fares between 2010 and 2017. Even at constant proces, the rehabilitation of Cervantes-Mankayan-Abatan road had made fares almost four times lower before its pre-rehabilitation period.

Table 3.10. **Estimated value of Opportunity Cost of Time: 2010 & 2017**

Comparative Years	Time spent to reach destination	Mode of transportation	Estimated cost of travelling	Comparative cost
Abatan – Mankayan, Estimated length: 12 kilometers				
2010	1 hour	Tricycle, FX	Php150.00-Php200	Php150.00
2017	30 minutes	Jeepney	Php30.00	Php30.00
Amount Saved				**Php120.00**
Mankayan-Cervantes, Estimated length: 20 kilometers				
2010	2 hours	Tricycle, FX, motor	Php200-Php300	Php200.00
2017	1.5 hours	Jeepney	Php60.00	Php60.00
Amount Saved				**Php140.00**

Overall, the greater implication of the rehabilitation of the Cervantes-Mankayan-Abatan loop shows that interior municipalities and barangays have benefited from the better roads in terms of: 1) shorter travel time; 3) recovery of lost opportunity cost; 3) cheaper fare.

3.4. The Economic Impact of the Road with Insights from Regional Trends

3.4.1 Investments on Transportation

Infrastructure matters. The construction of transport road network brings economic development, by bringing direct benefits to employment and income generating sectors, e.g., the agriculture and industrial sectors

Fueled by income from these sectors, services follow, such as transportation, financial, and tourism oriented services. No doubt, government spending on infrastructure had increased over time, because it provides a system for telecommunication, transportation, and trade to flow into the regions.

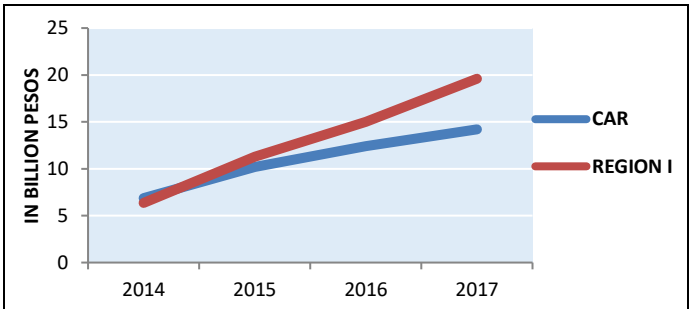


Figure 3.6. **Capital Outlay for Road Development in Region 1 & CAR**

Figure 3.6 shows that government spending had increased four times since 2014 in Region 1, while in CAR, road spending increased at least three times larger than in 2014. As the figure shows, the capital outlay for Region 1 is greater than in CAR.

As roads are developed, spending and investments on transportation is expected to increase spontaneously. Roads is a necessary condition for development, but investments on transportation for logistics and access to market and social services completes the necessary and sufficient conditions for road development as mechanisms to catalyze growth and development. Bringing the directness of relationship between road spending and increase in transportation acquisition can be analyzed from the lens of the Cervantes-Mankayan-Abatan road rehabilitation. There are already telling signs, such as: 1) Increasing volume of land transport vehicles; 2) the changing pattern of household assets;

and, 3) pattern of road usage. All three indicators are associated with the increase spending on road development and rehabilitation.

Increasing volume of land vehicles. These are noticeable in choke point areas, such as crossing, intersections, and the main hub of the commercial activities, i.e. markets, churches, schools, and private and public premises. The volume of passenger cars have been increasing, comprising 45 percent of all vehicles plying the Cervantes-Mankayan-Abatan road in 2015. It was noted that bus (which was always mentioned as the popular transportation in the 60s), is only one percent, indicating that newer vehicles took its place as a means of mass transportation.

Changing pattern of household assets. Increase expenditures on road increases demand and or desire of households to own their own vehicles either for business or private use. This is evident in the results of the survey.

The increase in the ownership of motorcycles and cars (i.e. mostly FX, jeeps) is largely brought by the improved road. Recalling the insights from the focus group discussion, there were very few households who have vehicles, only those who have money, and those who travel most of the time to Baguio. But with the improvement of road, it was an opportunity to buy motorcycles (i.e. for tricycle) that can double as a family service, and at the same time an additional source of income. It is also the most immediate source of cash among the households. People would not walk anymore since there are many available transportation that ply short distances from the main town to the barangays, or even municipality to municipality.

Table 3.11 **Assets Owned by the Households**

Types of asset owned	Abatan N = 40		Mankayan N = 120		Cervantes N = 120	
	Yes	%	Yes	%	Yes	%
Farmland	5	12.50	15	12.50	33	27.50
House site	24	60.00	86	71.67	110	91.67
Green House	1	2.50	1	0.83	0	0.00
Piggery / Poultry	0	0.00	0	0.00	0	0.00
Trucks	3	7.50	4	3.33	6	5.00
Car/Motorcycle/Bikes	9	22.50	32	26.67	64	53.33
Appliances	34	85.00	112	93.33	115	95.83
Electric Pump	0	0.00	4	3.33	4	3.33
Generators	0	0.00	1	0.83	1	0.83

The rise in the demand for transportation, such as cars/motorcylces/bikes is reflected in Table 3.11. Citing the case of Cervantes, 53 percent of the households surveyed own a motorcylce as a means of transportation. It is used for everything that can be conveyed in the town proper or any place, such as transporting people, agricultural products, and merchandise. Distributors of motorcycles are found in Abatan and Cervantes, which are sold on easy installment terms. With better roads, complemented by light installment terms to acquire vehicles, demand for vehicles had increased. In Abatan, FX is one of the dominant preferred transportation for interior barangays that can't be reached by tricycles or jeepneys. Interviews among the respondents that most of them bought an FX from taxi operators in Baguio. A key informant also narrated that *'baknangs'* own ford fierras and tamaraws vehicles before (referring to circa '70s and '80s) because these are the vehicles that can traverse rugged and narrow terrains and roads, but today the '*baknangs'* own trucks. Wider and concrete roads made it cost wothy to own trcuks to transport farm products.

Aside from households owning vehicles, majority of the households have appliances. They have appliances to make life and work easy. As one key respondent described the increased in asset (particularly equipment and appliances), *"from asolutely nothing to having everything that an improved road can bring the household"*. For example anecdotal evidence of childhood experience of watching TV in a neighbors house is a thing of the past. Almost all households own a TV. Good roads

and cheaper brands of TV made it possible for household to own one. Households have also washing machines and refrigerators in their house.

The pattern of road usage. Most households in Abatan, particularly those interviewed within the 100 meters ZOI, search for jobs within the municipality. While respondents from Mankayan and Cervantes work in other municipalities and the cities.

Structural problem, example remoteness of the areas, is one of the causes of structural unemployment, that is persons looking for job remain unemployed even if there are jobs available because those persons have no access to information due to bad roads. It can be observed that still a large number of the households would prefer to work within the municipality. It is noted in Mankayan and Cervantes that some family members have jobs in other municipalities and also in the cities (mostly Baguio and Candon). *The road in a way eases emotional separation from families as travel time is shorter and commuting daily is possible*. Most of those working in cities and other municipalities traverse the Cervantes-Mankayan-Abatan road every day or every week.

Table 3.12. **Households with Family Members Earning Wages Outside their Barangay/Municipality**

Location of work	Abatan		Mankayan		Cervantes	
	N	%	N	%	N	%
Within the municipality	37	*92.5*	86	*71.7*	54	*45.0*
Other municipalities	1	*2.5*	6	*5.0*	23	*19.1*
Cities	0	*0.0*	18	*15.0*	25	*20.8*
TOTAL	**40**	***100.0***	**120**	***100.0***	**120**	***100.0***
Number and percent using the AMC Road	**23**	***57.5***	**68**	***56.7***	**64**	***53.3***

These new types of commuters, who do not bring big luggages, increased the demand for PUVs to convey workers to and from their work. Aside from walking to their work, there were other mode of transportation.

Table 3.13. **Mode of Transportation Going to Work**

Mode of Travel	Abatan			Mankayan			Cervantes		
	Ave DIstance (km)	Ave. Travel Time (1 way, in min)	Cost/ Trip (1 way, in Php)	Ave DIstance (km)	Ave. Travel Time (1 way, in min)	Cost/ Trip (1 way, in Php)	Ave DIstance (km)	Ave. Travel Time (1 way, in min)	Cost/ Trip (1 way, in Php)
Walk	0.212	6.67	0.00	4.10	96.31	0.00	0.71	11.0	30.00
Motor Bike	0.0	0.0	0.00	3.26	21.28	64.64	179.17	26.25	69.19
Private car	0.0	0.0	18.00	38.87	88.60	165.71	177.71	139.64	307.14
Bus	5.0	45	25.00	19.57	133.33	63.33	420.63	181.0	373.00
Van/ Jeep	2.0	19	40.00	78.33	116.89	114.38	236.11	182.27	273.75
Tricycle	0.500	5.0	25.00	7.14	19.56	15.89	10.0	30.0	58.00

Households from Abatan reside near their working place. They ride a tricycle, take a bus, or a van. The transportation cost vary with the mode of transportation. Households from Mankayan and Cervantes are the most dependent on all modes of transportation. Bus is taken the farther the place of work, while van/jeep and tricycle are the usual mode of transportation for nearby workplace.

Clearly defining to the respondents the use of Abatan-Mankayan-Cervantes road to search for job, the responses are shown on Table 3.14. Based on the responses of the households in Abatan, they have traveled the Cervantes-Mankayan-Abatan road to look for a job. This is in contrast to the responses from Mankayan and Cervantes. Over the last five years they have used the road less and less to search for a job. Life was harder when there was no road that often,

Table 3.14. **Average Household Use of the Cervantes-Mankayan-Abatan Road to Look for Work**

Category	Abatan	Mankayan	Cervantes
In the last 5 years	1.73 **(2)/year**	18.8 **(19)/year**	28.8 **(29)/year**
Last year	4.52 **(5)**	24.41 **(24)**	24.09 **(24)**
In the last six months	13.37 **(13)**	7.80 **(8)**	11.77 **(12)**

households search for a job even in far places. But now that the roads are improved, there are opportunties within the municipalities and nearby municipalities. Surplus products from small backyard gardens can be sold, and there are always buyers. This has lessened the number of households leaving their place to search for a job. This result can be cross-referenced with Table 3.12. While there are those who work in other municipalities or cities, majority of them still prefer to work within their municipalities. This changing patterns of road usage, will predict also the type of vehicles needed to convey people and products.

These evidences of the impact of the increase of budget for road development will drive the demand for low cost vehicles in the short run and in the long run mass transportation (i.e. buses). As budget allocation for road increases, the road improvement will attract expenditures and investment on vehicles. There will be more households and firms owning vehicles, travel would be fast, convenient and easy. The long-term increase in the annual average daily traffic will require more budget allocation for roads, particularly maintenance, monitoring and evaluation and eventually demand for wider roads.

3.4.2 Road and Changes in the Gross Regional Domestic Product

Government spends to propel development in the regions. Good roads hasten the production of goods and services. The largest producer in CAR is the industry sector, then service sector. Agriculture lags and remains to be the lowest contributor to the GRDP. Growth in the service sector climbs steadily in Region 1, even with the agricultural sector despite that it is the second major contributor to the region's GRDP. Figure 3.7 shows that between 2008 to 2009, growth in the industrial sector out-produced the agricultural sector.

Both regions show growth in all sectors. The fastest growth was experienced by both regions between 2008 and 2010, which can be insinuated from the stable growth of the industry and service sectors.

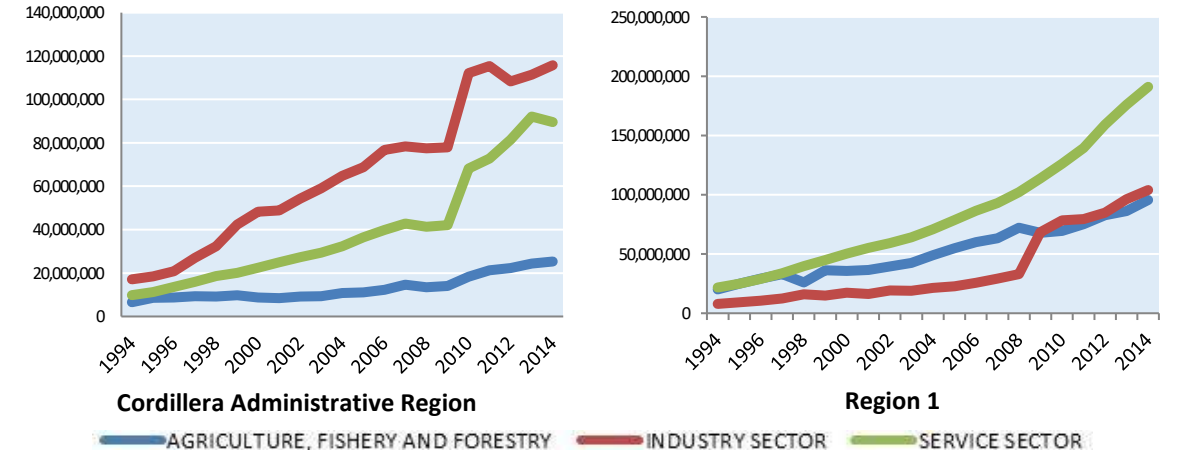


Figure 3.7. **GRDP at Current Prices, CAR & Region 1** *(Source: Philippine Statistical Agency)*

The impact of road development is largely reflected in the growth in the service sectors. Compared to the industry sectors, investment requirement in the service sector is relatively lesser. For example it is relatively easy and cheap to buy motorcycles, put up a merchandising store, or a small *carinderia*. Road creates job in services faster than in other sectors. In the short run (i.e. during the road development) services type of livelihood opportunities and jobs are created, either diversifying or complementing existing livelihood activities or farm work. This analysis is observe in Table 3.15.

The typology of livelihood activities have notably spread from farming to trading and industry to trading, and a combination of agricultural activities with trading and employment. These are derived demand created in the Cervantes-Mankayan-Abatan loop due to the road construction. For example, the demand for sand and stone is a derived demand of road construction. This creates employment which complements for example farming or mining. On the other hand also, it may create new livelihood activities such as trading.

Table 3.15. **Livelihood Activities of the Households**

Livelihood Activity	Abatan		Mankayan		Cervantes	
	N	%	N	%	N	%
Farming	7	*18%*	11	*10%*	44	*37%*
Small Scale Mining	1	*3%*	14	*13%*	0	*0%*
Livestock	0	*0%*	4	*4%*	7	*6%*
Trading	19	*48%*	22	*21%*	24	*20%*
Others (employment combined with the major livelihood activity)	13	*33%*	55	*52%*	45	*38%*
Total	40	*100%*	106	*100%*	120	*100%*

The rehabilitation of the Cervantes-Mankayan-Abatan road increased trading of agricultural output as shown in Table 3.16, and there were accounts from the respondents that middlemen sourced livestock and rice at the source of the supply chain as shown in Inset Box 3.2.

Table 3.16. **Place of Trading of Agricultural Outputs**

Place	Abatan	Mankayan	Cervantes
Within the Town	0	3	12
Nearby Towns	0	0	2
Major Trading Areas	5	7	2
Others	0	0	2

Inset Box 3.2

With the improvement of roads, every product can reach the market and be sold. The farmers bring the products in the market, but in some cases, improved road brings the traders and the middleman to the farm and pick up the products of the farmers at farm gate prices. For example in Cervantes, traders from Abatan would come to Cervantes to pick farm products and rice.

The improvement of the road had shortened travel time. Farmers with their own transportation (i.e. truck, FX) can sell their products in real time, at the right time and right price. Mankayan benefitted most from the improved roads for mobility of agricultural products to major trading areas. For Cervantes, it means selling their products to nearby towns and to travelling salesmen of major trading areas in Ilocos Region. The households hardly trade from the Ilocos Region unless the trader comes to the municipality to pick up the farm produce. Households from Mt. Province, particularly Tadian, Bauko, and Sabangan buy rice in Cervantes.

3.4.3 Road and Changes in Agriculture

Agriculture remains to lag behind the industry and service sectors, yet it also shows a linear growth with infrastructure spending. Fishery and Forestry outputs remain to be the lowest contributor in the regions gross domestic product.

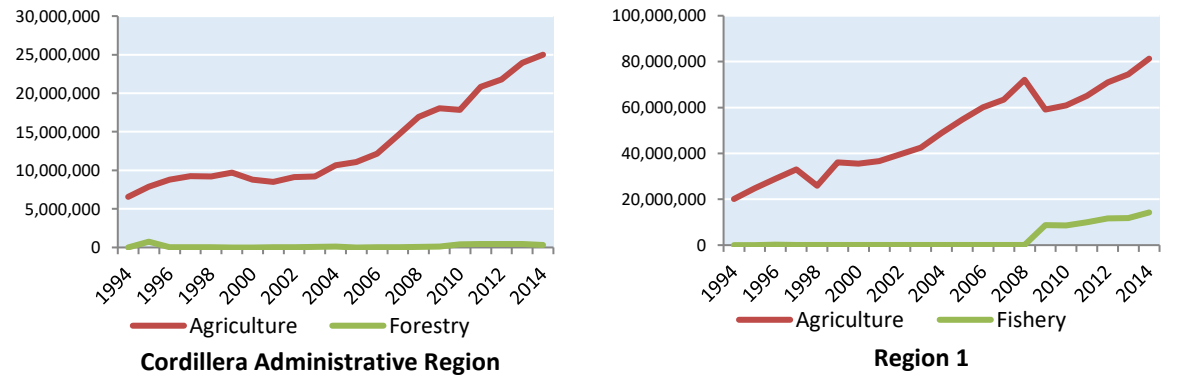


Figure 3.8. **Agricultural Production at Current Prices, CAR & Region 1: 1994-2014**

The growth in agricultural output are from: 1) product diversification; 2) increased agricultural trading; and 3) access to technology and innovation.

Product diversification. The rehabilitation of the Cervantes-Mankayan-Abatan road hasten product diversification. Sayote was hardly produce on a commercial scale, because it cheap and easily bruise from bumpy pressures when roads are not in good condition. But with the rehabiltation of the road, sayote is now a major agricultural product in Mankayan. With shorter travels and better roads, products can reach the market in good condition. Spoils from bumpy roads are also reduced, consequently increasing the income of the farmers, through quality vegetables.

Increase trading drove agricultural output to rise. Mankayan and Cervantes have a long history of livestock trading. Although Mankayan is known as a mining town, there is a robust livestock industry, particularly in barangays that are almost at the boundary of Cervantes. Cattle and swine are the commonly traded livestocks. Cattle and pigs are among the major agricultural products traded between Mankayan and Cervantes, and Abatan and Cervantes. Abatan traders usually travel to Cervantes to buy pigs which are either sold live or butchered. Abatan has the highest demand for livestock as observed by a key respondent, which is understanble given that Abatan is a stop-over of travellers traversing the Halsema road and the Cervantes-Mankayan-Abatan road.

Table 3.17 shows that there are no transportation expenses incurred for swine and cattle. The buyer, either a direct or a trader (middleman) comes to the municipalities to pick-up the swine and the cattle. The largest buyer of swine and cattle is Abatan. The transportation expenses incurred for selling chicken is just Php30 to Php40 implying that these were transported either through a tricycle or a jeepney.

Table 3.17. **Livestock Production**

Type of Produce	Ave. No. Sold	Ave Price per Head	Average Sales	Ave Cost of Transport
Mankayan				
Swine	26	12,813	120,200	0
Chicken/ Fighting Cock	4	250	1,000	0
Cattle/Carabao	2	13,500	27,000	30
Cervantes				
Swine	7	8,500	51,000	0
Chicken/ Fighting Cock	6	200	1,100	40

Traders who picked up livestock usually have their own trucks. The average time of trading which is from 0.85 to 1.75 hours. This indicates that the traders and buyers are just within the Cervantes-Mankayan-Abatan loop, which validates observations of livestock sold along the road of Abatan.

Table 3.18. **Mode of Transportation for Trading of Livestock**

Type of Transportation	Mankayan	Cervantes
Own Private Car/ Truck	1	0
Jeepney	1	1
Tricycle	1	1
Others, trader's pick up the livestock	2	6
Ave. time of trading (going & returning)	1.75 hrs	0.85 hrs

Trading of livestock is very different today. During the '60s and '70s livestock, particularly cattle are herded in Mankayan and Abatan and sold on auction (the highest bidder). Today the traders and direct buyers search for livestock raisers, once found, the buyer and/or trader makes arrangement with the households when to pick up the households. Once the livestock are sold, the trader and/or buyer places again an order.

Trading livestock is now made easier with cellphones, and better arterial roads leading to the barangays. With the roads much improved today, traders' trucks and/or jeeps can scour even far flung barangays in search of livestock.

Roads have changed the arrangement on livestock trading, it had reduced search cost, and roads solve the problem on missing markets. With a much improve road, there is no problem for double coincidence of want. Roads had in fact minimized asymmetric information in the market, particularly prices of livestock.

Aside from livestocks, rice is heavily traded. Cervantes' rice which was never commercially traded, before the rehabilitation of Cervantes-Mankayan-Abatan road, is now one of its most traded agricultural product. It was mainly produced for home consumption and to ensure food during the fallow period. With the improved road, rice are sold. Most of those who buy rice, picked up the rice including vegetables sold by the households to travelling merchants who buy cheap and sell high, and households who likes to store rice all year round.

Transporting goods to and from these places had become fast and easy. Households have acquired trucks purposely for their businesses, while jeepneys/vans had become better substitute of the buses. Tricycles and motorcycles have become convenient mode of transporting small items.

Access to technology and innovation. Indirectly, improved road, transportation and trading are push factors that drive agricultural production. Increasing production means increasing the land, improved seed varieties, techniques, and new markets.

Municipalities along the road loop had benefited from government services to improve crop output and quality through new technology and innvoations. Abatan and Mankayan have more markets than Cervantes in the last five years. Land expansion continued to grow just last year in Abatan and Mankayan, but not so with Cervantes' households. The latter had the widest land among the three areas, thus expansion last year and this year was more on planting new plant varieties. From the results of the survey, the respondents noted that the average number of times that they observed their neighbors expanded production was three time as fast in both Abatan and Mankayan, while expansion was slower in Cervantes.

Table 3.19. **Agricultural Production Expansion**

Types of Expansion	Abatan			Mankayan			Cervantes		
	5 Years Ago	Last Year	This Year	5 Years Ago	Last Year	This Year	5 Years Ago	Last Year	This Year
Land	1	2	-	3	6	-	3	-	-
New Seeds or Plants	4	-	-	5	1	1	2	2	1
New Techniques	3	-	-	5	2	-	-	-	-
New Markets	1	-	1	2	-	1	-	-	-

These evidence from key informants and macro-data can be mirrored in terms of the simultaneously growth in road expenditures, transportation, and trading. Table 3.20 shows households acquiring transportation for purposes of trading. It had become a necessity to own a truck and other types of transportation to sell their products, and even to buy products from other municipalities. For example, in Cervantes the mode of transporting their produce is via other type of transportation. As their products are mostly picked-

Table 3.20. **Mode of Transportation for Trading of Agricultural Produce**

Type of Transportation	Abatan	Mankayan	Cervantes
Own Private Car/ Truck	5	4	2
Bus	-	-	-
Jeepney	-	1	2
Motorcycle	-	-	-
Tricycle	-	3	4
Others	1	3	**10**
Average time of trading (Going & returning)	6.17 hrs	4.19 hrs.	1 hr**

***most sell it in front of their houses or the businessmen are the ones coming to pick up the produce*

up by traders, the "other" category of the type of transportation refers to travelling merchants, which insinuates the creation of a trucking business or hauling business in the road loop. Most of these merchants are mostly from Abatan that often pick up rice and livestock. These merchants are usually found along the Abatan road, selling live pigs. Trucks and buses indicate inter-trading among the municipalities. But it has to be noted that intra-trading is indicated in the results of the survey. Smaller mode of transportation, i.e. tricycle, manifests intra-trading.

Increasing agricultural production is among the major reason why roads are constructed and/or rehabilitated. Cervantes produces quality rice, that it commands a high price. Households were able to send their children to school, improve their house, buy furnitures, and even the latest gadgets and appliances. But it has also its downside: households who sell all good rice to dealers, consume the cheaper variant of rice which are sold commercially in the market place.

3.3.4 Road and Changes in Industry

Manufacturing and electricity, gas and water sectors experienced a tremendous increase in output. The rehabilitation of roads, which includes the Cervantes-Mankayan-Abatan loop propelled, investments and growth on: 1) manufacturing; 2) interest on renewable energy; and 3) construction due to increase in infrastructure spending.

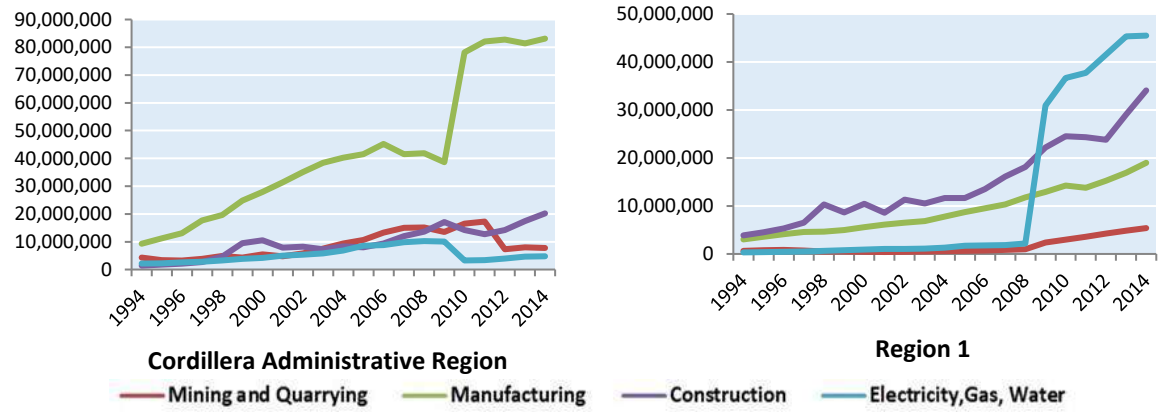


Figure 3.9. **Industrial Sector Output at Current Prices, CAR and Region 1: 1994-2014**

The manufacturing sector. Road connects industries by encouraging the growth of logistic support such as transportation and warehousing to manufacturing companies. Products reach the final consumer in real time at lower prices. With the development of roads, logistic support lowers prices along the value chain.

The increase in manufacturing provides the backward linkage to agriculture. For example canning industries will source their raw materials from the agricultural sector. It also provides the forward linkages to the service sector, for example wholesalers and retailers are part of the chain of the channels of distribution to reach the final consumer.

Investment spending on renewable energy. Investment spending on energy from air, water, and sun are reflected in the sharp increase in output from electricity, gas and water. Region 1, particularly Ilocos Norte is home to the windmills and solar energy farm. Mini-hydro facilities are also developed from run way water in the region.

Construction. Construction is on the rise in both region, which is expected due to the rising allocation of budget on road development and rehabilitation. The construction boom provided employment to

the households and have indirectly contributed to the growth of small businesses particularly trading. With the road development, many of the households are employed in construction, quarrying, hauling and construction assistants. The increase in the output in mining and quarrying in Region 1 originates more from expenditures and output from quarrying for materials for road and home construction, than from mining. During the survey, the municipalities of Cervantes, Suyo and Quirino openly oppose mining – tarpaulins bearing campaign of "no to mining" are visible along the road. Quarrying are visible along the road particularly in Cervantes. Even contractors from Abatan buys construction materials from Cervantes.

Mining and Quarrying: The Case of Mankayan. Mankayan has two types of major industry: agriculture and mining. Those who are mining revealed that average production of gold is 200 grams per year which on the average earns the household Php50,250/year. Most of them sell their gold produce within the municipality, but they also sell to traders who come to Abatan, or they may go to the city or a nearby municipality. They usually ride a bus or drive a motorcycle to sell gold, which usually takes them 45 minutes to and from the gold trader.

There was no reported expansion in the current mine portals, but this should not be expected according to a key respondent. The expansion of operation is inside the mine portal, rather than from the surface. The increase in migrant workers who lease and enter into supply arrangement with the owners of the mine is also a clear sign of expansion of small scale mining operation in the municipality. The small-scale industry's expansion had not elevated this sector to better working conditions with congestion of shacks near the mouth of mine portals.

Trading of gold remains to be a discreet business between traders and producers. The price of gold is traded on a per gram basis and is dependent on the current buying and selling of gold in the international market. The increase in earning is associated with access to information (i.e. trading price of gold) which minimizes assymetric information between buyer and seller. Miners who feels they are not getting the correct price of gold travels to Baguio to look for gold traders who can offer a better price than the agents. The improvement of the road, eliminated gold agents, but instead financial suppliers travels all the way to Mankayan to buy gold while doubling also as financiers. This saves the miners transprtation cost.

Before the gold buyers are within Mankayan, there are also buyers now who meet the miners during market days. Although there are no clear indicators of gold buyers in the Cervantes, some small scale miners meet up with gold traders in Cervantes to sell their gold produce. The trading is done discreetly, and knowledge of the buyer is pass from one miner to another, but mostly it is kept within close circles.

An interview with key people of a mining company in Mankayan opines that small scale miners are not much of a competition to them in terms of price competition. Mining companies sells gold directly to the central bank, which commands higher price. Their major concern is more on environmental safety and high graders. Coupled with the boom in small scale mining, traders and financiers had also increased, which had worsen also cases of high grading. The effect of the deregulation of the small scale mining act is more pronounced with the improvement of road. Improved roads have increased migration to the mining areas of the Mankayan. *Wherever there is a road, economic activities follow*. This maxim rings truth into the small scale mining in Mankayan.Gold is a high value product because its value per gram can cover the cost of trvelling bad roads and incidental cost that goes with having a bad road, but small scale miners will not mind at all. But with good roads too, the pie becomes smaller with migration influx. Collectively the production and earnings from small-scale mining may have increased, but on a per miner basis a miner is likely to deny this feigning competition as the reason. The miner is banking on luck to earn big, if he hits the right vein, but for as long as he is still on search of that gold vein, he competes with other migrants working in search of the elusive wealth from gold.

Mining was one of the major reason of the existence of the Cervantes-Mankayan-Abatan road. Historical account of booming trade between these three areas is largely fueled by two major economic activities: agriculture and livestock, and mining. Suyoc was an old mining site before Mankayan became the seat of large scale commercial mining (Lewis, 1991). Cervantes provides the major exit of the Cordillera to the Ilocos Region. The improvement of the Cervantes-Mankayan-Abatan road fully connects Cervantes to the Mt. Province via the newly constructed Aluling bridge, and Benguet. It developed new trade routes, and an alternative road for Lepanto mines.

Before the rehabilitation of the road, local government executives and officers from the Lepanto Consolidated Mining Company (Lepanto) narrated that the maintenance of Mankayan and Abatan stretch had always been the responsibility of Lepanto to ensure passable roads for its trucks and equipment. The rehabilitation of the Cervantes-Mankayan-Abatan road provided an alternative route for the trucks and equipment of Lepanto. Since the company have outsourced raw material to third parties, timber and bamboos are now sourced in the Ilocos regions, which indicates road usage through the Mankayan-Cervantes vein. Although a runway for small planes and helicopters is maintained inside the mining area to ensure the timely delivery of mining output, the company welcomes the alternate route, and admits that the task of maintaining the road is now the government's responsibility. The company budget allocated for road maintenance can be re-allocated to disaster risk reduction and environmental concerns.

3.4.5 Road and Changes in the Service Sector

The service is the largest contributor in the GRDP of both regions. In CAR, occupied dwellings had increased faster than private services, and trade, while in Region 1 transportation services had the most distinctive increase relative to the growing sectors such as trade, finance and occupied dwellings. This increase in these sectors can be associated with the massive development of road in both regions.

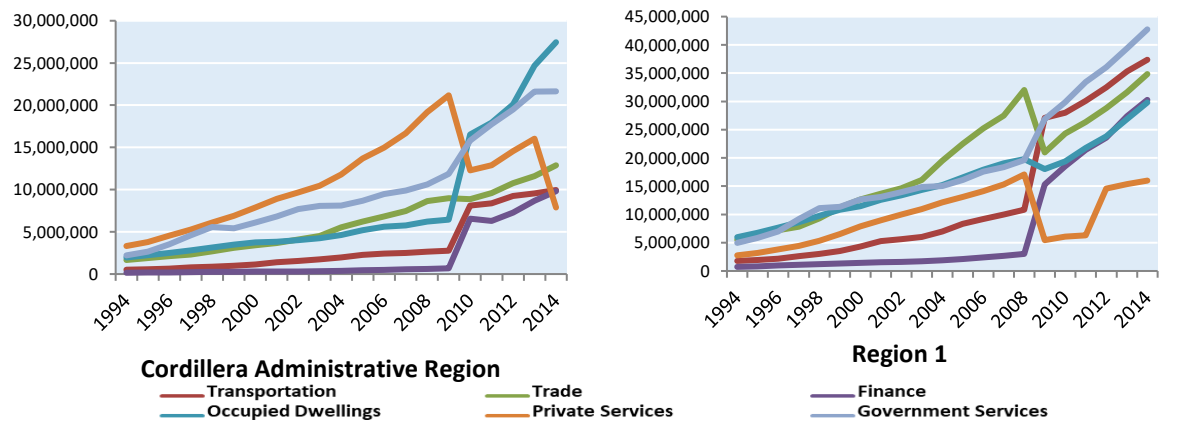


Figure 3.10. **Service Sector Output at Current Prices, Car and Region 1: 1994 –2004**

Transportation is important for logistic management. The Ilocos Region is a growth area and the Cervantes-Mankayan-Abatan-Suyo-Quirino Road links it directly with the CAR. The development of Port Currimao, Laoag International Airport, and the national highway will hasten the mobility of people, goods and capital to and from the Ilocos Region. The Ilocos, particularly Ilocos Norte, is emerging as the prime seaport north of Luzon and is expected to boost the development of warehouse industries. This region is an ideal drop-off point for goods for Northern Luzon. Ilocos entry point to the CAR is via the Tagudin and Candon road, which converges at the Cervantes-Mankayan-Abatan loop.

The growth in the Ilocos Region is expected to spill-over into the municipalities of Suyo, Cervantes, and Quirino, Ilocos Sur through the development of logistic support such as trucking. This municipalities are expected to benefit from the development of warehousing and logistics in the Ilocos

Region via the development of secondary industries such as the rise in retail and services like inns and restaurants. The three municipalities are likely to become depots, stop-overs and distribution centers.

The rise of industries in the Ilocos Region had already started since 2008. It is expected to grow further as more infrastructure projects are developed in the region. Situated in the coastal areas, the transport of good through water is logical to serve the landlocked areas of Northern Luzon.

As shown in Figure 3.11 the Quirino-Cervantes-Mankayan-Abatan road will provide the trade route of goods and people. By observation, the stretch of the Quirino-Candon road is wider that can accommodate two trucks as compared to the Cervantes-Suyo-Tagudin road.

The rise in transportation spending has already trickle-down effect on the types of in-situ business that developed in Cervantes, Mankayan and Abatan.

The result from the survey, offers new insight about the impact of improved roads on migration. The improvement of road brings opportunities, for example trading and other logistical support for trading, which increases the opportunities for new work, particularly in the service sectors. The creation of new jobs, which is an indirect impact of having improved roads, decreases the desire to migrate, thus in effect increases the demand for occupied dwellings, for example house or rooms for rent.

Figure 3.11. **Roads & Potential Trade Routes Between Region 1 & CAR**

The pattern of the sources of income intimates growth in the area after the rehabilitation of road. Within the Cervantes-Mankayan-Abaan loop, farming, small trade, small scale mining, employment in the government, mining, service sectors, and overseas.

Farming and small scale mining were old sources of livelihood even during the prewar period. The construction of roads brought the structural changes in the economic, social and political life of the people. During the pre-war and before the rehabilitation of the Cervantes-Mankayan-Abatan loop, there exist trading relationship between Abatan and Mankayan. Before the rehabilitation of the road loop, the main exit and entry of mining companies in Mankayan was through Abatan. Money flowed in Mankayan from salaries and wages of the mine workers which explains the development small trade businesses in Mankayan and Abatan. The pattern of the sources of income in Mankayan showed income from office employment. Mankayan draws trade and employment due to the presence of mining companies. After the rehabilitation of the road, Mankayan is a vibrant melting pot of various economic activities due to migration and employment (See Inset Box 3.3).

Inset Box 3.3
OF MIGRATION, ROAD AND WORK, AND TRADING

Manila-based traders entered already the community, such as the Telecoms and internets, because of the access of easy transportation. There was an increase in merchandise trading. The past 10 years, households witnessed the establishment of mining firms such as Itogon-Suyoc Resource Incorporated, and the exploration of the Far Southeast Resources, Incorporated.

Economic activities follow wherever there is road. It happened in Abatan spanning all the way down to Cervantes. Money economy creates services to support the logistics needed by trading, such as transportation, communication, cargo, banks, and hotels and restaurants. This logistical support created employment opportunities within these areas, and have created even additional supply chains for small traders. The household survey provides measurements on the households average incomes, as shown in Table 3.21, from employment in various economic activities.

Table 3.21. **Average Annual Household Income**

	Earner	Abatan	Mankayan	Cervantes
Farming	HH Head	106,000	129,666	55,253
	Wife	-	154,000	-
	Children	-	300,000	-
Small Trade	HH Head	38,333	58,460	41,400
	Wife	59,200	26,000	-
	Children	360,000	78,500	-
Office Worker	HH Head	-	57,000	210,266
	Wife	100,000	120,000	-
	Children	-	114,000	-
Small Scale Mining	HH Head	-	116,848	-
	Wife	50,000	-	-
	Children	-	-	-
Others (OFW, Skilled Worker)	HH Head	99,583	76,459	92,168
	Wife	50,666	61,776	-
	Children	57,600	66,685	-

The pattern of income indicates growth of the service sectors that mostly supports agriculture and industry activities in the road loop. Money flow and industry development provide leading indicators of potential service sector expansion, logistic supports and transportation locus.

Inset box 3.4
OCCUPATION STATUS PER MUNICIPALITY

Occupation	Abatan	Mankayan	Cervantes
Farming	5	19	62
Small Trade	15	31	16
Office Worker	0	7	13
Mining	0	19	1
Others	*47*	*119*	*122*

The improvement of road opened opportunities, particularly small trading, such as cooking and selling of rice cakes, transportation barkers, extras in driving tricycles or vans, quarrying for sand and collecting stones for the contractors. The job is not permanent, these workers are into everything provided that it generates them income.

3.4.6 Road and Employment

Rural workers are likely to migrate in the cities, leaving behind agricultural activities to older family members or those with lower education. Rural migration to work as OFWs has also exacerbated the already slow growth in the agricultural sector. Women are likely to work in the services sector than men.

Although growth in the agricultural sector is observed, the source of growth can be accounted to: 1) access to techniques and technology, and frequent visits of technicians and even farm input companies; 2) increase in demand for agricultural products powered by purchasing power of consumers from industry and service incomes; 3) expansion of land use; 4) introduction of new high yield varieties; and 5) new interest among young generation and retirees to go back to farming. Even then, agriculture lags behind, despite that it is also the largest source of employment among the household sectors in the rural areas.

Table 3.22. **2016 Employment Data by Sector and Sex**

	Total	Male	Female
CAR (in 000)	**765**	**460**	**306**
Total	100%	100%	100%
Agriculture	43.8%	46.5%	39.8%
Industry	14.2%	21.4%	3.3%
Services	42.0%	32.2%	56.9%
Ilocos Region (in 000)	**1,988**	**1,256**	**731**
Total	**100.0%**	**100.0%**	**100.0%**
Agriculture	30.0%	36.0%	19.7%
Industry	16.1%	21.3%	7.0%
Services	53.9%	42.7%	73.2%

Source: Regional Outlook 2016, PSA

An in-depth understanding of the relative decline in agriculture output can be explained by structural changes. Structural changes such as infrastructure spending and development and industrialization will shift employment patterns from agriculture to industry and/or agriculture to service sectors. These observed changes in employment patterns are theoretically predicted by the stages of growth and development. Table 3.22 shows empirical evidence of the structural changes in both regions. The largest employment feeder was the service sectors.

Inset Box 3.4 reflects the regional data through a typology of the occupational status of the households. Households are employed in multiple sectors. Every able body works. The construction boom along the Cervantes-Mankayan-Abatan loop created temporary jobs in the quarrying, logistics, and service sectors. Subsistence agricultural production became valuable and are sold for cash. Before the road construction, subsistence crops were grown for household consumption.

Mankayan is known as a mining town, yet the occupation status shows that household are more engaged in small trade and multiple occupations, than small scale mining. Small scale mining is largely found in the in the now closed Suyoc Mines. Most households finance small scale mining and are engaged in gold trading. These household usually enter into labor supply agreements with migrant workers from the Cordilleras.

A focus on 'other type of employment' reflected how the rehabilitation of the road changed the pattern of employment. The data shows that there are hardly any households that rely on farming, trading or mining as their sole source of income. This is indicated by the high response count on "Others" as the more realistic definition of the household's employment *after* the infrastructure development in their areas. The disaggregated data of the service sector in section 3.3.5 shows the following patterns of growth in the service sectors: CAR, *occupied dwellings, trade and transport*; and in Region 1 the pattern was *transportation, trade and government services*. These changes in the usual employment before the rehabilitation of the road translated into how the households described their present types of occupation and sources of employment after the rehabilitation of the Cervantes-Mankayan-Abatan road.

Mining companies at the regional level have experienced a major drawback, due to falling metal prices during the late '90's and in recent years, environmental concerns. Mining, black sand and gold, lags behind. Previous experience from black sand mining had a major impact on household's acquiescence due to its environmental impact on the shore lines of regions' beaches. There is also a strong opposition to any mining exploration in the Ilocos Region, Cervantes in particular having learned much of the impact of mining from the siltation of its river, loss of income from fishing and farming due to the contamination of water due to mining activities. The redirection of water tributaries affected also their water supply. Either they have shortage during the dry season or too many during the rainy season which overflows into the low lying areas.

4.4.7 Road and Tourism

In Region 1, the services sector was the major employer owing to its large retail and trade sector and the boom of heritage and resort tourism. Despite this though, tourist arrivals remains to be higher in CAR, but it is notable that tourist arrivals in Region 1 started to rise faster between 2009 up to 2013 as shown by Figure 3.12. It was also during those years that tourist arrivals started to taper in CAR and for years (2011-2012) experienced a slump in tourist arrivals, while arrivals continued to rise in Region 1. While both regions showed a rise and fall in tourist arrivals, Region 1 was able to sustain the interest of tourist as shown by a stable rise of tourist.

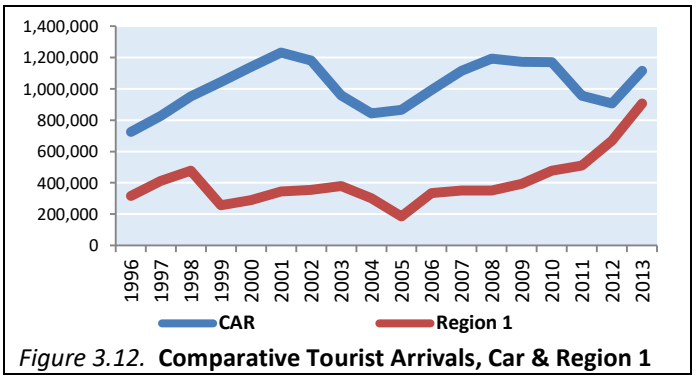


Figure 3.12. **Comparative Tourist Arrivals, Car & Region 1**

When roads are in bad condition, tourism is not necessarily a major driver of income, but when roads are in good condition, tourism becomes a major driver of economic development as indicated by an

increase of tourism oriented and related establishments, and the changing pattern of households sources of income, employment and livelihood activities.

Tourism is a complement good that tends to rise with better roads. The Cervantes-Mankayan-Abatan loop is expected to draw tourism interest on historical monument, scenic natural landscapes, heritage and culture, and agritourism. Roads will define tourism flow from Region 1 via Cervantes which has a direct tourism route to Sagada via the Aluling bridge. This tourism route does pass by the Mankayan and Abatan loop.

This observed pattern in the tourism route is observed in the results of the household survey. Tourism oriented enterprises, such as hostels, remains very few. Tourism related establishments such as dry goods stores and trading are still very few and mostly catering to product distributors, speculators, industry visitors, than tourists.

Table 3.23. **Types of Trading and Services Enterprises**

Types of Trading	Abatan		Mankayan		Cervantes	
	Total	%	Total	%	Total	%
Tourist Oriented Services	4	*10%*	1	*1%*	4	*3%*
Small Dry Goods Stores	6	*15%*	5	*4%*	16	*13%*
Trading	10	*26%*	13	*11%*	4	*3%*

Tourism is an after fact of the road development, instead of an ex-ante demand. This means, road lead to the discovery and eventual marketing of scenic views. There are natural endowments to the areas (i.e Cervantes-Tagudin-Suyo route) which were hardly noticed as tourist attractions as these are not destinations that are purposely travelled but are scenic views that makes travelling to the destination of purpose more pleasurable. Travelers take brief stops to appreciate the magnificent mountain formations or rugged terrains of the highlands, which provides a respite to the long journey before reaching major tourist destinations.

With more and more improvement of roads, and development of alternative routes to reach tourism destination, stop-over such as hotels and inns may hardly develop in these areas unless a major tourist attraction is developed to let the tourists spend two to three nights that will make the trip worthwhile. Some households operate restaurants and inns for tourist who cannot make the long travel to Sagada, Banaue, or Bessang Pass, or those who miss their trips from Baguio. These tourists would usually sleep in Abatan and continue their trips the next day.

3.4.8 Road and Poverty Reduction

As the region experience growth, poverty tends to move inversely with infrastructure spending. Poverty incidence and the magnitude of poor families generally declined over time. In the case of the provinces of Benguet and Ilocos Sur, the largest decline in poverty incidence was observed in 2003 as shown in Table 3.24. This is true for both provinces.

Table 3.24. **Poverty Scenario in Benguet & Ilocos Sur**

Year	Benguet			Ilocos Sur		
	Poverty Incidence of Families	Magnitude of Poor Families	Per Capita Poverty Threshold	Poverty Incidence of Families	Magnitude of Poor Families	Per Capita Poverty Threshold
1997	18.9	21,054	11,788	28.7	35,595	11,046
2000	14.1	17,992	14,185	30.6	35,367	13,455
2003	4.4	5,386	10,727	19.9	24,727	11,893
2006	4	5,773	13,341	16.4	22,174	14,836
2009	4.2	6,937	16,217	13.4	19,256	18,610
2012	2.8	5,121	19,140	13.7	20,886	20,885

Source: Annual Poverty Incidence Survey 2015, PSA

One of the reasons on the decrease of poverty incidence of families can be increased government spending on services and road development and rehabilitation. Roads provide connectivity to economic opportunities, particularly the agricultural sector. At the household level, for instance, surplus crops which were intended for household consumption are sold in the market

Table 3.25 shows the general types of crops grown in the three municipalities. For example roots and tubers (with the exemption of potatoes in the case of Abatan) were produced mainly for household consumption. These are not propagated on large scale but meant to tidy up household consumptions. Key informants from Cervantes provide validation on this observation, narrating that fruits and rice were rarely traded before the rehabilitation of the road. These products are heavy and can be hardly brought to the market unless there are available transportations. With better roads, fruits and rice are among the heavily traded agricultural products of Cervantes.

Table 3.25. **Average Production per Farm in Abatan, Mankayan and Cervantes**

Place/ Type of Produce	Ave. Total Production (kg)			Ave. Gross Sales (Php)			Ave Transport Cost (Php)		
	1st Cropping	2nd Cropping	3rd Cropping	1st Cropping	2nd Cropping	3rd Cropping	1st Cropping	2nd Cropping	3rd Cropping
ABATAN (Average Farm size 1000 sq. meters)									
Vegetables	13,338	200		55,000	6,000		1,250	1,000	
Root & Tubers	-	2,000		-	77,500		-	1,750	
Others	800	-		45,000	-		1,000	-	
CERVANTES (Average Farm size 6,929sq. meters)									
Fruits	1,000	-		50,000	-		-	-	
Root & Tubers	-	-		9,800	-		-	-	
Rice	1,695	1,714		23,005	19,541		214	231	
MANKAYAN (Average Farm size 1,323 sq. meters)									
Fruits	-	80	30	-	2,000	9,000	-	-	720
Vegetables	3,079	2,769	377	20,333	25,500	19,833	4,620	33,600	720
Root & Tubers	800	3,500	-	14,000	-	-	4,500	6,000	-

In Mankayan, a barangay official saw the importance of the road in terms of the expansion of agricultural production. Migration of labor supply for small scale mining, the vibrant business in Abatan and increase in transportation are among the drivers of agricultural production. Crops like pechay, which used to be produced in small volume for household consumption, are now traded within the three areas. Other vegetables such as snap beans and new varieties of lettuce are sold in mostly in Baguio. He concluded that all year round, money flow in the households. *Life is still difficult, but it had become better, he said*

Roads hastened the growth in the agricultural sector in terms of increase in the number of crops traded in the market. This provided a steady flow of income to the households, which provided an empirical evidence of the declining poverty incidence in both provinces.

3.4.9 Road Development and Migration

Road also accelerates migration. The source for migration could be employment, investment, and better environment. Figure 3.13 shows the pattern of population changes in the three municipalities. From 1990 up to 2000, Mankayan was highly populated than Buguias and Cervantes. Mankayan was mostly populated by migrants due to the mining industry and growth of retail trade. The population of

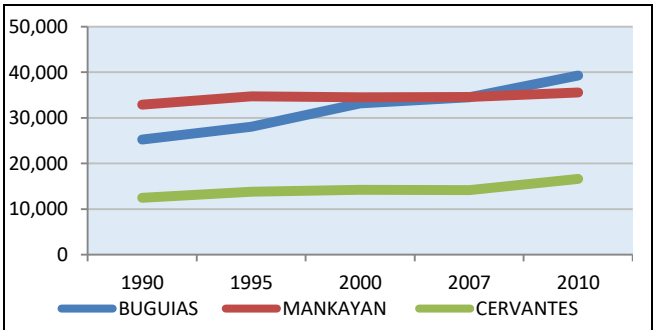


Figure 3.13. **Population Per Municipality**

Cervantes hardly grew over time. This is an indicator that population growth is most likely associated with birth rather than immigration. In contrast, population continues to rise in Buguias. The population increase in Buguias can be associated with the development of both Halsema and the Cervantes-Mankayan-Abatan road. Abatan, Buguias is at the cross roads of Benguet, Mountain Province and the Ilocos Region. It had become a melting pot for all types of trade.

Along with the improvement of roads, the insights from the focus group discussion supports the recollection from the key informants. Electricity, and communication and technology made the once laid back municipalities a bustling trading and stop-over hubs for travellers and merchants.

Employment and economic opportunities are drivers of migration. Road, no matter its state, hastens migration. Table 3.26 indicates that Mankayan and Cervantes had experience a surge in migration due to the improvement of the road. Mankayan had a long history of migration due to the mining companies. Cervantes increase in migration is largely due to economic opportunities given its vast lands, and at the moment its strategic location. It connects Cordillera and the Ilocos region.

Table 3.26. **Migration Factors**

Migration drivers	Abatan		Mankayan		Cervantes	
	N	%	N	%	N	%
Employment & economic opportunities	6	*20.0*	52	*43.53*	46	*38.33*
Better road	0	*0.00*	1	*0.83*	19	*15.83*
Others	1	*2.50*	2	*1.67*	1	*0.83*

Economic opportunities, powered by investments from financial and service sectors provide support to the agriculture and emerging tourism industry of Cervantes. Account from the focus group discussion indicated mass migration of people from Cavite. The migrants are not prospecting for employment, but they ring economic opportunities to the community by putting up a soap factory. Better roads funneled migration in Cervantes as compared to Abatan and Mankayan.

Migration increased in different forms which are described by the participants and key informants as follows:

> ***Increase in trading in Abatan raised the labor demnd for the service sectors.*** Most migrants are lowlanders working in restaurants, sash and iron works, automotive, and travelling merchants who settled in Abatan. A migrant worker who works in one of the most established hardwares in Abatan shared that they were recruited by the owner who is from Pangasinan. All his workers are from Pangasinan. They have established residence in Abatan but still go home to their provinces. With good roads, travel is fast and it is easy for them to go home anytime of the year, or their relatives can visit them too.
>
> The changing pattern of industry in Abatan changed also farm arrangements. Farming families who benefitted from the high demand of temperate vegetables, improved roads, powered by money in-flows from remittances abroad, established their businesses, lease their farms to labor suppliers and enter into profit sharing arrangements. This contributed to migration, mostly coming from Kibungan, Kabayan, Ifugao and even La Union.
>
> ***Small scale mining, employment, and increase demand for transportation services increase migration in Mankayan.*** There is a marked increased of migrants from Kalinga and Ifugao since the early '90s. In the early '50s up to the '80s the migrants were mostly from Pangasinan and the Mt. Provinces. Migrants come to Mankayan as workers and speculators of the boom of the small scale mining, particularly in Suyoc.[7]

[7] Suyoc used to be an old mining site. The mining site is now closed (abandoned) and had been taken over by speculators, financiers, and workers of the boom of the small scale mining.

Makeshift and temporary shacks made of GI sheets crowd in limited spaces which are always within the mine portal periphery. The old housing units of Suyoc mines are occuppied by migrant workers. The road is heavily travelled by all weather trucks mostly financiers and/or owners of the portals. In contrast agriculture remains to be unfettered by migrant workers as compared to mining. Labor supply remains to be supplied within the areas.

Booming trade and emerging tourism encourage migration in Cervantes. Migrants come mostly from Abatan, Suyo, Quirino, and the Mt. Province. Most migrants are enticed by the booming trade and emerging tourism in Cervantes. Migrants have acquired properties to operate their business, speculate a mining boom, and to farm and settle for good in Cervantes.

A migrant interviewed consider Cervantes as an ideal place to migrate with its wide plains, knolls, and abundant water. Besides, they trace many relatives who used to reside in the Mt. Province, such as Bauko and Tadian. The key respondent also shared that there is also a mass migration of a religious group that brought with them a soap-making industry, but mostly work in the small factory and is contained among the members.

3.5. Impact of the Road on Social Welfare and Development

3.5.1. Impact of the Road on Access to Health Services

Barangay health stations, some private clinics and a health personnel are the nearest that households can go for check-up. They can walk, or ride going to these health facilities. The improvement of the road have made all types of transportation available anytime for households when they visit these clinics or bring their patients for check-up.

The common reasons household visit a barangay health station is for pre- and post-natal, maternal and child check-up and the common flue. Some households also go to the barangay health stations, clinics or to a health personnel for routine check-up of their blood pressure, and/or get a prescription for their medicines, or get free medicines.

Many households in rural areas live more than two kilometers and have to walk for over thirty minutes to reach the nearest health facility, or in some instances this is how long it takes a health personnel to reach the community, if the health personnel does not live within the community. Table 3.27 shows the average distance of the various health facilities to the households.

Table 3.27. **Average Distance of Health Centers from Households**

	Abatan	Mankayan	Cervantes
Average Distance (Km)			
Barangay Health Station	.37	1.06	.34
Clinic	1.29	2.31	75.94
Hospital	5.08	33.35	272.60
Health Personnel	.05	4.92	46.34
Ave. minutes it takes when walking			
Barangay Health Station	10.10	13.99	8.92
Clinic	12.80	12.04	22.77
Hospital	12.69	-	-
Health Personnel	8.33	13.85	21.17

The Lutheran Hospital in Abatan and the Luis Hora Hospital in Bauko, Mt. Province, had always been mentioned (by the respondents, the discussants and the key informants), as the nearest hospital that they can bring a sick person, aside from the usual health centers in the barangays. But those from remote barangays travel farther (but they cannot walk the distance) than those in Abatan and Mankayan. With roads these hospitals can be accessed at the shortest time possible with any type of transportation.

Table 3.28 shows the average travel time going to the health facilities. The availability of at least motorcycles and tricycles in all barangays provides a clear impact of the development of road in these

communities access to health. The alternative means to access health facilities will be only through walking in the absence of road development in these rural areas. To the households, roads made access to health facilities easier and cheaper. It is cheaper in a sense that they save more time that can be re-allocated to economic activities. It discourages households to visit health facilities when they have to walk. The development of road encourages investment on transportation services, providing household the means to access health facilities at the shortest possible time.

Table 28. **Average Travel Time and Cost of Travel Going to Health Facilities**

Health Facility	Average travel time (minutes)					Average cost of travel (Php)				
	Bus	Minivan/ Van	Private Transport	Motor/ Tricycle	Others	Bus	Minivan/ Van	Private Transport	Motor/ Tricycle	Others
Abatan										
Bgy Health Station	0	0	0	4.60	0	-	-	-	15.00	-
Clinic	0	0	0	5.60	10	-	-	-	17.14	18.00
Hospital	30	7	0	7.31	25	30.00	20.00	20.00	16.84	32.67
Health Personnel	0	0	0	7.31	0	-	-	-	13.13	-
Mankayan										
Bgy Health Station	0	0	3.5	12.14	13.56	-	-	10.00	18.00	12.27
Clinic	32.5	11.5	15.00	17.59	20.31	43.33	15.00	255.00	32.27	16.18
Hospital	81.54	95.64	30.00	52.13	47.00	45.83	99.00	330.00	126.29	45.33
Health Personnel	25.00	30.00	37.00	28.50	13.75	10.00	10.00	255.00	39.55	14.38
Cervantes										
Bgy Health Station	0	0	3	4.67	3	-	-	67.5	18.29	100.00
Clinic	15	0	5	12.76	3	-	-	40.00	36.73	-
Hospital	12.5	150	5.11	14.29	3	-	200.00	40.0	33.78	50.00
Health Personnel	15	0	3	16.25	3	-	200.00	60.00	47.44	0.00

As to transportation cost, households generally do not find the transportation cost expensive. This considers that they are valuing the opportunity cost of time that is lost in the absence of transportation due to bad roads. Randomly chosen respondent are happy that they can walk and ride on good roads. With better roads, the visits to the health facilities had become better, with most of the households visiting any of these health facilities at least once a month or every other month.

Household inability to visit health facilities, particularly hospital or private clinics, is not due to bad roads but they cannot afford the fees. When services and medicines are free, households are wont to visit health facilities because they would rather work than avail of the services. With better roads, health personnel (i.e. Barangay Health Workers) can visit as many households. Better roads had made walking relatively easier and faster.

3.5.3. Impact of the Road on Access to Education

Table 3.29 shows that day care centers, elementary and high school are near and can be reached by walking at an average of six to 30 minutes. While some walk others still take a tricycle or jeepney to go to school. Households who have day care and elementary children usually hire tricycles to fetch their children. This saves them time bringing and fetching their children to school.

Table 3.29. **Average Distance from Households to schools**

Level	Average distance (km)			Average minutes it takes when walking			Average minutes it takes when riding		
	Abatan	Mankayan	Cervantes	Abatan	Mankayan	Cervantes	Abatan	Mankayan	Cervantes
Daycare Center	2	10.44	.82	0	11.31	6.38	0	5	3.86
Elementary School	.14	.82	.80	14.67	18.3	8.57	6.33	7.05	7.81
High School	.11	2.49	2.01	16.25	30.67	19.46	7.50	12.22	15.44
College	80	77.25	2.13	0	0	38	2.50	202.50	109.09

Table 3.30 shows that the mode of transportation going to school are the jeepneys and tricycles. Some households who have their own transportation bring their children to school. The usual fare would range from less than ten pesos to about 30 pesos.

Table 3.30. **Mode of Services Going to School**

Mode of Service	Abatan		Mankayan		Cervantes	
	Freq	%	Freq	%	Freq	%
Regular PUJ	1	2.50	8	5.9	5	4.2
Own Vehicle	1	2.5	6	5.0	28	23.3
Others (tricyle)	10	25.0	32	26.7	56	46.2
Ave. Fare for PUJ	**Php 32.50**		**Php 14.50**		**Php 9.50**	

Majority of the households agree that the improved road made it easier for the children to go to school. Discussants from the focus group discussion remember too well how difficult it was to go to school when the roads were muddy and slippery during the rainy season. How they would wake up early just to start walking from their home to school. The road cannot be anymore a reason why children cannot go to school. Sick or plain lazy is the most cited reason why children cannot go to school.

3.5.4. Impact of the Road on Housing and Access to Water and Electricity

One of the immediate impacts of road can be observed on the changes in houses. The development of road increases household income, which are spent on the construction, improvement and extension of the house.

With cash flows easing their way to the household through trade and job opportunities, households are more likely to renovate or build a new house. Transporting materials have become relatively easier and cheaper than when they started constructing their house in the early 1990's. This can be seen in Table 3.31. The respondents said the cost of transporting is almost the same today, but then before hey have not that much money, and money has more value before due to lower prices, but today despite the increase in prices, and with more money, the prices are almost the same. The improvement of the road made travel time shorter and even cheaper.

Table 3.31. **Transport Cost of Housing Materials With Improved Road & Before Improvement of the Road**

Method of Transporting	Abatan		Mankayan		Cervantes	
	Average Time (Hrs)	Average Expenditure (In Php)	Average Time (Hrs)	Average Expenditure (In Php)	Average Time (Hrs)	Average Expenditure (In Php)
With the improved road (2017)						
Delivery Truck	0	0.00	1.23	816.40	.93	619.59
Hired Transportation	1	115.00	1.94	1,464.05	2.87	2,190.00
Bus	0	0.00	2.02	311.43	5.33	273.33
Own Vehicle	3	500.00	1.43	557.14	2.74	610.83
Before the improvement of the road (1990's)						
Delivery Truck	1	300.00	2.25	696.88	1.67	549.80
Hired Transportation	1.72	253.33	4.03	944.29	4.75	1,404.00
Bus	0	0.00	1.50	232.00	6.67	63.50
Own Vehicle	0	0.00	1.92	640.00	4.32	791.25

Transportation made the cost of transporting materials cheaper and faster. The current state of houses in the Cervantes-Mankayan-Abatan manifest these observations. While houses are old, there are houses renovating and constructing new houses.

Table 3.32. **Current State of the Houses of the Respondents**

Type	Abatan		Mankayan		Cervantes	
	N	*%*	N	*%*	N	*%*
New	8	*20.0*	23	*19.2*	22	*18.3*
Old	*25*	*62.5*	*62*	*51.7*	*71*	*59.2*
Renovated and Extended	3	*7.5*	32	*26.7*	26	*21.7*
Others	4	*10.0*	3	*2.15*	1	*.8*
TOTAL	40	*100.0*	120	*100.0*	120	*100.0*

Many of these houses are sometimes unfinished and are still in the middle of construction. A typical house of these types always show that there is an intent to build a second floor or an extension. The improvement of the road resulted also to consruction boom. Households who can transport cement are now building their houses or extension of their houses using cement instead of wood and GI sheets. This can be validated in Table 3.32.

The materials used in constructing a house is an indirect impact of the importance of road. Mankayan and Cervantes transported construction materials more often than those from Abatan. The results from the survey show that more than 50 percent from Mankayan (57.5%) and Cervantes (66.7%) used the road to transport materials through the Abatan-Mankayan-Cervantes road. In Abatan, only 20 percent transported contruction materials trhough the same road. Households from Abatan would expectedly travel through the Halsema road to buy construction materials for their houses.

The improvement of the road resulted also to construction boom. Households who can transport cement are now building their houses or extension of their houses using cement instead of wood and GI sheets.

The prototypes of houses after the rehabilittion of the road resulted to better materials used for housing. As shown in Table 3.33, GI sheets, which was a dominant material for building houses, is the least preferred material for housing now. More and more households use cement to build their houses. The survey revealed that many of these houses are sometimes unfinished and are still in the middle of construction. A typical house of these types always show that there is an intent to build a second floor or an extension.

Table 3.33. **Type of House**

Major material used	Abatan		Mankayan		Cervantes	
	N	%	N	%	N	%
Wood	0	0.0	3	2.5	1	.8
Cement/ Concrete	4	10.0	6	5.0	27	22.5
GI SHEETS	1	2.5	0	0.0	2	1.7
Combined Wood & Concrete	1	2.5	14	11.7	22	18.3
Combined Cement/ GI Sheets	*10*	*25.0*	*29*	*24.2*	*32*	*26.7*
Combined Wood, Cement & GI	*13*	*32.5*	*43*	*35.8*	*33*	*27.5*
Combination of Wood & GI Sheets	11	27.5	25	20.8	3	2.5
TOTAL	40	100	120	100	120	100

Majority of the respondents have been living in their own house, as shown in Table 3.34, between 18 to 25 years. This implies that the types of houses have been built in the early to the late nineties. While it is observed that most households own the house, at least one third of the respondents in Abatan rent the house (35%), while in Mankayan they live in the house for free (30%).

Table 3.34. **House Ownership**

Type of Ownership	Abatan		Mankayan		Cervantes	
	N	%	N	%	N	%
Own the House	20	50	65	54	98	82
Rent the House	14	35	19	16	6	5
Occupy the House for Free	6	15	36	30	16	13
Total	40	100	120	100	120	100
Ave. years living in the house	25		22		18	

It is now easier for houses to get connected been easier because of the good roads. All barangays within the road ZOI are 100 percent energized.

In terms of access to water, improved road made it easier for the households to access water. Table 3.35 shows the different sources of water. Despite tubed/piped in water from the source, not all

households are connected. Households still walk to fetch water from the source, but some also ride to fetch water. Fetching water is made easier with the improved roads. It makes walking easier, they can even ride to fetch water. Most respondents said it was easier to access water with improve road.

In some areas where water can become difficult, the household fetch water to nearby rivers or spring or they have to buy delivered water. These are changes that took place with a much improve road. While the road cannot solve the problem on water, it can at lease ease the burden of fetching and carrying water from the source to the house.

Table 3.35. **Source of Water**

Source of Water	Abatan		Mankayan		Cervantes	
	N	%	N	%	N	%
Tubed/ Piped from Source	33	82.5	111	92.5	91	75.8
Communal Water Source	0	0.0	1	.8	25	20.8
Pump from the Source	0	0.0	3	2.5	2	1.7
Others	4	10.0	2	1.7	1	.8
Combination (1,3)	1	2.5	0	0.0	0	0.0
Combination (1,4)	2	5.0	3	2.5	0	0.0

With access to cleaner water only few of the households responded that they have been ill of water-borne disease. Of the three municipalities, majority of the respondents from Abatan and Mankayan noted that there was a change in the quality of their potable water. Only about one third of the households in Cervantes noted changes in the quality of their water.

Table 4.36. **Usage of the Abatan-Mankayan-Cervantes Road in terms of Access to Water**

	Abatan		Mankayan		Cervantes	
	N	*%*	N	*%*	N	*%*
Fetch Water	0	*0.0*	8	*6.67*	6	*5.0*
Buy Water/Water Delivery	3	*7.5*	4	*3.33*	4	*3.3*
Both	0	*0.0*	10	*8.33*	6	*5.0*

3.5.5. Impact of the Road on Peace and Security

Physically isolated and inaccessible areas can become perfect refuge for rebel groups operating in the province. However, the development and improvement of road may have also made civilians vulnerable to breach of security. For example, on June 2017, during the household survey, equipment of a mining company and the newly constructed police station between Cervantes and Mankayan had been bombed.

The development of Cervantes-Mankayan-Abatan road made escape routes faster according to a key informant, but on one hand, it had become faster also for military to respond to the incident. Improve road network may connect conflict areas with the rest of the community. With a road access, communities become accessible to government services, which may discourage people from being waylaid to join extreme advocacy groups.

3.6. Impact of the Road on Selected Indicators: With and Without Analysis

3.6.1 The Propensity Score Use and Analysis

The procedure used in the study followed the fourth propensity score method suggested by Austin (2011). “The fourth propensity score method is covariate adjustment using the propensity score”. The propensity score is a covariate[8] variable that is possibly predictive of the outcome under the study, which in this case, the outcome of having a road as observed in the increase in income, decrease travel

[8] In statistics a covariate is a variable that is possibly predictive of the outcome under study. A covariate may be of direct interest or it may be a confounding or interacting variable. The alternative terms explanatory variable, independent variable, or predictor are used in regression analysis.

time to social facilities such as health stations and schools. Of the four propensity score methods, this is the only one that requires that a regression model relating the outcome to treatment status and a covariate (the propensity score) be specified (Austin, 2011).

Table 3.37 shows the predicted changes in the proportions of those within the Cervantes-Mankayan-Abatan road and those not within the road. It shows the predicted changes in the classification of households given the predictors of who are more likely to have the characteristics of one residing within the road. Without the predictors, there are 133 respondents currently within the road, and 66 not within the road. The count shows that 67 percent are within the road. The table also shows that 66 respondents should be within the group given the observed characteristics of those households within the road.

Table 3.37. **Predicted Changes in Classification, Logistic Regression Model**

Observed	Predicted		%age correct	Predicted		%age correct
	Within	Not within		Within	Not within	
Within the road (Treatment)	133	0	100	129	4	97.1
Not within the road (Control)	66	0	0	64	4	6.1
Overall percentage correct			66.8			66.8

After running the logit regression those households who are not within the Cervantes-Mankayan-Abatan road manifest the same observed behavior as that of those within the road. Only four or six percent manifest characteristics of not being on the road. On the other hand, only four does not manifest characteristics of not within the road. The predicted value does not change. This means that there is no difference in the observe characteristics of those within the road and those who are not within the road.

Table 3.38 shows that family size decreases the probability that a household is likely to live within the Cervantes-Mankayan-Abatan road, while households with younger family heads are likely to be observed to live within the road. The rest of the chosen variables are not significant.

Table 3.38. **Results from the Logistic Model**

Variables	B	Standard error	Significance
Family size	-.599	.317	.059*
Age(1)	1.117	.602	.0.64*
Age(2)	.644	.490	.189
Years of schooling (1)	.562	.473	.235
Years of schooling (2)	.147	.349	.673
Gender (1)	.046	.316	.884
****significant at 0.01, **significant at 0.05, *significant at 0.10*			

The logistic model generates the propensity score to adjust for confounding covariates. The study is interested in investigating the impact of the Cervantes-Mankayan-Abatan road thus the removal of confounding variable is necessary, particularly that the study is unable to collect experimental data (Li, 2012).

The study has no baseline data to compare the conditions of the households without the road and with the road. The impact had been simulated using econometric models and propensity scores to analyze for the counterfactual. While the results are logical and the signs of the coefficients are economically significant, the results though are not statistically significant.

This concern is of academic relevance, but for practical use, one may take a look at what Sneed (no date) said on this matter: *"Analyzing and verifying economic significance would insure that when an economist makes a claim about potential relationship it is only mathematically founded, but the validity of the relationship is present in both a mathematical and applied real-world manner."* Therefore the study did not fail to deliver what is expected from a road project.

Nevertheless, if only to emphasize again, the result of the survey shows there was a road impact on the households both from a narrative to quantitative analysis.

Lastly, the results of the Difference in Difference (DID) and the Double Difference in Difference (DDID) provide symptoms on the timeliness of impact evaluation. The study had been conducted, after more than 10 years. The massive infrastructure development during those years may make it difficult to isolate for the respondents to isolate the impact of the Cervantes-Mankayan-Abatan road from that of other road improvements.

3.6.2 Weighing the Impact of the Road Project on Selected Socio-economic Indicators

The outcomes chosen are continuous variable, such as income, time spent travelling to a health facility and to school. Hence a linear model is chosen and estimated using ordinary least squares (OLS). The coefficients have been scaled to standardized coefficients to determine which of the covariates have a larger effect on the response.

Table 3.39. **The Impact of the Abatan-Mankayan-Cervantes Road on Income, Health & Schooling**

Variables in the equation	The impact of the Abatan-Mankayan-Cervantes Road on					
	Income		Health		Schooling	
	Standardized Coefficient	Sig.	Standardized Coefficient	Sig.	Standardized Coefficient	Sig.
Within the Cervantes-Mankayan-Abatan Road	-.040 (-.484)	0.629	-.133 (-1.960)	.052*	-.039 (-.400)	.690
Occupation	0.95 (1.212)	0.227	.062 (.936)	.350	.074 (.783)	.435
Total Income			-.039 (-.602)	.548	.003 (.030)	.976
Propensity Score indicator (Counterfactual)	-.056 .(.691)	0.491	-.055 (-.826)	.410	.090 (.946)	.346
Abatan	0.25 (.290)	0.772	-.426 (-6.028)	.000***	-.077 (-.741)	.460
Cervantes	0.69 (.843)	0.400	-.454 (-6.610)	.000***	.030 (.296)	.767
Coefficient of correlation and variation	R .124	R-square .015	R .519	R-square .270	R .151	R-square .023

****significant at 0.01, ** significant at 0.05, *significant at 0.10*

The Income Model. The variables that have the largest effect on income is occupation. If the household head has an occupation, the income will vary by 0.95 from the mean. If the mean income for example is Php10,796 (see Table 3.40), the income between those who have occupation and those who have not will vary only by 0.95 which is negligible. While this is expected, and logical, the results from the cross section survey indicate that the type of occupation that households have, directly explains the rise in their income.

The second with the largest effect on income is the area of residence or municipality. If the household is located in Cervantes, the household income will vary by 0.69 from that of Abatan and Mankayan. Also the standard deviation is relatively immaterial.

The least that contributes to household income is the propensity score for the counterfactual variables. Lastly, households who are along the Cervantes-Mankayan-Abatan road have less income than those who are not within the road. The variations are however immaterial.

Given these observations, *the chosen covariates are not significant predictors of changes in income.* This is confirmed by a very low coefficient of variation which is only 1.5 percent. This means the covariates explains only 1.5 percent of the variation of the household's income.

The Health Model. The estimates on the health model shows that those within the Cervantes-Mankayan-Abatan road spends less travel time to the health facilities than those who are not within the road. The variation in time travel is less by 0.133 than those who are not within the road. *This implies that with a road, travel time to access health services becomes shorter. The result shows that road significantly affects travel time, by saving more time to go to the clinic due to better roads.*

The areas of Abatan and Cervantes show that they have shorter travel time going to the hospital than compared to Mankayan. The location of the household along the road vein significantly decreases travel time. Mankayan's access to health is a different matter among the three areas. Along the ZOI in Mankayan, most of these areas are within the mining operation which has a health facility, yet it is not accessible to households who are not company workers. A household for example who is just 500 meters away from the hospital, may have to travel to the nearest barangay health station which is about one or two kilometers away, or in cases of emergency, they have to bring their patient to Abatan or Baguio City, rather than the company hospital.

To further explain this observation, of the 13 barangays of Mankayan, almost 60 percent of these are within the operation of the mining company. Roads traversing these barangays are through the mining company. Access roads to the barangays takes a longer route as these are peripheral roads or roads outside of the mining company. The settlements in Mankayan had become more dispersed from the health facilities as they may have to take the longer route because they cannot pass through the mining concessions.

The rest of the covariates are not significant. The table shows further that the coefficient of determination R which is 0.519 imply that there is a correlation between travel to the hospital and all the covariates. The coefficient of variation 27 percent variation on travel time is predicted by the significant covariates.

The Education Model. The results are not statistically significant in this model, but the impact behavior expected from this model is logically correct. For example those who are within the Cervantes-Mankayan-Abatan road spends less travel time going to school. If households have occupation and earn income from it, they will most likely send their children to school, hence they will travel more often to school than those with no occupation and lower income. The correction is very low and the coefficient of variation is also very low. This implies that variables chosen are not sufficient to explain why time in school varies.

The coefficient of correlation, 15.1 percent, indicates a low correction between education and chosen predictors. Using the R-square to summarize the result of the regression model, the value means that only 2.3 percent on the variation of the time travelling going to school can be explained by the chosen predictors.

Of the three models, the best predictor of the impact of road is the health model. Households along the road have more access to the health facilities due to the Cervantes-Mankayan-Abatan road, than those who are not within the road. This implies that the weight of impact is felt more in the improvement of access to health than income and education. The result makes sense and is logical. In the absence of improved road, among the social services that household will wish for, health would be the last priority among households, this may explain the result of the standardized coefficients.

3.6.3. Changes in Household Income and Accessibility to Health and Education Services Because of the Road Project

To measure the predicted impact of road to income, health and schooling, Table 3.40 is interpreted and analyzed. The propensity score is interpreted as the counterfactual variable. The score is used to represent at observe phenomena on the impact of the road among households. The relevant counterfactual condition is: *If they have not been beneficiaries of the road, what would have happened to them in terms of their access to health, schooling and opportunity to earn more income.* The unstandardized coefficients provides a practical measurement of the impact of the improved A Cervantes-Mankayan-Abatan road in terms of income and travel time spent or saved in accessing social services such as health and education.

Table 3.40. **The Impact of the Abatan-Mankayan-Cervantes (in unstandardized coefficients)**

Variables in the equation	The Impact of the road on		
	Income (Php)	Health (Travel time)	Schooling (Travel time)
Constant	130,190.27	103.46	-4.60
Within the Cervantes-Mankayan-Abatan road	-15,487.62	-15.78*	4.93
Occupation	10,795.54	2.12	2.70
Total Income	-	-.000	.001
Propensity Score (Counterfactual indicator)	-113.033	-33.90	63.15
Abatan	14,441.84	-72.90***	-14.27
Cervantes	26,016.48	-51.59***	3.55
Standard error of the estimate	189,274.093	48.982	61.123
Predicted value	165,843.48	-68.59	55.46

****significant at 0.01, ** significant at 0.05, significant at 0.10*

The Standard error of the Regression (Se) shows that the average distance from the predicted values (fitted line) of the model are quite distant. This means that there are other variables that can explain the behavior of the variables of interest as a basis of evaluating the impact of the road, other than those that were identified. The Se provides a validation to the R- squared. This implies that the model may not predict correctly. However, the result of the regression models are interpreted based on its economic and conceptual relevance rather than on its statistical significance[9].

Change in Household Income. To have a clearer understanding of the impact of road per area, the values in the tables are translated into equations as follow:

$$\text{Income (Mankayan)} = 130{,}190.27 - 15{,}487.62\text{AMC} + 10{,}795.54\,\text{Occupation} - 113.033\text{PS} \quad \textit{(eq.1)}$$

Controlling for the socio-economic variables, the average income of households in Mankayan is Php130,190.27. Households residing along the Cervantes-Mankayan-Abatan road has lower income by about Php15,487.62. However, this loss in income for not being located along the road compensated by earning more Php10,795.54 for various occupation. The equation also means that households who are not within the road have Php15,487.62 more income, but may have less opportunity to earn income from various occupation, such as small trading and seasonal employment from construction.

[9] (1) Economic researchers distinguish between economic and statistical significance. The reason that the chosen models may have negligible systematic deviations between the data and the model is not because the chosen variables are not correct. As roads are evaluated based on the variables chosen, the model remains true and not false on pretense that the coefficients are not statistically significant (Engsted, 2008). (2) Analyzing and verifying economic significance would insure that when an economist makes a claim about potential relationship it is only mathematically founded, but the validity of the relationship is present in both a mathematical and applied real-world manner (Sneed, no date)

The value of the propensity score means that as the tendency of the household's characteristics comes closer to being randomly selected as beneficiaries of a road project, they could have earned more by about Php113.033, but if they have not chosen as beneficiaries of the road improvement their income will be less than Php133.033.

Income (Abatan) = 144,632.11 -15,487.62 AMC +10,795.54Occupation – 113.033PS *(eq.2)*
Income (Cervantes) = 156,206.75 – 15,487.62AMC + 10,795.54 Occupation – 113.033PS *(eq.3)*

Equations 2 and 3 are analyzed based on the differences in income among the three municipalities. Of the three areas, the largest household income is observed in Mankayan. But between Abatan and Cervantes, Cervantes has the largest income increment amounting to Php26,016.28, while the incremental income from Abatan is only Php14,441.84

Synthesizing the significance of the model, the value of the propensity score means that if households have not been beneficiaries of the improvement of the road, they will lose income of about Php113.00, which they could have earned if there was a road. The municipality that benefitted most from the Abatan-Mankayan-Cervantes road is Cervantes. In terms of incremental increase in income, Cervantes had the highest as compared to Abatan and Mankayan. With the improvement of road, Cervantes traded rice and fruits which used to be for home consumption (these were hardly or never traded before the road development). This has economic significance, with inaccessible good market, households have to store food, particularly rice. Fruits are generally heavy and perishable, hence these would rather be consumed (or rot) than sold. Fruits as compared to gold or potatoes are perishable and are generally priced which does not make sense to sell to when it is more costly to transport it than earn from it. With the improvement of road, Cervantes had become known for its quality rice and variety of fruits. Good roads retain the quality of fruits and freight cost had also decreased. With good roads traders earn more by buying rice at the farm gate and re-sale it at higher value because transaction cost had decrease (for example search cost).

Change in accessibility to health services. Households that visit health facilities take them on the average 103.46 minutes riding a public utility vehicle. If they are within the Cervantes-Mankayan-Abatan road, travel is significantly shorter by 15.78 minutes, which also means that if the households are not within the road, the travel will be longer. Households with occupation tends to travel more by 2.12 minutes than those who have no occupation. This means those with no occupation have done less travelling to health facilities.

The propensity score means that if the households were not beneficiaries of improved road, they would travel more 33.90 minutes (it would take the longer to travel), but with improve roads travel time to the health facilities is reduced. The road is even more significant to Cervantes and Abatan. For the households in Cervantes, the road had reduced their travel time to health facilities by almost one hour or 51.59 minutes. This is also true to Abatan. In the case of Mankayan, travel time to health facilities, controlling for other socio-economic factors, they spend 103.46 minutes travel time to health facilities. As has been discussed earlier, barangay road routes are longer due to mining property rights which increases the travel time to health facilities.

Change in accessibility to education services. The households who are within the Cervantes-Mankayan-Abatan road travel more by at least five minutes (4.93) than those who are not within the road. Household whose head has an occupation and with children who attend school have longer travel time of about three minutes than those with no occupation. Income positively increases the travel time to school. These imply that better road access give more opportunities for households to send their children to better schools (i.e. central

schools) which are usually located in the municipal proper. Children may attend the nearest school to their house have it not been for the improvement of the Cervantes-Mankayan-Abatan road. Powered by an occupation and income, households may send their children to better schools, which means also longer travel time.

The propensity score means that if the household were not beneficiaries of the road, they would be travelling less to go to better schools because this requires a travel of more than one hour (63.15 minutes). This means their children would go to school nearer to their home.

Households in Abatan spend less time going to school, while households in Cervantes spend more time travelling to school. This contrasting result can be explained by the location of the better schools in the area. The households interviewed in Abatan are within the 100 meters ZOI. They are very accessible to the catholic high school, so understandably they will travel less to school. On the other hand the best school in Cervantes is located in the municipal town, since the respondents come from the 2.5 and 5 kilometers ZOI, it is logical that their travel time will increase to go to school due to the much AMC road.

Using the predictors to compute for the predicted values and the data from the survey, the difference in difference were compared to determine statistical significance. The result shows that that there is no difference at all between the groups within the Cervantes-Mankayan-Abatan road and those who are not within the road. Even if the two groups have received treatment (i.e having a road), the impact of the road is the same for both treated and control variables (Table 3.41).

Table 3.41. **The Difference in Difference (DID) and the Double Difference in Difference (DDID)**

	With the Road		**Without the Road**	
	Treatment (T1) Predicted	**Treatment(T0) Actual**	**Control (C1) Predicted**	**Control (C0) Actual**
Impact of road on schooling				
Mean DID	20.76	20.76	22.096	22.096
DDID	0.001		0.000	
T-Test DID	T critical > t, 1.98 >1		T critical > t, 198 >1	
	Not significant			
T-TEST DDID	T critical > t, 198>1			
Impact on heath				
Mean DID	44.13	44.12	48.94	48.94
DDID	0.001		0.000	
T-Test DID	T critical > t, 1.98 >1		T critical > t, 198 >1	
	Not significant			
T-TEST DDID	T critical > t, 198>1			
Impact on Income				
Mean DID	125,170	125,170	109,815	109.815
DDID	0.001		0.000	
T-Test DID	T critical > t, 1.98 >1		T critical > t, 198 >1	
	Not significant			
T-TEST DDID	T critical > t, 198>1			

Although the results of the DID and DDID are not significant, the result imply that it is difficult to separate the impact of the Cervantes-Mankayan-Abatan road from other roads, like the arterial roads, farm to market roads, and barangay roads which have been improved simultaneously with the other roads.

3.7. Summary of Findings

Transport costs. The short run impact of the development of the road is observed in relatively shorter travel time along the road project and towards major exits leading to major roads such as Halsema Highways and Ilocos Expressway. The result of the different surveys conducted in the Cervantes-Mankayan-Abatan loop shows that the households now enjoy cheaper travel and transportation cost, faster travel time and lesser opportunity and search cost. The lower travel time translated into a relative lower transport cost when considering the opportunity cost of waiting that is associated with undeveloped roads.

Services sector. The liveliness of economic activities were observed in the Cervantes-Mankayan-Abatan road, particularly in the growth of the service sectors. Roads as the backbone of economic activities made mobility of people and goods and services faster. Along with this mobility is also the development of new market opportunities in the service and agricultural sectors. These are observed in the development of road side restaurants which is an important service facility for trading depots. The growth in formal lodgings such as inns and hotels spawns from the growth in the logistic sectors, such as couriers, and travelling salesmen. Communication and financial services are also indicators of lively economic activities. At the moment, these services have small operations, but these observed growth in these sectors are significant market signals towards the establishment of an agro-industrial economic structure that will spur the development of the regions.

Agriculture. The development of the Cervantes-Mankayan-Abatan road increased agricultural trading, particularly in Cervantes. Better roads made it possible for farmers to transport agricultural output daily without loss in its value since road hump bruising is reduced thus the quality of the vegetable is retained when it reach its destination. Agricultural products which were rarely produced, and were typically raised for household consumption, are now produced on larger scale due to better roads.

Employment and income. The major driver of income among household is occupation. The development of the Cervantes-Mankayan-Abatan road created new job opportunities for the households, like trading, roadside eateries and other enterprises in the services sector. This observation was validated by the income model, indicating that households who are along the Cervantes-Mankayan-Abatan road vein may be earning lower income from individual occupation compared to those in the interior barangays. But because the former can engage in several occupation/livelihood activities, the total household income is greater than in the latter.

Tourism. Tourism, at the time the impact evaluation was done, remains sluggish, with the Cervantes-Mankayan-Abatan road mainly used as gateway and exit to well established tourist destinations in the Cordillera and the Ilocos region. Nonetheless, the road exposed to travelers the scenic and historical appeal of Bessang Pass. This hints at the potential of the place to emerge as a tourist destination in the future.

Mining. The migration pull of mining in Mankayan was facilitated by the improved Cervantes-Mankayan-Abatan road. There was an observed increase in the influx of labor supply for small scale mining, particularly in Suyoc. Moreover, among small scale miners, the improvement of the road made it easier to access information. This minimized assymetric information between buyer and seller, particulalry the trading price of gold which used to be under the sway of gold agents. Better information meant that the small scale miners have better handle over traders. Improved road also resulted to savings in the miners' transportation and transaction costs as it eliminated the gold agents, with financial suppliers now travelling all the way to the mining communities. For Lepanto Mining Corporation, the rehabilitation of the Cervantes-Mankayan-Abatan road provided an alternative route

for its trucks and equipment for the hauling of raw materials like timber and bamboo coming from the Ilocos regions.

Health. Statistical analysis show that the road project has the most significant impact on access to health services. Health services are more accessible to households, both in terms of the facilities and the services of health personnel. The development of the road made other interior roads more accessible, providing shorter routes to major hospitals, i.e Luis Hora in Mt. Province and the Lutheran Hospital in Abatan, Buguias. With better roads, there are more transportation options, and households ownership of low to high cost vehicles makes it possible for them to bring emergency cases anytime at their chosen health facility. And on the other hand too, health personnel can immediately respond to emergency cases without so much delay.

Education. Children still walk to school, but with the development of road, it changed also lifestyles in the once sleepy towns of Cervantes, Mankayan and Abatan. With the development of roads children can go to schools located in the municipality (i.e. private schools) which saw the rise on the demand for school services and the increase in jeepneys, tricycles, and motorcycles mostly catering to this specific need.

Housing. With better roads, the increase in household's income can be indirectly inferred to improvement and changes in the type of materials used in the construction and renovation of houses. The improvement of the road resulted also to construction boom. Households who can transport cement are now building their houses or extension of their houses using cement instead of wood and GI sheets.

Chapter 4
EVALUATION OF ENVIRONMENTAL IMPACTS

The overarching objective of the Cervantes-Mankayan-Abatan road project is to increase socio-economic benefits by enhancing agricultural productivity, increasing mining outputs, and increasing tourism activities. These are anthropogenic actions that are entirely dependent on natural resource extraction and exploitation. Roads often bring significant economic and social benefits, but they also have substantial negative impacts on communities and the natural environment (World Bank Technical Paper, 1997). This part of the study endeavors to generate information on these environmental issues and impacts that are associated with the life cycle of the Cervantes-Mankayan-Abatan road project with the end in-view of providing guides for future decisions on road planning, design, implementation and operations in the CAR in such ways that can mitigate adverse environmental impacts.

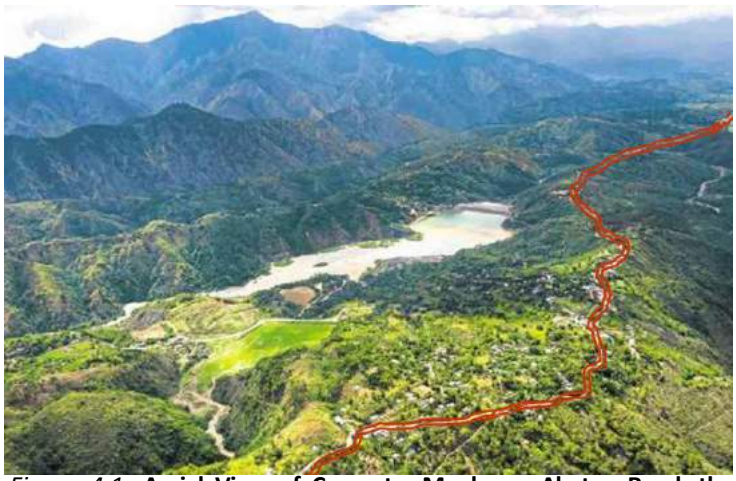


Figure 4.1. **Aerial View of Cervantes-Mankayan-Abatan Road, the Lepanto Mine Tailings Impounding Dam is on the left side of the road** *(Source: R. Balonglong, 2017).*

The environment is defined as: "the sum total of bio-physical (water, air, and land) interrelationships among themselves and also with human beings, other living organisms and property." Environmental studies provide an approach towards understanding environment and the impact of human activities on the environment. The road is contained, adjacent, and/or traverses several Environmentally Critical Areas, particularly national parks, river networks, areas at risk to natural hazards, and ancestral domains. This calls attention to the importance of the environmental concerns arising from or associated with the road project.

The Cervantes-Mankayan-Abatan Road project was undertaken within the framework of pertinent environmental laws in the Philippines. The timeline of the enacted decrees, acts and proclamations relative to the timeline of the Road Project is presented in Inset Box 4.1. Almost all laws on environmental protection were enacted before and during the inception and planning stages of the project, hence a strong policy, legislative and administrative support framework had been present at that time to guide project decisions as to environmental concerns. The laws on climate change and disaster risk reduction and management were promulgated during the road's construction, and it would be of interest to learn if there were design decisions that were changed or rectified to accommodate these Acts or if they had been earlier accounted for during the project design stage. The updating of the DPWH Social and Environmental Management System (SEM) in 2014 accounted for the lessons learned from devastations caused by natural hazards, indicating that laws, policies and issuances are constantly reviewed and strengthened.

Inset Box 4.1
TIME LINE OF PERTINENT ENVIRONMENTAL PHILIPPINE LAWS vis-à-vis the Cervantes-Mankayan-Abatan Road Project

Before the Project (Pre-2008)
- PD 1586: Philippine Environmental Impact Statement (EIS) System of 1978; Revised Procedural Manual of 2003;
- DPWH DO 245 s. 2003: DPWH Social and Environmental Management System Manual of Operations of 2003, updated in 2014
- PP 2146: Environmentally Critical Areas (ECA) of 1981ODA Act, 1996
- RA 8749: Clean Air Act (CAA) of 1999
- RA 9003: Philippine Ecological Solid Waste Management (ESWM) Act of 2000
- RA 9275: Philippine Clean Water Act of 2004

During Project Construction (2008-2010)
- RA 9729: Climate Change Act of 2009
- RA 10121: Disaster Risk Reduction and Management (DRRM) Act of 2010

Road Operation (Post 2010)
- Updated DPWH Social and Environmental Management System Manual of Operations, updated in 2014

4.1. Environmental Impact Assessment, Environmental Compliance Certificate, and Environmental Management Plan of the Road Project

The Department of Environment and Natural Resources (DENR) through the Environmental Management Bureau (EMB-CAR) granted an Environmental Compliance Certificate (ECC CAR0009-070-208) to the DPWH for the "Rehabilitation/Improvement of the Cervantes-Mankayan-Abatan Road Project" on October 2, 2000. The ECC was issued subject to the conditions indicated in Inset Box 4.2.

Inset Box 4.2
ECC CONDITIONS FOR THE PROJECT, "REHABILITATION/IMPROVEMENT OF THE CERVANTES-MANKAYAN-ABATAN ROAD" ECC dated October 2, 2000

1. Validity of the ECC to the 33.34 km length and 6-meter wide carriage width of the proposed road project;
2. DPWH shall strictly implement the Environmental Management Plan (EMP);
3. Design shall be in accordance to the following considerations:
   - Limitation of widening and improvements to geo-technically safe and socially acceptable areas;
   - Inclusion of slope protection, proper drainage structures, traffic, and pedestrian safety measures;
4. Minimization of land take in cultivated areas.
5. Implement a fair land acquisition and compensation program;
6. Tight supervision of construction works by DPWH to ensure the strict implementation of sound engineering practice;
7. Protection of the integrity of nearby streets, properties, building, drainage canals, public utilities, and other structures;
8. Implementation of a storm water management plan by DPWH to prevent surface runoff sediments to flowing into nearby streets, properties, and drainage structures;
9. Minimize the impact of traffic flow during implementation;
10. Relocation of affected existing public utility services;
11. Proper disposal of earth materials and other construction spoils from the project to well-maintained and stable designated areas and so that they will not be a source of pollution;
12. Aggregate materials shall be sourced from sand and gravel operators with an ECC from DENR;
13. Prioritization of hiring of local residents for labor;
14. DPWH shall ensure that the Contractor's All Risk Insurance (CARI) supplemented by the Quick Response Fund (QRF) shall be provided to cover expenses for the following:
    - Restoration and indemnification/compensation of damage to life and property caused by the implementation of the project;
    - Abandonment/decommissioning of the project facilities related to the prevention of possible negative impact; and
    - Emergency repairs/restorations of the critically damaged infrastructure facilities after calamities.
4. Proper disposal of trees in accordance with existing Forestry Laws, Rules and Regulations and their replacement of twenty-five (25) saplings for every tree cut along the sides;
5. DPWH to secure all pertinent permits/clearances from appropriate permitting government agencies/units prior to project implementation;
6. DPWH shall form, prior to the implementation of the project, a Multi-partite Monitoring Team (MMT) through a Memorandum of Agreement (MOA) with the DENR-EMB, the concerned Local Government Units (LGUs), a local environmental NGO, and the affected communities. The MMT will oversee the compliance of proponent on ECC conditions, EMP requirements and other applicable laws, rules, and regulations;
7. The EIA Project Office (EIA-PO) of DPWH shall oversee the implementation of the Monitoring Program and shall ensure the submission of quarterly monitoring reports to DENR/EMB-CAR and to coordinate closely with the MMT;
8. DPWH shall set aside an Environmental Monitoring Fund (EMF) to support the activities of the MMT such as trainings, travel costs, and other incidental expenses;
9. On-the-spot monitoring/inspection at any reasonable time by DENR/EMB in coordination with other concerned groups;
10. DPWH to furnish DENR/EMB with detailed engineering design of the road network which shall include, among others, details on selected waste dumps for construction spoils;
11. Any modifications, expansion, and/or deviation from the submitted project scheme/scale shall be subject to the EIS requirement;
12. The ECC shall be part of the Terms of Reference (TOR) of the Contractor; and
13. Any transfer of contract of the project will carry the same conditions of the ECC.

The EIA's main objective is to describe, identify, predict, and evaluate potential impacts early on during the road planning process. By doing so, provisions for avoiding, mitigating, or compensating for negative environmental impacts wherever possible is considered to avoid future problems in its operation and maintenance which will further compromise the environment. Project compliance to the ECC requirements before and during project implementation are documented in Inset Box 4.3.

There were no indications of requirements for the maintenance and protection of the environment after the completion of the project. There is thus a discontinuity on the intentions of an EIA and an ECC because the entire life cycle of the project is not accounted for. It is only during the design and implementation stages that considerations for environmental compliance are taken into consideration. Upon completion of the project, environmental compliance, in effect, also ends.

The Monthly Progress Reports of the Contractor included a section entitled "Status of the Project Compliance to ECC Conditions" (Inset Box 4.4).

For the entire duration of the project, the Contractor indicated by checking "yes" or "no" beside an ECC Condition if they complied/ observed/ followed on the following thirteen ECC Conditions but there were no indications on the report as to event, location, magnitude, and mitigation activities performed as proof of compliance.

Inset Box 4.3
ECC REQUIREMENTS
DURING PROJECT INCEPTION, PLANNING AND DESIGN

ECC Requirements	Before	During	After
Geotechnical investigation	✓		
Social acceptability study	✓		
Public Consultation	✓		
Design to have:			
Slope protection	✓	✓	
Drainage structures	✓	✓	
Traffic safety measures	✓	✓	
Pedestrian safety measures			
Minimal land take on cultivated areas	✓		
Fair land acquisition and compensation	✓		
DWPH supervision to implement sound engineering standards	✓	✓	
Protection of integrity of nearby structures	✓		
Relocation of affected public utility structures	✓		
Storm water management plan	✓		
Well-maintained area for construction spoils	✓		
Aggregate suppliers have an ECC	✓	✓	
Hiring of local residents for labor pool	✓	✓	
Project facilities			
Workers' accommodations	✓	✓	
Stockpile, Batching Plant	✓	✓	
Water system	✓	✓	
Waste dump (solid, liquid, earth)	✓	✓	
Use of CARI and QRF	✓		
Disposal of Trees and replanting of 25 saplings for every tree cut	✓	✓	
Permits/licenses prior to project implementation	✓		
Multi-partite Monitoring Team (MMT)			
Composition		✓	
Minutes of Meeting		✓	
DPWH EIA-PO Quarterly Monitoring Report		✓	
EMF			
Trainings		*(No data)*	
Travel expenses			
Incidental expenses			
DENR/EMB on-the-spot inspections		✓	
Deviations from designs subject to EIS requirements		✓	
ECC at part of TOR of the contractor	*(No data)*		

Inset Box 4.4
ECC CONDITIONS ON THE PROGRESS REPORTS

1. Protection of the integrity of nearby streets, properties, buildings, drainage canals, and other structures.
2. Storm Water Management Plan to prevent silt-loaded run-off from flowing into nearby streets, properties, natural waterways, irrigation and drainage structures.
3. Traffic Management to minimize transport disturbance.
4. Minimization of noise disturbance especially in populated areas.
5. Priority of residents of host municipalities in hiring of unskilled labor.
6. Tree cutting permit prior to tree removal and disposal in accordance with Forestry Laws.
7. Disposal of unsuitable soil properly, in designated areas.
8. Source of concrete mix and materials should have ECC.
9. CARI should have indemnity for damages caused by the project, supplemented by Quick Response Fund (QRF)
10. Permits and licenses be obtained.
11. Expeditious removal of surplus excavated earth material.
12. Minimize slope failure/soil erosion in slopes to be modified by the project.
13. Separate ECC for batching and aggregate crushing plant.

The construction phase activities that would have had pronounced environmental effects are:

- Taking possession of the site, land acquisition, building relocation/displacement, agricultural land conversion, forest land conversion; conversion of ecologically sensitive area;
- Clearing, land development, building of construction plant and facilities, site grading, excavation and backfill;
- Barrow pits, dumping of soil, transportation of materials, equipment and people;
- Foundation work, soil protection, trench digging;
- Concreting work, water sources, sand and gravel sources, cement sources, steel reinforcement sources; and
- Housing and living facilities for workers, sanitary facilities, fuel requirements for cooking/lighting.

There were no indications on the reports on the locations and environmental events that would have indicated changes in the environment because of these activities. The only visible remnant of change were the buildings that were constructed for workers' accommodations which were built on the grounds of the Mankayan National High School (Figure 5.2). These structures were donated to the school upon project completion.

Figure 4.2. **Workers' Accommodations at Mankayan National High School.** The two buildings in the background (painted green) were donated to the school upon the completion of the project

The timeline in Table 4.1 attempts to map environmental events before, during, and after the project. The ECC, Monthly Progress reports, Comprehensive Land Use Plans of the three municipalities, as well as the information derived from the Focus Group Discussion and Key Informant Interviews were referred to as main resources. The timeline events may not be entirely attributed to the road project due to the dearth of specific information given and method of reporting.

Table 4.1. **Environmental Impact Timeline, Cervantes-Mankayan-Abatan Road Project**

Environmental Parameter	Environmental Event	Positive or Negative Impact	Mitigation Measure Employed
Pre-2008 (Project Inception/Planning)			
Water	none	None	None
Drainage	none	None	None
Air/Temperature	none	None	None
Soil/Minerals	Sand & gravel extraction, Landslides, Rockslides	Bank erosion Earth movements	ECC
Flora & Fauna	none	None	None
Land Use	none	None	None
Aesthetics	none	None	None
2008-2010 (Project Construction)			
Water	Reduced quantity	Water scarcity	None
Drainage	flooding	erosion	ECC
Air/Temperature	Temperature increase, dust	Health	None
Soil/Minerals	Sand & gravel extraction Landslides, Rockslides	Bank erosion Earth movements	ECC
Flora & Fauna	Reduced forested areas	Rapid conversion, landslides, rockslides	Reforestation, ECC
Land Use	Increased settlements	Rapid conversion	Land use & zoning
Aesthetics	none	none	None
2011 to present (Project Operation)			
Water	Reduced quantity	Water scarcity	Reforestation
Drainage	flooding	Erosion	Drainage works in 2017 Road Rehabilitation Project
Air/Temperature	Temperature increase, dust	Health	None
Soil/Minerals	Sand and gravel extraction, Landslides, Rockslides	Bank erosion	ECC
Flora & Fauna	Reduced forested areas	Rapid conversion, landslides, rockslides	Reforestation, ECC
Land Use	Increased settlements	Rapid conversion	Land use and zoning
Aesthetics	degradation	Reduced cultural identity	Land use and zoning

4.2 Bio-Physical Changes

This section discusses general shifts in the environment of the three municipalities traversed by the road project based on information available from various sources and further cross-referenced with the results of key informant interviews, focus group discussions and site observations. Conditions were classified across the time periods of "before road improvement" and "after road improvement" to trace indications of changes that can be associated, directly or indirectly where data permit, with the road project. It should be pointed out that the information and the relations made therefrom are from a very broad perspective. Nonetheless, these provide trends of the changes from the before- to after-road project time frame and some plausible clues of how the road project may have contributed to the changes.

4.2.1 On Land Use

The change in land use within the road ZOI is very palpable after road improvement. The biggest increase appears to be the land area used for commercial purposes which expanded by nearly 400 percent the area before the road was improved when aggregating the three localities covered by the road ZOI. This is very pronounced in Mankayan where commercial land area expanded by nine times after the road was improved. Increase in commercial land use also transpired in the Abatan area but most of these are along the Halsema Highway. In Cervantes, the widest expansion took place in agri-industrial land use. These are consistent with the findings in the economic impact study showing, after the road was improved, growth of trading in Mankayan, further intensifying in Abatan and the progress of agriculture in Cervantes.

Forest lands, on the other the hand, are shrinking. The combined forest areas of the three municipalities shrunk by about 21 percent after the road was improved. In the town of Buguias, the CLUP indicated an increase in protected forest, but this area is outside of the road ZOI. Available data from the CLUP of Buguias indicates that forest lands within the road ZOI in Abatan more or less remained the same in the before and after-project, with development expansion concentrating primarily along the Halsema Highway. In Cervantes, forest lands used to occupy 73 percent of its total land area before the Cervantes-Mankayan-Abatan road was improved. After road improvement, this percentage of forest lands went down to 61 percent. In Mankayan, before the road was improved, forest lands accounted for 16 percent of its total land area. This dropped to 12 percent after road improvement.

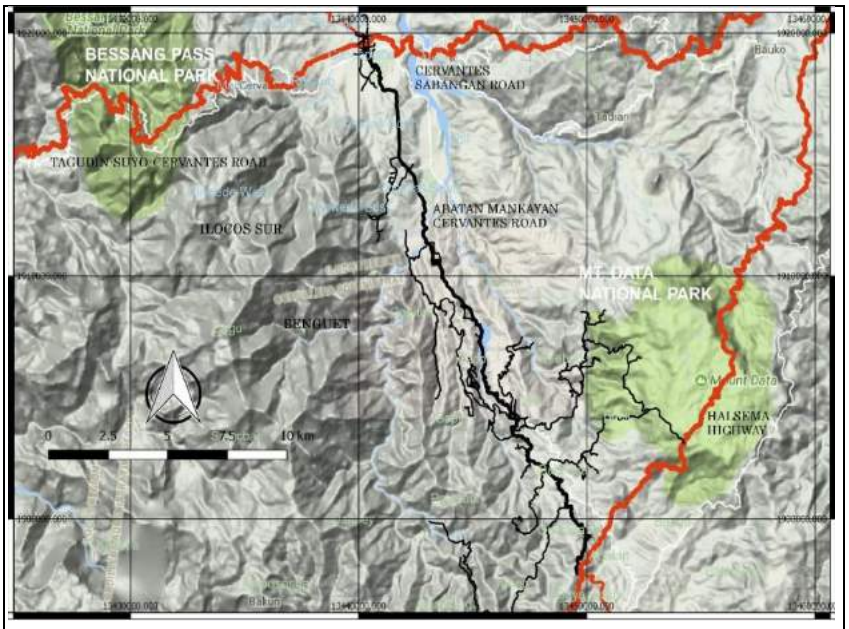


Figure 4.3. **Location of the Road relative to Bessang Pass National Park and Mt. Data National Park**

The road is located 10 kilometers away from Bessang Pass National Park and five kilometers away from Mt. Data National Park. Bessang Pass is an important

historic and tourism site, whereas Mt. Data's status as a National Park is under re-consideration due to the rapid deforestation and conversion of large parts of the park to agricultural use.

The contribution of the road project to the reduction of forest areas can be said to be significant. Much of the forested areas within 5-kilometer radius from the Cervantes-Mankayan-Abatan road were converted to agricultural purposes, citing for instance the communal forest in barangay Sapid in Mankayan that shrunk to just about a tenth its size before the road was improved. Moreover, some new road veins that were developed from the main road towards the interior communities traverse forest lands that opened them up for development. This is the case for instance of the feeder road leading to barangay Balili in Mankayan that runs through Mt. Data National Park, leading to the clearing of much of the forest cover for agricultural purposes.

Figure 4.4. **Agricultural areas at the foothills of Mt. Data National Park**, Barangay Balili, Mankayan which may see more expansion

And as the Cervantes-Mankayan-Abatan road facilitated the development of in-roads to the interiors that subsequently invited crop cultivation in forest lands, more and more of the existing agricultural areas near the road are being converted to built-up uses. The combined area of agricultural lands in the three municipalities traversed by the road went down by nearly 11 percent after road improvement. Most of the conversion occurred within the two-kilometer radius from the road which is very prominent in Mankayan and Abatan.

Mankayan's spatial strategy is a linear urban form/strip development with clustered rural communities. This means that physical changes will continue to be intensive along the road ZOI. Barangay Abatan in Buguias is planned to develop as a major part of the multiple growth quadrangle of the municipality. Commercial development and built-up land uses are then expected to further expand in this part. Cervantes meanwhile appears to be gearing up for the growth of its processing industries, primarily agricultural-based. And looking at the CLUP maps, these developments have been mostly occurring along the national road.

These developments manifested various issues associated with congestion and increasing urbanization, particularly at the town centers. The following were observed: (a) absence of sidewalks; (b) setbacks and road-right of ways according to DPWH Standards and the National Building Code are not followed; (c) prevalence of on-street parking and PUV terminals/staging areas; (d) expansion of settlements in urbanizing areas led through by narrow pathways or stairways.

Figure 4.5. **Pedestrian spaces like sidewalks were not provided** in Mankayan especially in the Market Area forcing the people to use the road (left), on-street parking is also prevalent in Mankayan which diminishes the effective road width (middle), and communities within the 100-meter ZOI at Poblacion, Mankayan can only be reached through stairways and narrow pathways hence, residents with vehicles park on AMC Road.

Figure 4.6. **Residences along the Road precariously cling to the mountainside** and slowly encroach into forested areas. These structures can be reached through stairways.

Table 4.2. **Land Use & Spatial Strategy of Municipalities Traversed by the Cervantes-Mankayan-Abatan Road**

	Before (1998-2002)	During (2010-2011)	After (2012-2022)	% Change (Before & after)
MUNICIPALITY OF CERVANTES, ILOCOS SUR				
Agricultural Lands (ha.)	2,122.90		2,122.97	0%
Commercial (ha.)	0.776		1.908	146%
Agro-Industrial (ha.)	0.015		10.54	70167%
Institutional (ha.)	27.032		47.289	75%
Production Forest (ha.)			1,689.27	
Protected Forest (ha.)	23,902.62		18,024.00	-25%
Protected Areas	693.316		693.316	0
Residential	101.305		109.013	8%
Tourism (ha.)	1,126.24		1,126.24	0
Recreation (ha.)	8		25	213%
Pasture/Grassland	4,913.37		5,706.44	16%
Cemetery (ha.)	11.22			
Dumpsite (ha.)				
Roads (ha.)	114.103			
Infrastructure/Utilities (ha.)			135.288	
Rivers and Creeks (ha.)	520.625			
Quarries (ha.)			*Quarrying noted along Abra RIver*	
Sand dunes (ha.)	259.375			
Others/Special Uses (ha.)	79.29		860.218	91%
Proposed Land Use Spatial Strategy: *(not indicated)*				
MUNICIPALITY OF MANKAYAN, BENGUET				
Agricultural Lands (ha.)	7,515.00		5,542.63	-26%
Commercial (ha.)	0.773		7.24	837%
Agro-Industrial (ha.)			43.99	
Institutional (ha.)			36.28	
Protected Forest (ha.)	2,517.48		2,366.58	-6%
Residential			1,100.91	
Tourism (ha.)			12.72	
Recreation (ha.)			7.06	
Pasture/Grassland	5,420.26		11,022.70	103%
Cemetery (ha.)	0		0.95	
Dumpsite (ha.)			2.86	
Roads (ha.)			191.6	
Rivers and Creeks (ha.)			194.07	
Quarries (ha.)			0.838	
Proposed Land Use Spatial Strategy: Linear Urban Form, Strip Development, Clustered Rural Communities				
MUNICIPALITY OF BUGUIAS, BENGUET				
Agricultural Lands (ha.)	8,592.72	8,592.72		0%
Commercial (ha.)	2.057	8.58		317%
Agro-Industrial (ha.)	1.789			
Institutional (ha.)	47.337	47.337		0%
Productive forest (ha.)	8,718.22			
Protected Forest (ha.)	6,655.38	10,793.35		62%
Residential	285.509	320.944		12%
Tourism (ha.)	2.42	3.45		43%
Pasture/Grassland	860.36			
Cemetery (ha.)	0			
Dumpsite (ha.)	0	1		
Roads (ha.)	194.43	194.43		0%
Rivers and Creeks (ha.)	385.6	385.6		0%
Special Use (ha.)	0	1.02		
Quarries (ha.)				
Proposed Land Use Spatial Strategy:: Multi-sectoral Growth Quadrangle (Abatan, Loo, Natubleng, Poblacion)				

Source: Municipality of Mankayan CLUP, 1998-2002; Municipality of Mankayan CLUP, 2012-2022.
Municipality of Cervantes CLUP, 2000-2010; Municipality of Cervantes CLUP, 2015-2024
Municipality of Buguias CLUP, 2003-2012. The projections in the CLUP were used to populate the "during" row of this table.

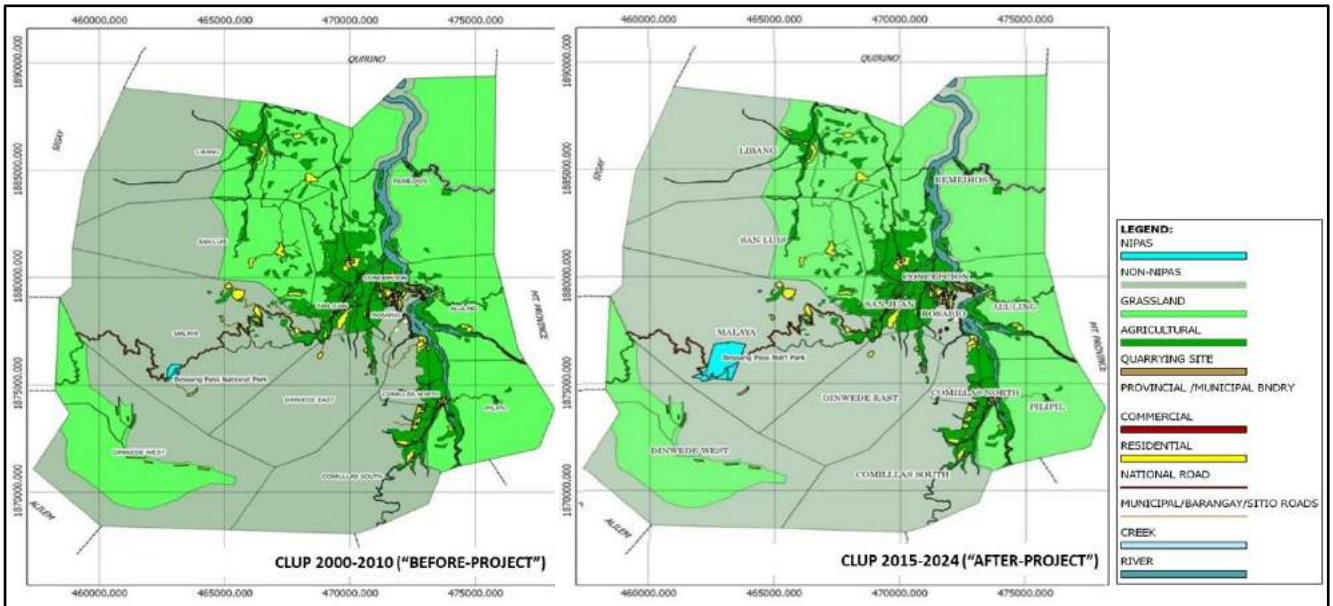


Figure 4.7. **Land Use Map, Municipality of Cervantes, Ilocos Sur**

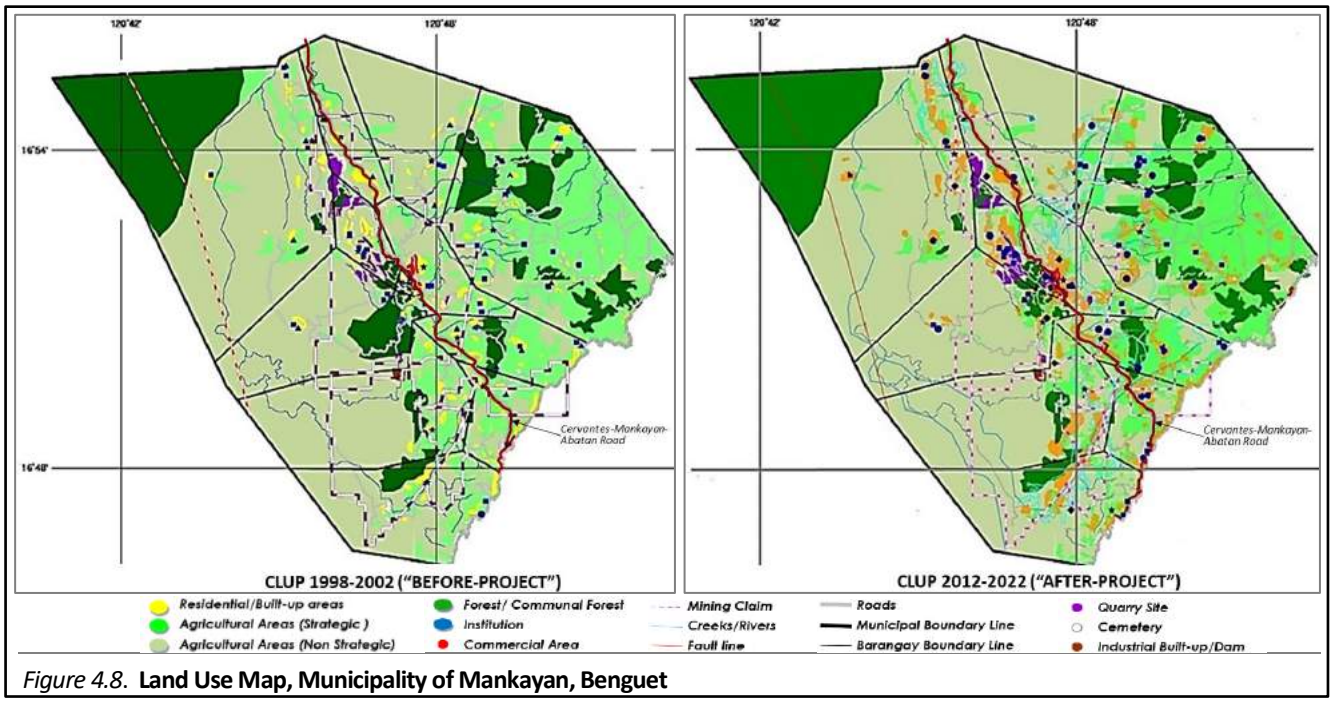


Figure 4.8. **Land Use Map, Municipality of Mankayan, Benguet**

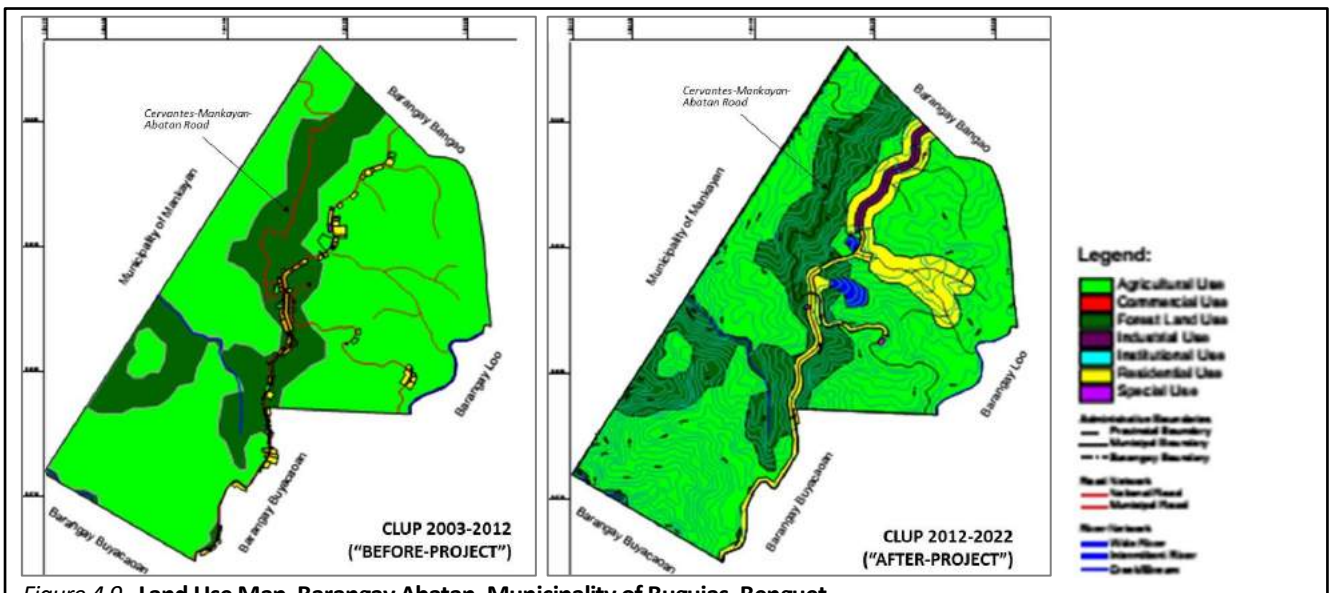


Figure 4.9. **Land Use Map, Barangay Abatan, Municipality of Buguias, Benguet**

4.2.2 On Land Resources and Biodiversity

The road passes through elevations of a high of 1,973m asl at the Mankayan side, and a low of 493.20m asl at the Cervantes side. From the valley and rolling slopes in Cervantes, the road climbs up to the predominantly rugged terrain in Mankayan and further up the steep slopes towards Abatan where the road meets with Halsema Highway.

This topography initially characterizes the areas traversed by the road project into various ecologies that are indicative of biodiversity within the road ZOI During the walk-through survey, different environmental characteristics or ecologies were recorded throughout the whole stretch of the Road, namely: a) urban/urbanizing areas; b) lowland ecology; and c) highland ecology.

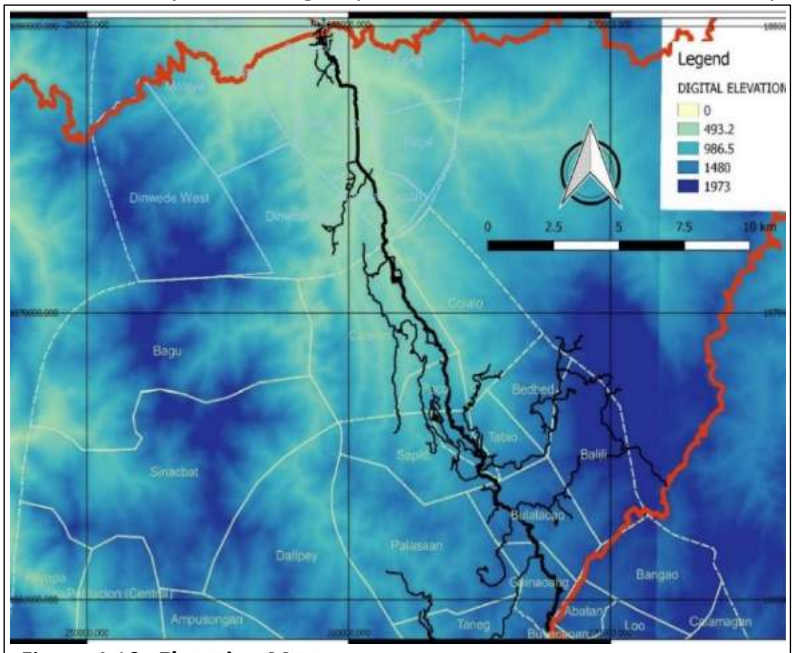


Figure 4.10. **Elevation Map**

Figure 4.11. **Lowland ecology from roadside, Cervantes Ilocos Sur**

Figure 4.12. **Highland ecology from roadside, Mankayan, Benguet**

The dominant forest vegetation in the highland ecology is Benguet pine. These can be observed lining the road sections passing through Abatan and Mankayan. Ferns and pitcher plants can be also noted at areas 100 meters and further from the Road. Forest vegetation at the lowland ecology in Cervantes, meanwhile, are mostly tropical forests with pine forest in higher elevations.

Figure 4.13. **Benguet Pine Tree stands observed at areas 2 km from the Road** *(left photo)* **and ferns and pitcher plants observed at areas 100 meters and further from the Road** *(right photo).*

Table 4.3 lists the flora and fauna that can be found within the localities traversed by the Cervantes-Mankayan-Abatan road and the corresponding conservation status as of 2017. Four of the inventoried flora species and ten of the fauna species have been assessed as either vulnerable to extinction or endangered in varying degrees. Although it is difficult to measure exactly the contribution of the road project to the risk of biodiversity loss, it is very plausible to associate this with the expansion of human activities up forested areas where physical access is directly or indirectly facilitated by the road project. The decrease in the area of forested lands by more than 20 percent from that before road improvement must have amplified the risk in biodiversity loss.

Table 4.3. **Inventory of Flora & Fauna in Areas Traversed by/Within the Environment of the Cervantes-Mankayan-Abatan Road, 2017**

Common Name & Scientific Name	Conservation Status	Common Name & Scientific Name	Conservation Status
FLORA			
Benguet pine *Pinus kesiya*		Avocado *Persea Americana*	
Japanese acacia *Acacia auriculiformis*		Lansones *Lansium domesticum*	
Alder *Alnus maritimma*	Endangered	Kapok *Ceiba pentandra*	
Calliandra *Calliandra calothyrsus*		Ipil-Ipil *Leucaena leucocephala*	
Alibangbang *Piliostigma malabaricum*		Flemingia *Flemingia macrophylla*	
Eucayptus, Red gum *Eucalyptus camaldulensis*		Thailand shower *Cassia siamea*	
Agoho *Casuarina equisetifolia*		Anchoan dilaw *Cassia spectabilis*	
Tuai *bischofia javanica*		Aplas *Ficus irisana*	
Mahogany *Sweitenia macropylia*		Tsa *Cameli sinensis*	
Acacia *Samanea saman*		Gipas *Sarcandra glabra*	
Tanguile *Shorea polysperma*	Critically Endangered	Uyok *Sauraria elegans*	
		Balukok *Microsos philippinensis*	
Oak tree *Quercus variabilis*		Coconut *Cocos nucifera*	
Kasui *Anacardium occidentale*		Kauayan tinik *Bambusa blumeana*	
Banaba *Lagerstroemia speciosa*		Kauayan killing *Bambusa vulgaris*	
Guyabano *Annona muricata anonacea*		Bayog *Dendrocalamus merrillianus*	
Dita *Alstonia schoolaris apocynaceae*		Bolo *Gigantochloa levis*	
Narra *Pterocarpus indicus*	Vulnerable	Rono *Miscanthus siilnensis*	
Yemane *Gmelina arborea*		Giant fern *Pteridium aquilinum*	
Akleng parang *Albizia procera*		Carabao grass *Paspalum conjugatum*	
Talisai *Terminalia catapa*		Bangbangsit *Ageratina adenphora*	
Calliandra *Callandra calothytsus*		Mirasol/sunflower *Tithonia diversiflora*	
Tibig *Ficus nota*		Samsamon *Themeda triandra*	
Sangilo *Pistacia chinensis*		Cogon *Imperata cylindrica*	
Balete *Ficus balete*		Kikuyo *Pennisitum cahndistinum*	
Mango *Mangifera indica*		Talahib *Sarchrum spontaneum*	
Caimito *Chrysophylium caimito*		Hagonoy *Ghromolaena odorata*	
Guava *Psidium guavaja*		Takip kuhol *Centalla asiatica*	
Tamarind *Tamarindus indicus*		Amorseco *Andropogon aciculatus*	Endangered
Pomelo *Citrus grandis*		Pitcher plant *Nepnthes bellii*	
Santol *Sandoricum koetjape*		Jack fruit *Artocarpus heterohylla*	
FAUNA			
Luzon racquet-tailed parrot *Prioniturus montanus*	Near Threatened	Chesnut faced babbler *Zosterormis whitehead*	
Luzon scops owl *Otus longicornis*	Near Threatened	Luzon cordillera forest mouse *Apomys abrae*	
Wild chicken *Gallus gallus*		Luzon montane forest mouse *Apomys datae*	
House sparrow *Passer domesticus*		large-toothed hairy-tailed rat *Batomys dentatus*	
Maya *Lonchura atricapilla*		Luzon hairy-tailed rat *Batomys granti*	
Philippine brown deer *Cervus mariannus*	Vulnerable	Short-footed Luzon tree rat *Carpomys melanurus*	
Philippine warty pig *Sus philippensis*	Vulnerable	white-bellied Luzon tree rat *Carpomys phaeurus*	
Northern Luzon Giant cloud rat *Polyramus pallidus*		Grey Luzon shrew-rat *Chrotomys silaceus*	
Cordillera greater forest mouse *Apomys Abrae*		Luzon bushy-tailed cloud rat *Crateromys schadenbergi*	
Common brown rat *Rattus norvegicus*		Luzon narrow-mouthed frog *Kaloula rigida*	
Luzon hairy-tailed rat *Batomys granti*		Benguet Bush Warbler *Locustella seebohmi*	Endangered
Golden crowned flying fox *Acerodon jubatus*	Endangered	Horned forest frog *Platymantis cornutus*	
Large forest rat *Bullimus luzonicus*		Mount Data forest frog *Platymantis subterrestris*	
Phil. common cobra *Najanaja pilippinensis*	Endangered	White-browed Jungle *Flycatcher Rhinomyias insignis*	Endangered
Monitor lizard *Varanus salvator*	Threatened	Mt. Data shrew rat *Rhynchomys soricoides*	
Flame-crowned flowerpecker *Dicaeum anthnyi*	Near Threatened	Luzon short-nosed rat *Tryphomys adustus*	
Philippine Bulbul *Hypsipetes philippinus* Pycnonotidae			

Sources: www.globalspecies.org; Upper Agno River Basin Resource Reserve Ecotourism Plan, DENR.

The next table generally scans the changes in major agricultural crops grown in the three localities traversed by the Cervantes-Mankayan-Abatan road before and after road improvement. This intends to skim through probabilities of plant species introduced or lost after the road has been improved. In the highlands, i.e., Mankayan and Abatan, the crops planted before road improvement remained

generally the same on the years after road improvement. This is except for corn in Mankayan, the production of which seemed to have ceased or been lessened after road improvement. It is in Cervantes where more of other crops were introduced in addition to the ones before road improvement. This municipality, where physical access used to be the most difficult among the three localities, was able to take advantage of the affordances of improved accessibility to diversify its agricultural products.

This suggests that the likelihood of introduction of new crop species into the ecosystem may be relatively greater for the lowland ecology than for the highland. Agricultural expansion areas are available in Cervantes and can now be made productive with improved physical access to markets and technologies. The likelihood of the same in Mankayan and Abatan may not be as high given limited farm sizes. Farm lands in these areas, already constrained by rugged topography, are increasingly under conversion stress as farmers see greater incentive to allocate more space for commercial purposes particularly those near the roads. The probability of loss of crop species can go either way in both highland and lowland, but the highland ecology appears to hint more of this.

These possible changes in the species of crops grown, directly or indirectly resulting from the road project, can have profound impact on the biodiversity of the areas. A more detailed biological accounting is required to ascertain this impact.

Table 4.4. **Crops Grown in Cervantes, Mankayan and Abatan**

Crop	Before (1998-2002)	After (2012-2022)
CERVANTES, ILOCOS SUR		
Plantation Crops	Banana, Coffee	Banana, Coffee, Pineapple
Root Crops	Peanut, Potato, Carrots	Peanut, Sweet Potato, Potato, Carrots
Legumes	String beans, Pigeon Peas	String beans, Okra, Pigeon Peas
Vegetables	Cabbage, ginger, cucumber, Sweet Pepper, Tomato, Eggplant, Ampalaya	Cabbage, Ginger, Sweet Pepper, Tomato, Eggplant, Ampalaya, Upo, Pechay
Fruit Trees	Mango, Rambutan, Lanzones	
Grains	Rice, Corn	
MANKAYAN, BENGUET		
Plantation Crops	Coffee, banana, pineapple, passion fruit, tiger grass	
Root Crops	Sweet potato, cassava, gabi	
Legumes	String beans, okra, peas, peanuts, cowpeas	
Vegetables	fruit vegetables, root vegetables, leafy vegetables	
Fruit Trees	Mango, citrus, avocado, jackfruit, lychee, star apple	
Cutflowers	Gladiola, chrysanthemum, aster	
Grains	Rice (HYV and traditional), Corn	Rice
ABATAN, BUGUIS		
Plantation Crops	Coffee	
Root Crops	Radish, Onion, Potato, Carrots, Sweet Potato	
Legumes	Garden peas, Beans	
Vegetables	Cabbage, lettuce, Bell pepper, Celery, Cauliflower, Pechay, Broccoli, Chayote, Zucchini	
Fruit Trees	Citrus	
Cutflowers	Calalily, Shasta Daisy	
Grains	Glutinous Rice, Corn	

Source: Municipality of Mankayan CLUP, 1998-2002; Municipality of Mankayan CLU, 2012-2022.
Municipality of Cervantes CLUP, 2000-2010; Municipality of Cervantes CLUP, 2015-2024
Municipality of Buguias CLUP, 2003-2012. The projections in the CLUP were used to populate the "after" column of this table.

4.2.3 On Water Resources

The road project traverses mainly the Abra River Basin which is fed by vast river networks including tributaries from/passing through mining areas in Mankayan. The impact of the road project on the conditions of the river basin resource reserve are indirect and very difficult to isolate. A river sampling study conducted by Dulay in 2005 found that the Abra River has deteriorated due to the combined effect of many human-related activities, with the mining industry in Mankayan as the major contributor to river pollution. This study found that all parameters of the physico-chemical characteristics of the river, except temperature, exceeded allowable limits (pH, dissolved oxygen, total suspended solids, total dissolved solids, biochemical oxygen demand, nitrates, lead, mercury,

chromium, and cyanide concentrations). The tailings dams of Lepanto have been identified as the major sources of pollution to the Abra River years before the Cervantes-Mankayan-Abatan road was improved.

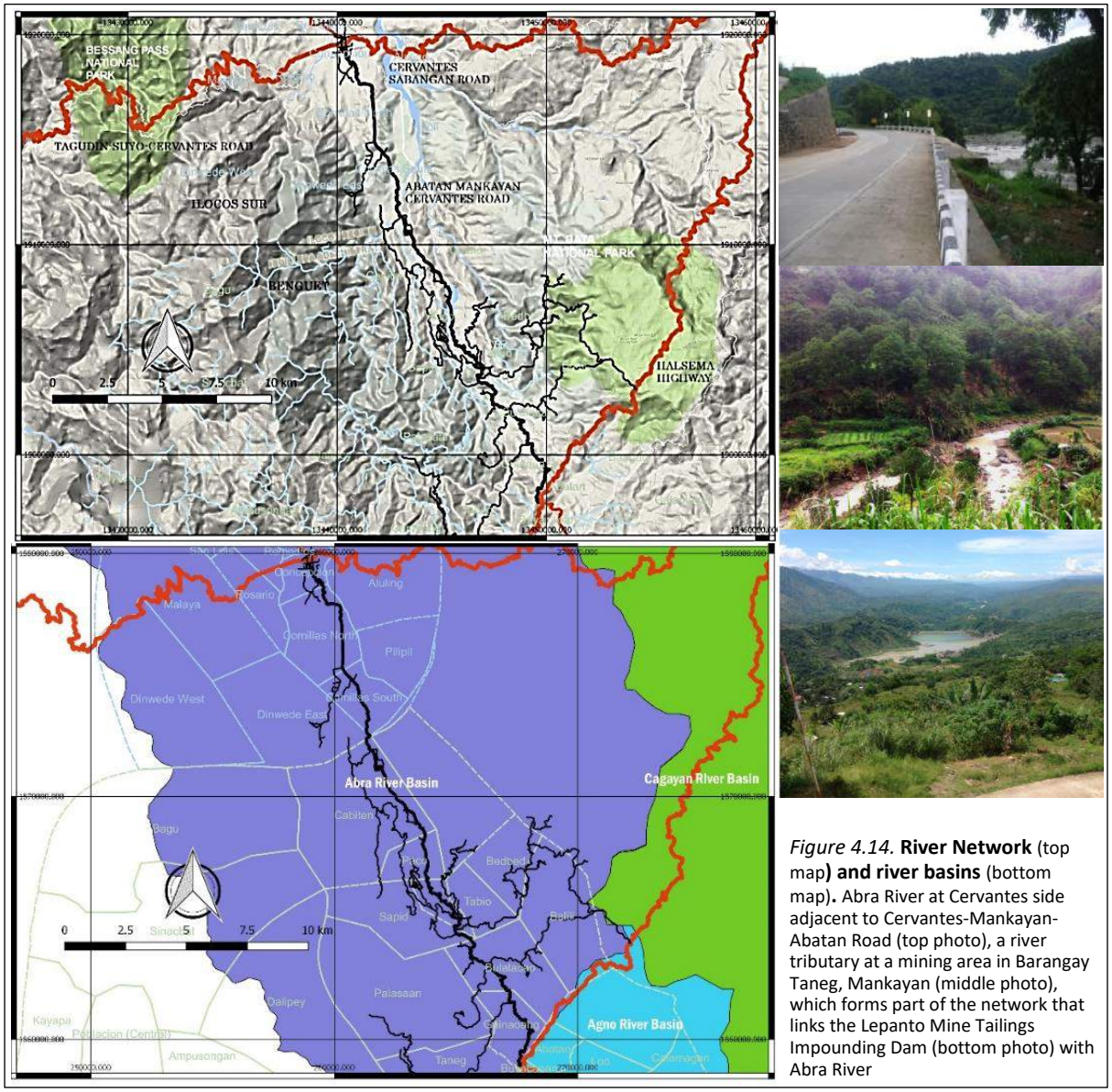


Figure 4.14. **River Network** (top map**) and river basins** (bottom map)**.** Abra River at Cervantes side adjacent to Cervantes-Mankayan-Abatan Road (top photo), a river tributary at a mining area in Barangay Taneg, Mankayan (middle photo), which forms part of the network that links the Lepanto Mine Tailings Impounding Dam (bottom photo) with Abra River

The socio-economic impact study discussed in Chapter 3 reveals that the improvement of the road appeared to have affected more the operation of small-scale mining than large-scale mining.[10] The improvement of the road have made small scale mining more lucrative which contributed to its recent growth spurt. Transport cost of miners was lessened and miners have improved access to market information that allows them better handle over trading. There is no data just yet to determine the extent to which the boom in small scale mining has exacerbated the problem of water pollution at the Abra River after road improvement. In general though, the adverse environmental impact of small scale mining is recognized especially with the lack of enforcement of regulatory mechanisms. The cyanide being used for gold extraction poses safety hazards to miners, and cyanide leaches are

[10] The Cervantes-Mankayan-Abatan road used to be maintained by the Lepanto Consolidated Mining Company. Because the road is a critical infrastructure for its operation, Lepanto would have continued maintaining this if the road project was not implemented by the government. This means that its mining operations would have proceeded in its present course even if the road project was not pursued by the DPWH. This much was hinted at in an interview with a key informant from Lepanto. The net effect of the road project on large scale mining operation in Mankayan can therefore be described as neutral.

environmental risks to biodiversity in river systems where they are released (Leung, et al). The rise in small scale mining in Mankayan may have increased further the cyanide concentration in Abra River.

River siltation has also most likely worsened after the project. The reduction of forest cover, the inadequacy of road drainage system, and the vulnerability of the ZOI to ground shaking have contributed to erosion and landslides that could be more severe now than before the project (see discussions on natural hazards).

In the FGDs, the participants assessed water quality in their areas to have deteriorated, from "good" before road improvement, to "fair" after road improvement. Mining and agriculture in the upstream were mentioned as the main causes of deterioration of water resources in these localities. The problem is more seriously felt in Cervantes being in the downstream. Mining is especially identified as the biggest cause which prompted the communities in Cervantes to take an impassioned opposition to mining.

4.2.4 On Air Quality

The municipalities traversed by the Cervantes-Mankayan-Abatan road have distinct wet and dry seasons. Average temperature is relatively cool in the highland areas, i.e, Mankayan and Abatan in Benguet, and warm in lowland Cervantes. Temperature has notably risen in all the three areas from the before-project period to the present. Rainfall and humidity also went up. These changes are most likely caused by general climate change and could not be attributed with determinable proximity to the road project. The local-level impact of the project would be more on air quality that can affect atmospheric conditions.

Table 4.5. **Temperature, Rainfall, Humidity & Wind**

	Abatan, Buguias	Mankayan	Cervantes
Average Temperature			
Before-Project (Pre 2008)	10.00 to 22.50 °C	9.50 to 27.00 °C	23.02 to 33.40 °C
After-Project (Post 2010)	23.00 to 30.00 °C	13.20 to 22.90 °C	17.80 to 29.90 °C
Mean Monthly Rainfall			
Before-Project (Pre 2008)	73.80	30.2 mm	22.80 mm
After-Project (Post 2010)	114.30	85.2 mm	54.80
Average Monthly Humidity			
Before-Project (Pre 2008)	82%	89%	51%
After-Project (Post 2010)	96%	98%	82%
Wind Speed and Direction			
Before-Project (Pre 2008)	10 kph NE	10 kph NE	8 kph
After-Project (Post 2010)	10 kph NE	10 kph NE	8 kph

CAR is considered an airshed but data to monitor airshed conditions are not widely measured, only in a few selected areas. Even the ECC of the road project does not indicate any baseline information on these. The DENR-EMB regional office routinely monitors air quality through its HV sampler which measures PM_{10}, NO_2, SO_2, and O_3. The air quality monitoring device is installed in Baguio City's central business district and is therefore not representative of the air quality in other places in CAR, much less so with the Cervantes-Mankayan-Abatan locale. A more localized monitoring station would provide more indicative and useful values.

To gauge the impact of the road project on air quality in view of the dearth of quantitative data, appropriate qualitative information can be referred to. In the focus group discussions with representatives from the communities within the road ZOI, a perception of increased pollution after road improvement was a consensus. Before the road was improved, pollution from dust during dry periods were experienced on account of the road being of gravel/soil surface. After the road was improved, pollution mostly came from vehicle emission. Data on AADT show that the volume of vehicles plying the road rose by 69 percent when comparing the annual averages over five years before project completion (767 vehicles/day) with five years after (1,294 vehicles/day). It appears that the communities within the road ZOI are experiencing the adverse impact on air quality resulting from the rise in vehicle traffic. This is felt mainly in the town centers where hourly traffic at present can reach as high as 458 vehicles in Cervantes, nearly 300 in Mankayan and close to 250 in Abatan.

4.2.5 On Natural Hazards

Hazard Data from the DENR-MGB, as of 2010, classifies the area traversed by the Cervantes-Mankayan-Abatan Road as:

- Rain-Induced Landslide Hazard: Moderate to High Susceptibility
- 14km away from active faults, namely, Abra River Fault and Ambuklao Fault
- Ground Shaking Hazard: Intensity VIII or higher (very destructive to devastating ground shaking)
- Earthquake-Induced Landslide Hazard: Moderate to High Susceptibility
- Specifically In Mankayan: sink holes, subsidence
- Specifically in Cervantes: silted river banks, flooding in low-lying areas/farms

Based on the CLUPs of the concerned municipalities, these hazards continue to loom over the said areas, generally unchanged in the before- and after-project. Specifically, the following hazard occurrences and/or disaster events along the road have been identified: erosion, landslides, sinking, ground movements, and flooding in low elevations.

The areas traversed by the road are located along the typhoon belt in the Pacific where approximately 20 typhoons are experienced each year (Figure 6.6). An average of five of these typhoons are categorized as destructive and had been known to incur vast infrastructure damages. Typhoons frequently make landfall at Northern Luzon, the Bicol Region, and the Eastern Visayas Area.

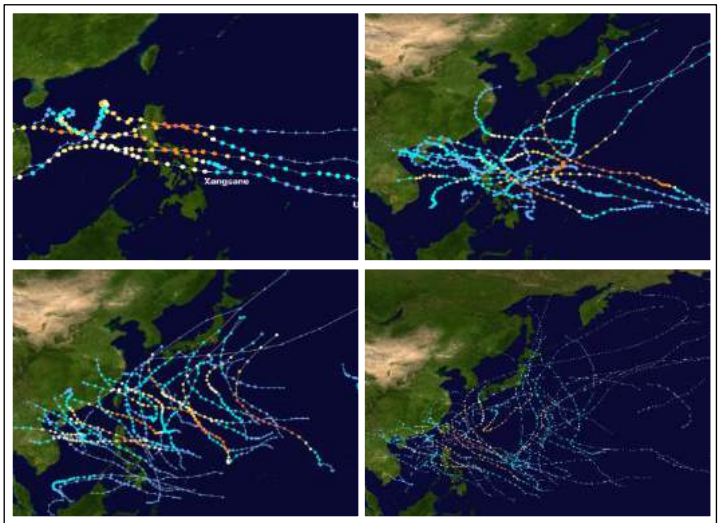


Figure 4.15. **Deadly typhoon tracks that pass through the Philippines**: 2006 (upper left), 2009 (upper right), 2013 (lower left), and 2016 (lower right).

The slope of the lands within the road ZOI make the area highly vulnerable to rain-induced erosion and landslide. This is particularly true in the Mankayan and Abatan areas where slope rises as high as 68.5 degrees. On the other hand, the lowlands of Cervantes where slopes are as low as 17 degrees, are vulnerable to flooding.

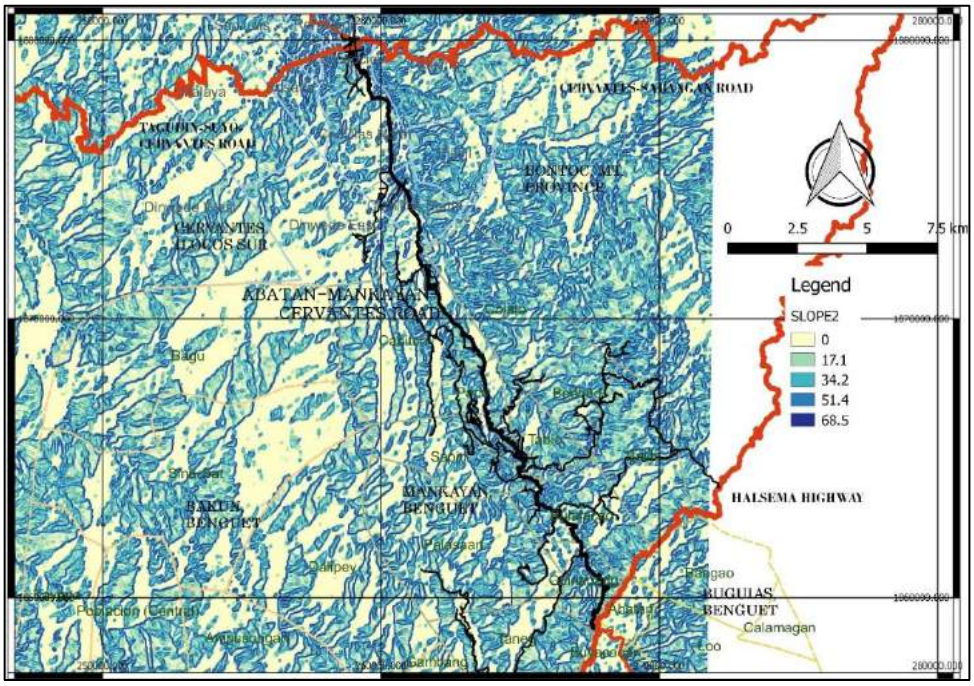


Figure 4.16. **Slope Map**

Figure 4.17 shows that the Abra River Fault lies within approximately 3-kilometer radius from the Cervantes-Mankayan-Abatan Road. Two earthquake epicenters of 5.3 and 5.4 magnitude were observed in Cervantes, within 5-kilometer radius from the road. Figure 4.18 is PHIVOLC's composite map of estimates of maximum intensities for various earthquake scenarios that may affect Mankayan and Buguias. The map shows that the Cervantes-Mankayan-Abatan Road traverses areas classified to experience very destructive to devastating ground shaking.

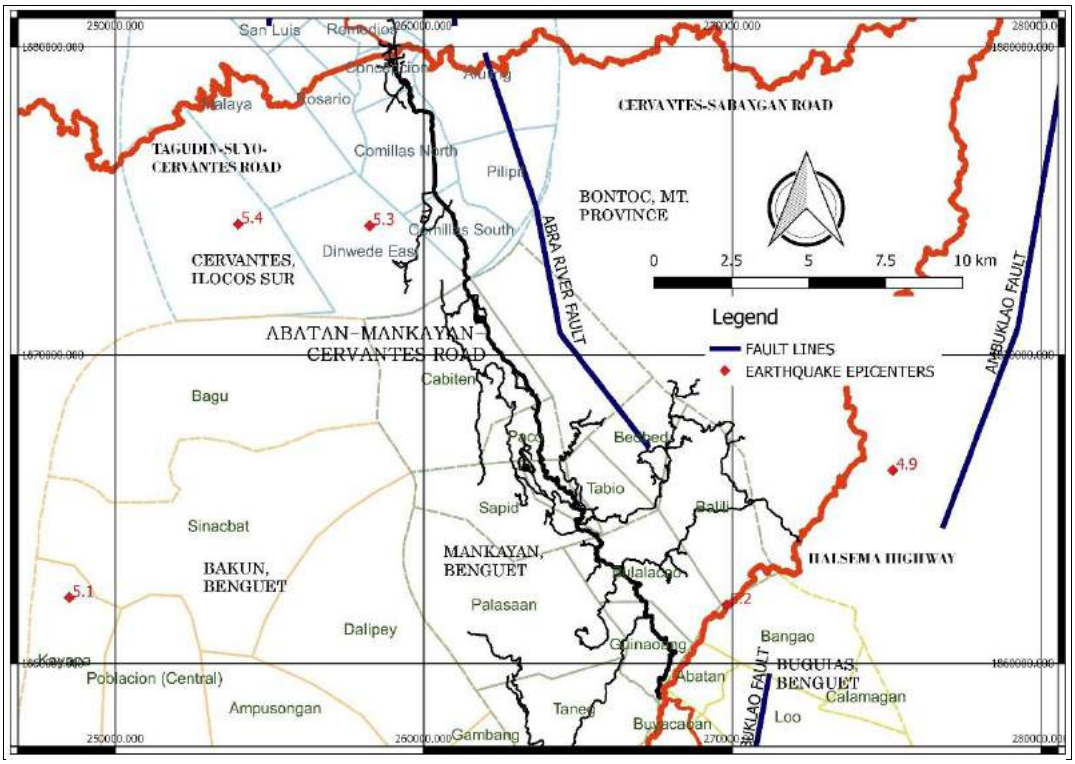


Figure 4.17. **Earthquakes and fault lines**

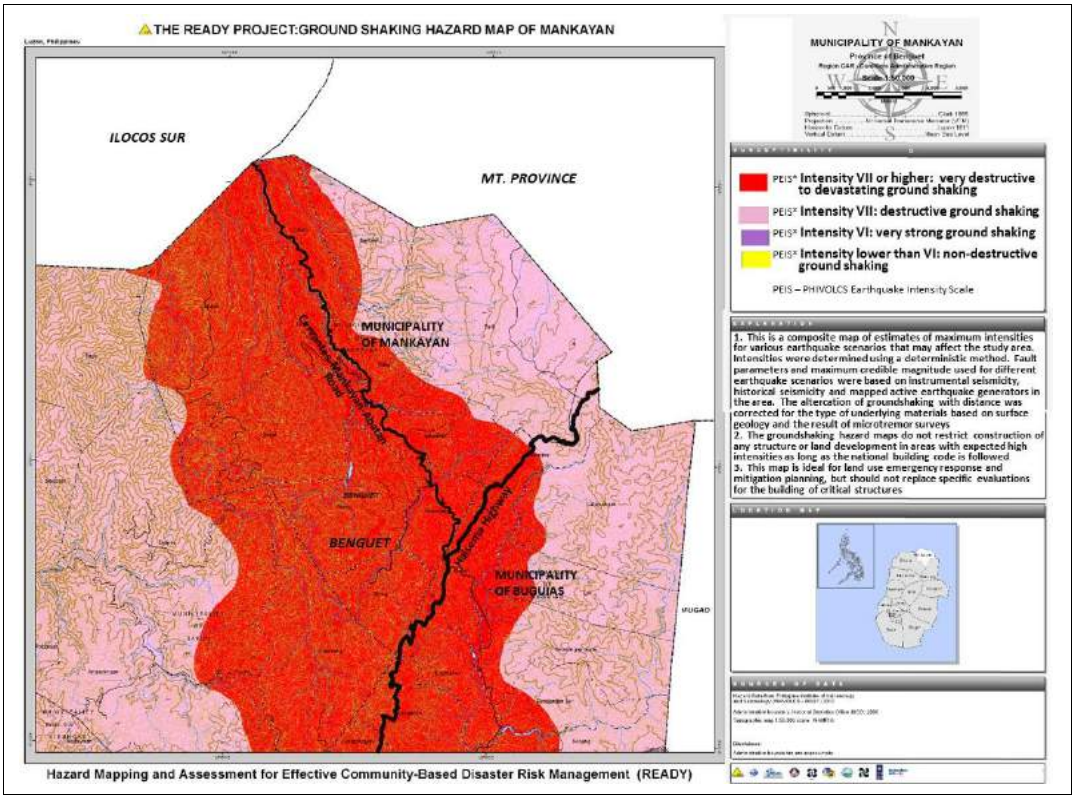


Figure 4.18. **Cervantes-Mankayan-Abatan Road traverses areas classified to experience very destructive to devastating ground shaking**

The road ZOI is inherently vulnerable to major hazards that can trigger events of landslides and erosion caused by heavy rains and/or ground shaking. The question is whether or not the improvement of the road raised the degree of exposure of the ZOI to these hazards compared to how it was before road improvement.

The discussions during the FGD and with key informants confirm the regular occurrence of roadside landslides before and after the road was improved. No major improvement in this regard was perceived after the project. During the pre-2008 phase, sand and gravel extraction in the lowland areas of Cervantes were observed to cause bank erosions and this event was covered by the ECC. Landslides and rockslides were already observed during heavy rains or typhoons especially on the Cervantes side and these were also covered by the project ECC. The frequent occurrence of landslides along the road that persists during typhoons and rainy season indicates that the road project did not adequately provide for road drainage facilities during its construction phase. Figure 4.19 illustrates this. Flooding and erosion arising from inadequate road drainage were among the major problems identified in the CLUPs of the concerned municipalities now that the road was concreted. Though road safety is perceived to have generally improved after the project, it is apparent that roadside landslides remain a travel safety issue during rainy seasons.

Figure 4.19. **Problems prevalent during the rainy season.** These photos were taken in June and shows the accumulation of water run-off (left), areas of soil erosion (middle), and the volume of water that runs on the road pavement if the drainages are not put into place (right). The absence of parapet walls/retaining walls allow for landslides to happen.

A road rehabilitation project is in progress as of the time of this study which is expected to solve the above-mentioned problem. The signboard (Figure 4.20) for this DPWH Project states: "Rehabilitation/Reconstruction/ Upgrading of Damaged Paved National Roads including drainage based on pavement management system" with a budget of Php 46.72 million.

Figure 4.20. **Signboard for on-going road works along the Cervantes-Mankayan-Abatan Road**

Sinking areas are also found within the two-kilometer road ZOI. The figure below shows a specific site affected by this. The people around the affected areas believe that the sink holes/sinking areas are caused by large scale mining operations. A key informant from Lepanto said that the Company deployed its Geologist to determine the real cause, and the findings point to the geology of the site—traversed by fault line and/or naturally vulnerable to ground shaking.

Figure 4.21.
Soil collapse in front of the Mankayan National High School where the elementary campus was previously located. The residents woke up to see the first stages of movement (left) which eventually led to soil collapse (right).

The impact of the road is on the magnitude of exposure to the hazards. The road project inadvertently contributed to the exposure of more people to the safety risk posed by ground shaking in Mankayan. The improvement of the road has strengthened the migration pull of mining in the locality, with migrant workers for small scale miners flocking into the place. Small-scale mine portals are very vulnerable to cave-ins due to sink holes, earthquake-induced ground shaking and rain-induced landslides. There are now more people working under these hazardous conditions than before the road was improved,

4.3. Perception of Change in the Environment

The information generated through the focus groups discussions lent the primary data, though of qualitative type, that can indicate general changes in environmental conditions after road improvement. The FGD-generated information are here used as proxy to pertinent quantitative data that are not available nor accessible at present, and to qualify some findings inferred from secondary information, those revealed by key informants and from site observations.

The participants to the FGD assessed seven aspects of the environment in the before-, during-, and after-construction phases as shown in the table below. Overall, the participants perceived that the environmental conditions in their respective areas have declined—from "Very Good" before the project, to "Fair" after the project.

Table 4.6. **Characterization of the Environment Before the Project, During Construction, and During Project Operation**

Environmental Issue	Before Construction	During Construction	During Operation
1. Water			
Water Quality	Good	Fair	Fair
Water Quantity	Plenty	Adequate	Adequate
2. Drainage			
Flooding	None	Yes	Yes
River/Stream run change	None	None	None
Siltation in rivers/streams	None	Yes	Very Yes
3. Air/Temperature			
Increased temperature	None	Yes	Yes
Dust/pollution	Yes	Yes	Yes
Increased noise	None	Yes	Yes
4. Flora and Fauna			
Loss of vegetative ground cover	None	None	None
Loss of forest cover	None	Yes	Yes
5. Soil/Land			
Soil quality	Good	Good	Fair
Soil erosion	Yes	Yes	Yes
Landslides	Yes	Yes	Yes
Rockslides	Yes	Yes	Yes
6. Land Use			
Increased urbanization / roadside communities	None	Yes	Yes
Resettlement of people	None	Yes	None
Relocation of structures	None	Yes	None
Conversion of agricultural lands to settlements	None	Yes	Yes
7. Aesthetics			
Landscape aesthetics	Good	Fair	Fair
Overall Assessment	**Very good**	**Good**	**Fair**

***Pre-2008, Before Construction**:* The state of the environment was characterized as "Very Good" though there were indications of soil erosion, landslides, and rockslides during rainy season and dust from the road during dry periods.

2008-2010, During Construction: The state of the environment was characterized as "Good." Perceptions of increased temperature, dust, noise, soil erosion, landslides and rockslides were expressed. The ECC provided mitigating measures to prevent/reduce flooding, landslides, and rockslides. It may be inferred that during this phase, road cuts along mountainsides resulted to the reduction of forest and ground cover which may explain the landslides. Urbanization along roadside communities also became apparent, together with the conversion of forests to agricultural use especially on areas where barangay roads were constructed. Mining settlements were observed to have increased at the Suyoc area which could be reached through a paved road. Flooding adjacent to the roads were experienced due to the ongoing road construction.

***2011-onwards, During Operations*:** The state of the environment was considered "Fair." Degradation was reported to be evident in both the man-made and natural environments. More pronounced events on increased temperature, dust, noise, soil erosion, landslides, and rockslides were perceived. At the same time, increasing urbanization along roadside communities continued, and pathways and narrow roads leading to urban settlements parallel to the town centers were observed. This gave rise to on-street parking along the road which diminishes the effective road width. The market area of Mankayan serves as a shared road for both vehicles and pedestrians. The aesthetics of the urbanizing areas were felt to be declining. The flooding that happens along and adjacent to the road were attributed to the absence of road drainage system, although this is already being corrected by an ongoing rehabilitation project of the DPWH.

The focus group participants were also asked to rank the importance of the different environmental features per locality. Table 4.7 summarizes the results. The numbers indicate the ranking, with 1 as the most important and 7 as the least. The qualitative assessment of condition in the after-project phase is also presented for each of the environmental parameter.

Table 4.7. **Ranking of Environmental Features Per Locality**

	Environmental Issues	Ranking & Qualitative Assessment per Locality		
		Abatan	**Mankayan**	**Cervantes**
1	**Water**	**2**	**2**	**1**
	Water quality	Fair	Fair	Very poor
	Water quantity	Adequate	Adequate	Adequate
2	**Drainage**	**3**	**5**	**3**
	Flooding	None	Yes	Yes
	River/stream run change	None	None	None
	Siltation in rivers/streams	None	Yes	Very yes
3	**Air/Temperature**	**5**	**7**	**6**
	Increased temperature	None	Yes	Yes
	Dust/pollution	Yes	Yes	Yes
	Increased noise	Yes	Yes	Yes
4	**Flora and Fauna**	**4**	**4**	**5**
	Loss of vegetative ground cover	No	No	No
	Loss of forest cover	Yes	Yes	Yes
5	**Soil/Land**	**1**	**1**	**2**
	Soil quality	Acceptable	Acceptable	Acceptable
	Soil erosion	Yes	Yes	Yes
	Landslides	Yes	Yes	Yes
	Rockslides	Yes	Yes	Yes

Environmental Issues		Ranking & Qualitative Assessment per Locality		
		Abatan	Mankayan	Cervantes
6	**Land Use**	**6**	**3**	**4**
	Increased urbanization/roadside communities	Yes	Yes	Yes
	Resettlement of people	No	Yes	No
	Relocation of structures	No	Yes	No
	Conversion of agricultural lands to settlements	Yes	Yes	Yes
7	**Aesthetics**	**7**	**6**	**7**
	Landscape aesthetics	Fair	Fair	Fair

The ranking of importance of the different aspects of the environment were averaged as shown in Table 4.8. The ranking can guide in prioritizing and designing the focus of interventions to address environmental issues.

Table 4.8. **Ranking of Attributes by Importance**

Environmental Attribute	Rank
Soil/Land	1
Water	2
Drainage	3
Flora/Fauna	4
Land Use	4
Air/Temperature	5
Aesthetics	6

It can be noted that the ranking is associated with the attentiveness that the people give to economic objectives, more than other considerations like environmental conservation and safety. The more proximate the environmental feature is to their livelihoods, the greater they deem its importance. The people in the localities ranked soil/land and water at the top among the environmental attributes. This is expected given that agriculture is their primary source of income.

The relatively low level of concern about issues on the quality of air/temperature can be among the reasons why small-scale miners brave the high risk of suffocation and acute dust exposure within mine portals. The low ranking of aesthetics in their scale of importance is also a challenge to the preservation of quality landscapes and important sites.

4.4. Summary of Findings

Land use. The road led to the expansion of commercial and other built-up areas, especially near the road. Congestion is increasingly felt in the town centers which led to RROW incursions and residential areas encroaching up forested lands. Agricultural areas near the road subsequently shrunk with the growing pressure of urbanization. Forest areas likewise contracted as roads opened these up to cultivation because of easier access.

Land resources and biodiversity. The elevation characteristics of the road ZOI classifies the area into lowland and highland ecologies apart from the urban/urbanizing areas. Vegetation in the highland ecology is mostly pine forest while the lowland ecology is predominantly tropical forest. The rapid expansion of human activities into forest lands after road improvement most likely intensified the risk of extinction of some species within these ecologies. A number of species are already vulnerable to extinction or endangered. Changes in agricultural activities could have also impacted on biodiversity resources within the road ZOI with any new introduction or loss of crop species.

Water resources. The pollution in Abra River caused by large scale mining may have worsened with the growth of small-scale mining in Mankayan after the road was improved. The likelihood of increased cyanide concentration at the river is higher now with the expansion of small scale mining activities. Siltation may have also worsened from erosion and landslides at the roadside and from other areas affected by ground movement and rain-induced landslides particularly with less forest cover than the time before the road was improved.

Air pollution. The people within the ZOI appear to be feeling the negative effect on the air of increased vehicular traffic resulting from the improvement of the road, specifically at the town centers where vehicular traffic merge.

Natural hazards. The road project facilitated the exposure of more people to the natural hazards that affect the road ZOI, particularly rain-induced landslide, earthquake-induced land slide and ground-shaking hazard. This is very pronounced in Mankayan where the road project contributed to the migration of workers for small scale mining in the locality. Occurrence of hazard-induced landslides and erosion, aggravated by the continuous loss of forest cover, resulted in the siltation of water ways. This, in turn, intensified the occurrence of flooding in the lowlands of Cervantes.

Overall perception of change in the biophysical environment. The communities within the road ZOI perceive the environmental conditions to have declined, from "very good" before the project to "fair" after the project. Perceptions on reduced quality of soil/land and water resources and inadequate drainage significantly weigh into this assessment as these directly affect one of their major livelihoods, agriculture.

Accountability for environmental changes. The environmental impacts of the project could have been given attention as early as the project planning phase if the environmental objectives are clearly stated and given due importance together with socio-economic goals, especially since the latter are dependent on natural resource extraction and exploitation. The lack of baseline environmental data reflects the inadequacy of environmental assessment of the project impazt area that could have also guided the project's environmental conservation/protection and management aims. Since the EIA accounted for environmental compliance only during the project design and implementation stages, the maintenance and protection of the environment after the completion of the project was practically left to chance, in an uncertain state.

Chapter 5
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The findings distill into conclusions along lines of: a) project effectiveness; b) project efficiency ; c) project sustainability; and e) the road and sustainable development.

5.1.1. Project effectiveness

Up to what extent did the project attain its intended impacts? The findings reveal that the improvement of the Cervantes-Mankayan-Abatan road delivered its promise, to a general degree. Its foremost objective of improving accessibility—to/from the Ilocos region to the west, to/from the rural areas, between and among growth centers—are generally being met. In the process, it was able to stimulate positive socio-economic changes as expressly intended in the project design.

1) On the objective of lowering the vehicle operating and maintenance costs

Using the PUJ as the case, the drivers and operators said that their VOC and vehicle maintenance cost have been reduced with the improved road, though the amount cannot be estimated at present because of the lack of past data. Compared with averages in Mega-Manila, VOC and vehicle maintenance cost are higher within the Cervantes-Mankayan-Abatan loop. This can however be due to differences in road terrain that affects vehicle performance efficiency.

2) On the purpose of the road as a western lateral road and the shortest route for vehicular traffic between western provinces of Ilocos Sur and La Union through the provinces of Benguet and Mountain Province.

The findings suggest that this objective is fairly being met. The improvement of the Cervantes-Mankayan-Abatan road reduced the travel time by about 45 minutes. Because of this, vehicle traffic along this route increased by about 69 percent when comparing the AADT for the five years prior to road improvement and five years after.

Data on the AADT indicate that the road is well utilized as an alternate route from east to west (Abatan to Cervantes) towards Ilocos and Mt. Province. Trading remains to be the major propeller of traffic along the road, but the direction is more towards Ilocos with the road appearing to be more of an exit point on this side of the Cordillera. From the commercial centers within the Cervantes-Mankayan-Abatan loop, merchants appear to continue on towards other commercial centers outside of the loop and take another route back to their points of origin. Some motorists coming from the northern areas of CAR are also drawn to the attraction of Bessang Pass that makes the Cervantes-Mankayan-Abatan road a preferred exit route.

The improvement of the Cervantes-Mankayan-Abatan road also enabled the development of secondary roads from the Benguet section of the road towards the southeastern parts of Mt. Province. Already, a shorter route is now in the works to reach Tadian from the road section in the Mankayan area.

3) On the objective of improving interconnection of growth centers through an upgraded, improved and expanded backbone of networks of roads

Abatan and Cervantes are the growth nodes that are directly within the road zone of influence. Abatan's long history of trading progressed into a buzzling commercial hub that it is now, gaining from its strategic location at the crossroads of major road networks. Cervantes is the growth center for the cluster of municipalities comprising Cervantes, Quirino and San Emilio that used to be left out from major road networks in the Ilocos Region due to their geographic location. The growth of agri-industrial enterprises in Cervantes is linked with the growth of commercial services in Abatan. The improvement of the road that connects this two nodes expanded the economic activities between them that radiated further to the localities around them via secondary trading routes. Cervantes now trades with municipalities in Mt. Province specifically Tadian, Bauko and Sabangan via the Cervantes-Sabangan road which effectively widens the economic network among the growth centers in these parts.

At the broader scale, the economic ties of these growth centers remain to be largely concentrated with the Baguio-La Trinidad area, through output and input markets. Cervantes notably benefited the most from the faster travel to Baguio City as a result of the road project. These growth centers have yet to establish substantial links with major economic centers in the Ilocos Region. Even Cervantes, a part of Region 1, is more linked with CAR.

The development of this localized networks of small growth centers in the Cervantes-Mankayan-Abatan loop can be viewed as a readying for more effective ties with major growth centers in Ilocos. The Ilocos Region is a growth area that is physically connected with the CAR via the Cervantes-Mankayan-Abatan-Suyo-Quirino Road. The development of Port Currimao, Laoag International Airport, and the national highway will hasten the mobility of people, goods and capital to and from the Ilocos Region. The rise of industries in the Ilocos Region already started since 2008. It is expected to grow further as more infrastructure projects are developed in the region. This growth is expected to spill-over into the municipalities of Suyo, Cervantes, and Quirino through the development of logistic support such as trucking and other service type industries such as trading and finance. The improvement of the Cervantes-Mankayan-Abatan road makes it viable for Abatan and other growth centers in Mt. Province to take advantage of potential economic linkages as well.

4) On the objective of providing a more efficient, faster, safer, and reliable means of transportation in the rural areas

This objective has been well achieved. Options on mode of transport have increased because of the improvement of the road. It spurred the demand for better modes of public transport that was met with the corresponding private investments. Operators of public utility AUVs/vans now service the communities within the ZOI. The ubiquitous tricycle are bringing commuters to interior barangays that, before, can be reached mainly be walking. There are now more and better-maintained PUJs plying the ZOI.

And while improving the quality and availability of public transport, with better road, the option to shift to the comfort and convenience of private mode of transport is also now open to more people.

Road safety, however, is a concern that needs to be addressed more. Landslides, inadequacies in traffic control devices, lack of sidewalks and road obstructions continue to pose travel hazards along the Cervantes-Mankayan-Abatan road.

5) On the intention of enhancing the socio-economic activities within the municipalities of Mankayan, Benguet and Cervantes, Ilocos Sur

The shorter travel time and improvements in the modes of transport translated into lower transportation cost, faster travel, and lesser opportunity and search cost. These positively affected the socio-economic conditions of the communities within the road ZOI. The following findings support this:

Agriculture. The development of the Cervantes-Mankayan-Abatan road increased agricultural trading. This, in turn, encouraged more farm production. In Mankayan, better roads made it possible for farmers to transport agricultural output with minimum spoilage losses while in transit. In Cervantes, with market already accessible and farm technologies physically reachable, subsistence farming have leveled-up towards producing for cash and diversifying the crops.

Mining. The improvement of the road contributed to increased income from small scale mining in Mankayan. Miners have improved access to market information that allows them better handle over trading. Additional savings from transportation and transaction costs are generated with financial suppliers now travelling all the way to the mining communities. For Lepanto, the rehabilitation of the Cervantes-Mankayan-Abatan provided an alternative route for its trucks and equipment for the hauling of raw materials like timber and bamboo coming from the Ilocos regions.

Trading and other services. The faster mobility of people and goods resulting from the road project propelled the growth of trading and other economic services in both Mankayan and Cervantes. Livelihood activities have notably spread from farming to trading and mining to trading, and a combination of agricultural activities with trading and employment. In Cervantes, income from trading is increased by the savings on transport cost--because the cost of transport is born primarily by buyers/traders that travel to their locality to pick up the products. In Mankayan, farmers are able to earn more income from trading due partly to lower spoilage of the produce they bring to markets outside of the locality.

Tourism. Tourism is yet to emerge as a major industry within the road ZOI. The Cervantes-Mankayan-Abatan road is mainly used as gateway and exit to well established tourist destinations in the Cordillera and the Ilocos region. Nonetheless, the road exposed the scenic and historical appeal of Bessang Pass to travelers, and has now become a favorite stop-over. This hints at the potential of the place to emerge as a tourist destination in the future.

Employment and income. The development of the Cervantes-Mankayan-Abatan road diversified the income generating opportunities within the ZOI that allowed households to expand their livelihoods beyond the primary income source. Cervantes, being the least developed and relying mainly on farming before the project, benefitted the most from this outcome. Moreover, because of shortened travel time, people can seek employment outside the municipality without incurring the psychological and economic cost of being away from their homes for an extended period.

Health. The road project has the most significant impact on access to health services. Health-related reasons came out as the biggest purpose of trip along the road in the case of Cervantes and Mankayan. The improvement of the road meant that health needs can be responded to on time because health services are more accessible to households and the means of

transport are more available now than before the road was improved. The communities in Cervantes, in fact, view the importance of the road mostly in terms of access to tertiary health facilities, the nearest for them are in Abatan.

Education. The development of the road shortened the travel time of children from home to school. Before the project, many children had to walk to school as far as two-kilometer distance. With the road, children can take a few minutes ride to school. And this created the demand for school transport services which in turn yielded additional income for operators/drivers of jeepneys, tricycles, and motorcycles catering to this specific need.

Housing. The improved road lessened the hauling cost of construction materials for housing. This resulted in the construction boom within the road ZOI using studier materials, particularly for concrete-made houses.

5.1.2 Project Efficiency

Granted that the project attained its intended impacts, are these at the level of best possible outcomes given cost and other constraints? Some efficiency issues surfaced that made accessibility outcomes less than optimal.

- Motorists avoid the Cervantes-Mankayan-Abatan route during times of heavy rains because of safety issues, particularly the regular occurrence of roadside landslides caused by inadequate drainage facilities and slope protection measures
- Other highway safety concerns arise from the inadequacy of traffic control devices, lack of sidewalks and road obstructions
- Incursions into RROW, especially in the town center of Mankayan and at the road entry point in Abatan, are effectively reducing the carriage width of the road, thereby restricting mobility
- Lack of terminals for public utility vehicles in the town centers contribute to RROW issues, and reflects the gap in the transport system borne by the failure of local land use plans to support accessibility and mobility.

The road project rates positively on matters of economic efficiency with the increasing traffic for goods utility, considered a high value trip. This exhibits the growing trade and commerce within the road ZOI after the road was improved.

An issue can be made in regard to the notable shift of mode preference from public transport to private transport after the road improvement. Public transport modes are generally more efficient. However, space-efficiency over the stretch of the road is not a major concern because the level of service of the road is very high—traffic is generally free-flowing from end to end. The road's designed carriage width of two-lane, two way is sufficient to carry the projected AADT even up to year 2050. Inefficiency along this line can arise on fuel consumption for low occupant vehicles. But this is not considerable at present given that many owners of private vehicles within the ZOI use their vehicles to also transport produce to the market.

5.1.3 Project Sustainability

How many years should the road last with proper maintenance? What decisions and arrangements did the government take to guarantee this? The DPWH adopted a 230 mm pavement thickness for the Cervantes-Mankayan-Abatan road, above the 200 mm minimum standard, which is over the design life of 20 years. This study finds that the volume of 2-axle and 3-axle trucks projected over the

next 20 years, including those from Lepanto mines, will not be heavy enough to cause serious structural damage on pavements as planned, even until year 2050.

At present, damages to pavement are not caused by trucks but by the lack of drainage facilities and slope protection measures. This is a concern that the DPWH is now addressing through the implementation of a road rehabilitation program for the Cervantes-Mankayan-Abatan road with a budget of Php 46.726 million.

To achieve a lifespan of 20 years, a yearly maintenance of the wearing surface is needed. The yearly routine maintenance budget of DPWH did not mention of wearing surface maintenance of the pavement. DPWH needs to take this into account to avoid further expensive capital outlays for major road rehabilitation in the future.

5.1.4 Sustainable Development and the Road Project

What changes in the bio-physical environment of the road ZOI transpired after road improvement that can be directly or indirectly attributable to the project? The road project has not been leveraged for development with an eye for sustainability. The project design was silent on the trade-offs between its economic objectives and the need for environmental conservation. As such, no measures and interventions were deliberately pursued to ensure that the socio-economic developments that followed the road will cause minimum impact on the bio-physical environment. In the process, it brought about unintended consequences of far-ranging magnitude, some irreversible.

- The expansion of built-up areas, especially near the road, is leading to congestion that caused RROW incursions and is driving residential areas further up forested lands.
- Agricultural areas near the road shrunk with the growing pressure of urbanization.
- Forest areas are receding as feeder roads made these accessible to cultivation, which in turn intensified the risk of biodiversity loss.
- The likelihood of increased cyanide concentration in Abra River is higher now with the expansion of small scale mining activities in Mankayan than it was before road improvement.
- Siltation may have worsened because of erosion and landslides at the roadside and from other areas affected by ground movement and rain-induced landslides.
- River siltation most likely intensified the occurrence of flooding in the lowlands of Cervantes.
- The road project facilitated the exposure of more people to the natural hazards that affect the road ZOI, particularly with the influx of workers for small scale mining in Mankayan.

The findings on the socio-economic impacts of the Cervantes-Mankayan-Abatan road project indicate that the expressed economic objectives of the project have been attained in varying degrees. However, sustainable development remains a nominal objective; many economic activities trailing the road are still manifestly unsustainable.

5.2 Recommendations

5.2.1 Optimizing the Socio-economic Benefits of the Road

The development of the Cervantes-Mankayan-Abatan road provides the missing link between the industry and the agricultural sector. The two areas, Abatan and Cervantes are predominantly reliant on agriculture, while Mankayan struggles to strike a balance between agriculture and mining. The growth in agriculture remains to be slow but stable, but the rise in industry particularly in Region 1 will change the economic landscape of the areas along the Suyo-Tagudin and Quirino-Candon routes and further along the Abatan-Mankayan-Cervantes route. These are the routes of the spill-over effects of the industrialization of the Ilocos Region. If households are slow to catch-up on the development of its neighboring areas, investment on logistics support such as warehouse, trucking, communication and financial facilities will be exogenously generated (i.e. external investors). While this may create jobs in the Abatan-Mankayan-Cervantes-Suyo-Tagudin-Quirino-Candon loops, social preparation is necessary to orient the development of these areas to be truly sustainable, by striking a balance between development and the protection of its natural resources such as water and forest. This calls for a political will to integrate sustainable investment plans where zoning and property rights are respected to minimize the eventual impact of the displacement of households further into the interior areas because land had been sold to external investors.

Specific focus of the development plans must be on:

a) Human capital which is integral to development will remain to be a challenge to reckon with. Most of those who are likely to stay along the road loop are those with lower educational attainment, and are likely to be employed by logistics industries. Service supports such as the operation of small-medium enterprise that supports the need of logistic industries has to be carefully studied so as not to exclude households from the fast growth and development that is expected to happen in these areas.

b) Tourism such as agri-tourism, eco-tourism, historical tourism, and food and culture tourism had to be carefully crafted, to encourage tourist to spend at least two days in these areas, if this remains to be undeveloped, these areas will remain to be stop-overs and depots. Tourism plan has to be “community-centric”, that is tourism must respect and preserve the values of the IP communities.

c) Develop a comprehensive study plan for warehouses and transport support in strategic places, particularly along the Quirino-Candon-Cervantes and Suyo-Tagudin-Cervantes loops.

d) Safety nets must accompany development plans to ensure that no one is left behind in the growth and development of these areas, for example estimate how much subsidies should be provided to farmers, micro-entrepreneurs, women, children and the senior citizens, in the form of social insurance, displacement and amnesty cost, for health, education and other welfare services.

e) Mining and other quarrying prospects will continuously nag the municipalities of Cervantes and Quirino, which is already happening in these areas, lessons have to be learned from previous mining operations and their impact on the environment, and the labor and migration diaspora of people of host communities.

f) Side by side with trading, agro-processing plants must be considered in the long run as these take the form of direct investments in terms of capital accumulation in the form of business firms assets such as building, factory, infrastructure, technology, and other physical capital such as equipment.

Properly planned spatial distribution of households, businesses and even government offices evenly distributes the benefits of improve roads, thus, planners whether planning for investment, tourism, and industry development, must consider the breadth and depth of the zone of influences of these activities.

The indirect impacts of road development, as observed in better standard of living, better health, high literacy rate, political and cultural maturity, in the long run will in some ways become automatic stabilizers of the desire for inclusive growth.

5.2.2 Recognizing and Planning for the Negative Environmental Impacts

Clarifying environmental objectives in the design and planning phase. By clearly defining the environmental objectives of the project as early as the planning phase, the environmental impacts of infrastructure projects can be planned for and correspondingly integrated into the project design. This points back to the need for an exhaustive environmental assessment of a project site which will set the baseline environmental data and also guide the project's environmental conservation/protection and management aims.

The dearth of environmental documentation, especially during the planning and design phase (pre-2008), the implementation phase (2008-2010), and immediately at the start of road operations (2011), regretfully does not allow for quantifying the "chain of causalities" at source before 2008 to the 2017 impacts, or the time of this study. Data that was gathered to account for the years before 2008 to 2016 remain anecdotal but these could be used in the future as the baseline.

It is recommended that at the EIA preparation stage, an expanded list of environmental characteristics that are susceptible to impacts may be generated which would present a full picture of the environment to which the project will be situated. This list, when properly documented, shall serve as the baseline for foreseen environmental impacts, their possible locations, and their indicators. The Table 5.1 is a suggestion of how the list may be generated. Accompanying maps and/or GIS database shall be very useful.

Table 5.1. **Suggested Baseline Data for Assessing Environmental Impacts**

Category	Possible Impacts	Unit of Measurement
WATER	pollution, reduced quantity	pH, SO_2, NOx nitrates, volume, number of polluted water sources
DRAINAGE	flooding, realignment	coverage area, volume, watercourse
AIR, TEMPERATURE, NOISE, & VIBRATION	pollution, temperature change	°C/°F, ppm, CO/CO_2, dB
FLORA/FAUNA	fragmentation, migration, loss/extinction, damage to habitat	population, habitat map
SOIL/LAND	contamination, erosion, slides	pH, area, volume
LAND USE	land cover permeability, land use/land cover change	area, volume
AESTHETICS	degradation, exposure, conversion	area, landscape quality, important sites

The EIA is expected to serve as the document that will present the latest environmental characteristics of a project area thus, data should be localized and quantitative in nature which will allow for the setting of benchmark and target values across different environmental parameters as suggested in Table 5.1.

Different environmental issues are adequately covered through different policy, legislative, and administrative orders in the country and these should always serve as the framework for organizing road project goals and objectives. The Social and Environmental Management Systems (SEM) Manual of Operations of the DPWH, which was adopted in 2003 and updated in 2014, clearly sets the Department's policy direction to "fast-track its development of infrastructure projects considering the need for integrating social and environmental requirements for sustainable development." This manual, together with all other pertinent regulatory measures now in place, can adequately cover all possible aspects that pertain to the environment.

Acknowledging the inextricable relationship of road and land use/land cover. Mankayan was declared as an ancestral domain. A CADT was issued with the expressed intent of empowering IP communities to manage their ecosystems and resources for their sustenance, building their capability for self-governance and preserving their indigenous knowledge systems, culture and traditions for their future generations. The incorporation of indigenous knowledge systems in land use planning and zoning can be a strategy to curb rapid land use and land cover change arising from the improvement of the road.

The Comprehensive Land Use Plan and Zoning Ordinance may be the best policy instrument at the local level that will set the tone to how environmental conservation and protection may happen together with road development and management. An Urban Plan, especially on the poblacion areas, may become necessary in order to manage road use and rights of way, land development, accessibility, and aesthetics.

Very specific and well-delineated boundaries as well as the mapping out of buffer areas that may separate the protected forests from settlement and agricultural areas may need to be drawn up as well in order to prevent further and uncontrolled encroachment.

The necessary actions towards the protection of Ecologically Critical/Sensitive Areas, on the other hand, should be performed on a regional scale since the considerations for this area goes beyond political boundaries and cultural domains. The natural landscapes, as evidenced by the biodiversity of the three municipalities), should also be a joint effort.

If roads linking the Cervantes-Mankayan-Abatan Road to interior barangays are not feasible or may cause further landscape fragmentation, other forms of mobility like trams and cable cars may be proposed.

Integrating related aspects of Disaster Risk Reduction and Management and Environmentally Critical Areas. The following can be considered:

- Incorporation of mitigation measures for climate change impacts, natural disasters, and man-made disasters;
- Incorporation of design parameters for environmental extremes; and
- Resiliency plan.

Natural Resource Accounting. As an adjunct to an EIA, a detailed quantitative and qualitative accounting of natural resources is deemed a necessity at this point in time especially in the light of Climate Change and Disaster Risk Reduction and Resiliency. An impact assessment on floral and faunal populations should start from a baseline numeric value.

5.2.3 Inter-agency Convergence in the Development of Road Projects

Crossroad convergence: keeping right. Roads can put communities at the crossroads of development, literally and figuratively. Roads will open them up to drastic changes in which the navigation of trade-offs becomes more complex. Leveraging a road project for development with an eye for sustainability means taking the opportunities presented by the road to advance sustainable development activities. Part of the challenge is to counter opportunistic inclinations that conspire with weak regulatory enforcement to advance exploitative practices.

Objectives of convergence. Developments always follow where roads are, and the purpose of the inter-agency convergence is to direct these developments towards more desirable outcomes. This can be done in two ways:

- Designing and implementing interventions to control and manage the risk of negative impacts on the environment that may result from the road project.
- Designing and implementing developmental activities that will engage communities to shift to more sustainable technologies in their livelihoods and widen ecologically-sensitive options for income-generation.

Road zone of influence as the unit of convergence. The road ZOI will set the physical boundary of convergence. It clarifies the impact area where agencies can be called upon to engage in the convergence efforts.

Negative-impact areas as the focus of convergence. Characterize the ZOI to determine specific locations and extent of vulnerabilities/risk of negative biophysical changes that may result from the road project. These negative-impact areas can be typified as follows:

- forest lands that are vulnerable to agricultural conversion because of easier physical access to these sites
- traditional farm lands of IPs that would most likely experience a shift to unsustainable farming practices because of easier access to modern farm inputs
- farm lands that are currently burdened with unsustainable farm management practices and will most likely be encouraged to further expand because of improved accessibility

Mapping out these negative-impact areas will determine the agency-composition and direction of "crossroad convergence" bearing in mind that the purpose is both impact-mitigation and transformative developmental action. For instance, in forest lands within the road ZOI that are vulnerable to agricultural conversion, impact-mitigation activities like establishment of buffer zones can be accompanied with projects/activities to develop low-impact ecotourism in appropriate sites. In areas where the expansion of unsustainable farming is a risk, developmental actions may be more effective than impact-mitigation, focusing more on influencing farmers to shift to good agricultural practices. For traditional farm lands of IPs that would most likely experience a shift to unsustainable farming practices because of easier access to modern farm inputs, focus interventions on strengthening of the indigenous farming practice (for instance in the form of link-up with markets, processing of farm produce, resource assistance).

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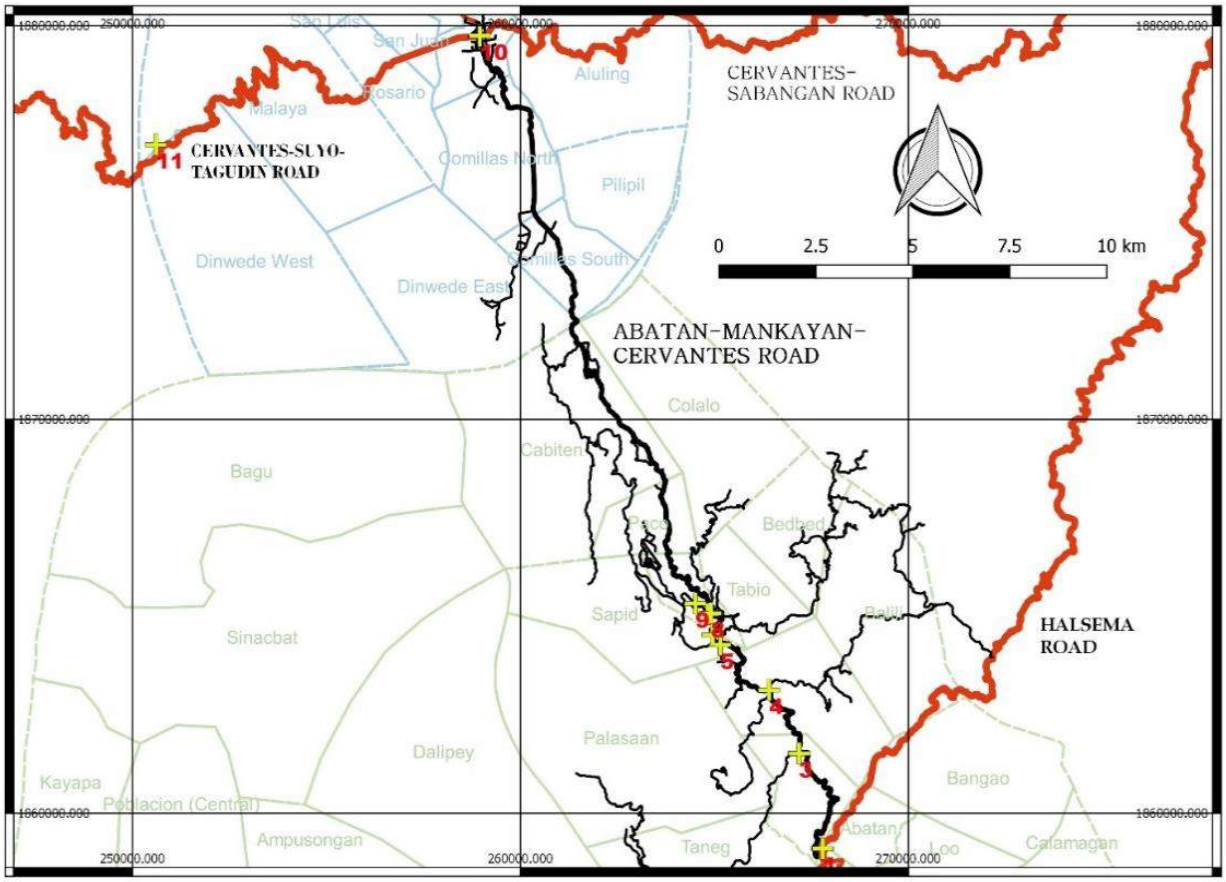
APPENDIX
Impact Evaluation of the Cervantes-Mankayan-Abatan Road Project

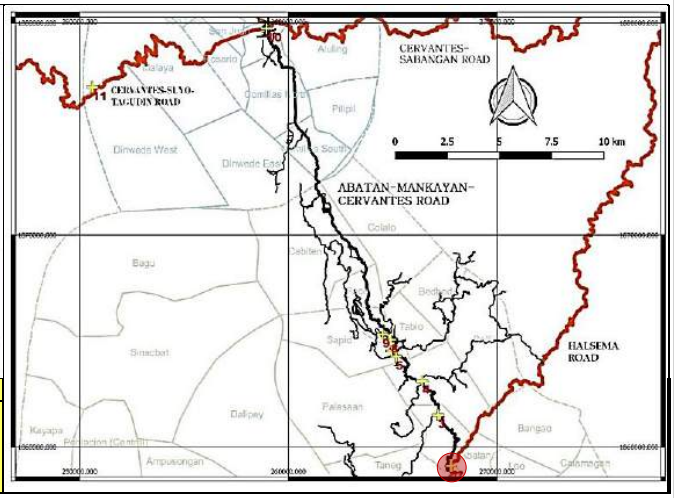
PHOTO COLLECTIONS
CERVANTES-MANKAYAN-ABATAN ROAD

The reconnaissance survey conducted for this study provided snapshots of the present-day general environment of the three municipalities through which the Cervantes-Mankayan-Abatan Road passes. The photo collections taken from selected sites/intersections can serve as baseline images for future physical changes in these areas that are adjacent to the road as it is expected that it will continue to influence their physical development. These areas are thus classified as areas of concern in future planning. The selected viewpoints are here presented as photo collections taken from the following locations:

1. *Photo Collection 1:* INTERSECTION OF HALSEMA HIGHWAY AND CERVANTES-MANKAYAN-ABATAN ROAD;
2. *Photo Collection 2:* INTERSECTION OF CERVANTES-MANKAYAN-ABATAN ROAD AND TANEG ROAD, AND GINAOANG BRIDGE;
3. *Photo Collection 3:* INTERSECTION OF CERVANTES-MANKAYAN-ABATAN ROAD AND ROAD TO BULALACAO;
4. *Photo Collection 4:* LEPANTO MINE DIVISION GATE 2;
5. *Photo Collection 5:* INTERSECTION OF AND CERVANTES-MANKAYAN-ABATAN ROAD AND ROAD TO BALILI;
6. *Photo Collection 6:* INTERSECTION OF AND CERVANTES-MANKAYAN-ABATAN ROAD AND ROAD TO MANKAYAN NATIONAL HIGH SCHOOL;
7. *Photo Collection 7*: CROSSROADS OF AND CERVANTES-MANKAYAN-ABATAN ROAD WITH CERVANTES-SUYO-TAGUDIN ROAD AND CERVANTES-SABANGAN ROAD.



Viewpoints for the sevenselected sites/intersections.



KEY MAP (LOC1)		
X	267789.6801	**INTERSECTION OF HALSEMA HIGHWAY AND CERVANTES-MANKAYAN-ABATAN ROAD**
Y	1859098.9214	

ALONG INTERSECTION AT HALSEMA HIGHWAY GOING TO BONTOC, AMC ROAD ON THE LEFT, TINOC-KABAYAN ROAD TO RIGHT

JEEPNEY LOADING STATION FOR MANKAYAN

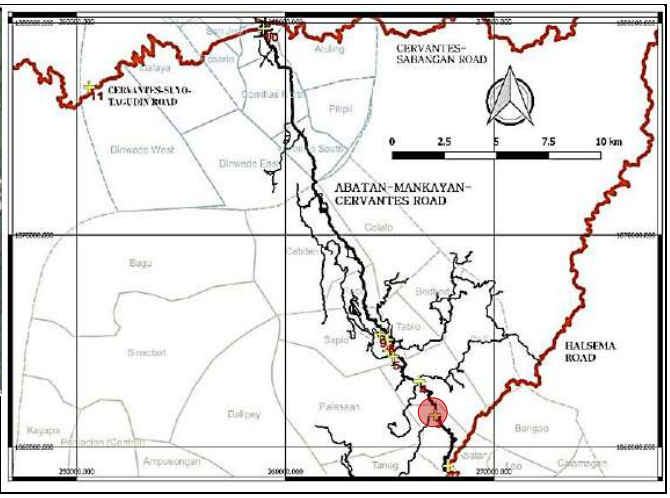
ABATAN MARKET. SIGNBOARD FOR AMC ROAD ON THE RIGHT

SIGNBOARD AT TINOC-KABAYAN INTERSECTION WITH DPWH SIGBOARD ANNOUNCING REBLOCKING/CONCRETING AND OFF CARRIAGEWAY IMPROVEMENTS STARTING MARCH 1, 2017

CMA ROAD 100 meters FROM THE HALSEMA INTERSECTION SHOWING JEEPNEYS BOUND FOR MANKAYAN PARKED ALONG THE ROAD

TINOC-KABAYAN ROAD 100 meters FROM HALSEMA INTERSECTION

Photo Collection 1: **Intersection of Halsema Highway and AMC Road**



KEY MAP (LOC2 AND LOC3) KM 337.610 – KM 349.800		
X	267186.26722	**INTERSECTION ABATAN-MANKAYAN-CERVANTES ROAD & TANEG ROAD, & GINAOANG BRIDGE**
Y	1861516.5016	

GINAOANG BRIDGE ON LEFT, ROAD TO TANEG ON RIGHT

SIGNBOARD SHOWING ROAD TO TANEG AND TO MANKAYAN. THIS STRETCH OF AMC ROAD IS ALSO CALLED GUINAOANG-SUYOC-GAMBANG PROVINCIAL ROAD

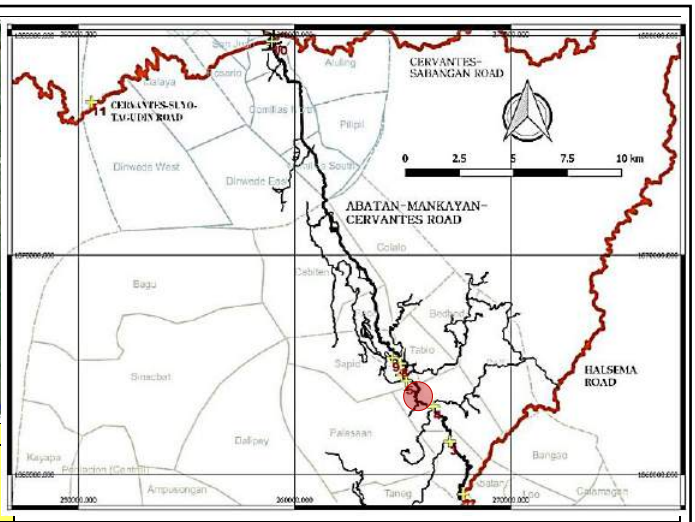
ABATAN MARKET. SIGNBOARD FOR AMC ROAD ON THE RIGHT

GUINAOANG BRIDGE SIGNBOARD AND VEHICULAR TONNAGE WEIGHT

RIVER AT TANEG BRIDGE

ON-STREET PARKING ON ROAD TO TANEG AT INTERSECTION

Photo Collection 2: **Intersection of AMC Road and Taneg Road**



KEY MAP (LOC4) KM 340.180 – KM 341.180		
X	266410.85736	**INTERSECTION OF CERVANTES-MANKAYAN-ABATAN ROAD AND ROAD TO BULALACAO**
Y	1863125.7444	

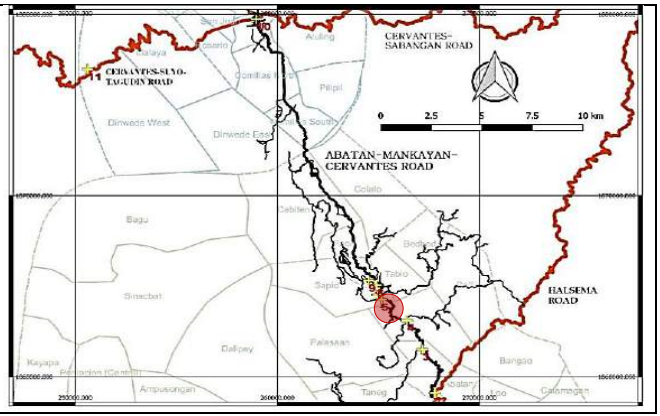
AMC ROAD INTERSECTION, BULALACAO ROAD AT LEFT AND PALASAAN ROAD AT RIGHT

ROAD TO PALASAAN

ROAD TO BULALACAO

SIGNBOARD AT INTERSECTION. THIS STRETCH OF AMC ROAD IS ALSO CALLED THE BULALACAO-PALASAAN PROVINCIAL ROAD

Photo Collection 3: **Intersection of AMC Road and Road to Bulalacao**



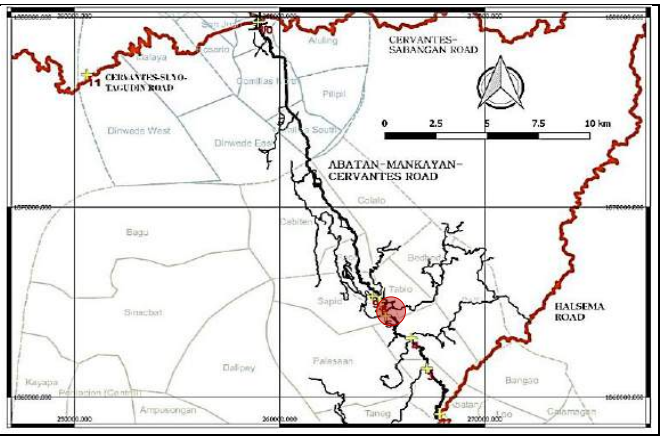
KEY MAP (LOC5)		
X	265147.46967	**LEPANTO MINE DIVISION GATE 2**
Y	1864276.0783	

LEPANTO MINE DIVISION GATE 2 ALONG AMC ROAD

AMC ROAD AT LEPANTO GATE 2, TOWARDS ABATAN

AMC ROAD ON RIGHT,
LEPANTO MIN DIVISION GATE 2 ON RIGHT

Photo Collection 4: **Lepanto Mine Division Gate 2**

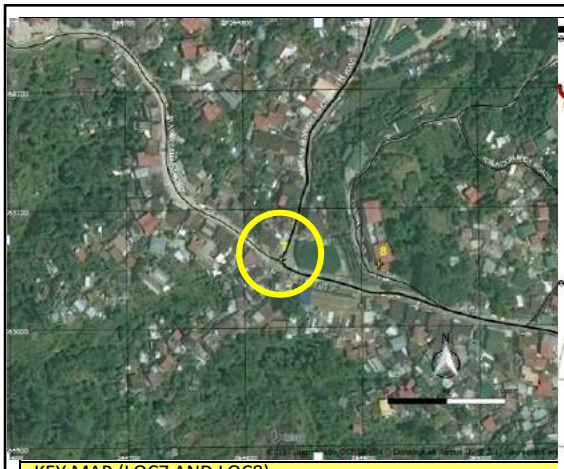


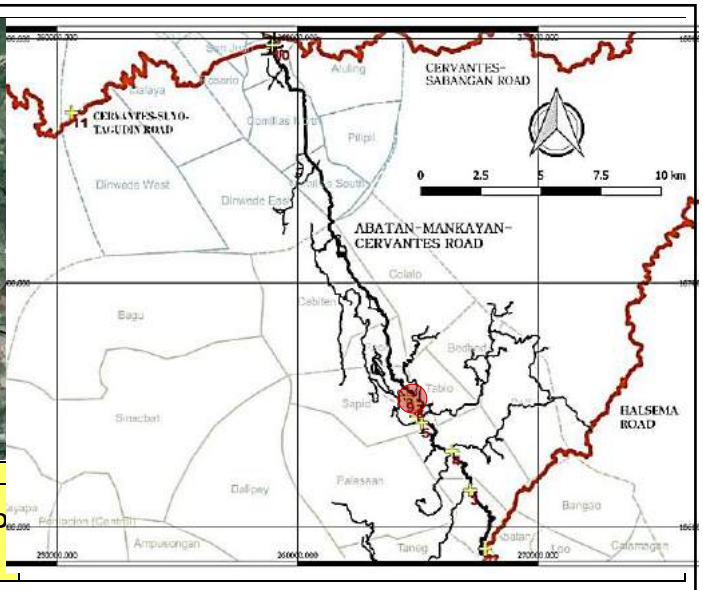
KEY MAP (LOC6) KM 343.200 – KM 352.200		
X	265147.46967	**INTERSECTION OF ABATAN-MANKAYAN-CERVANTES ROAD (AMC) AND ROAD TO BALILI**
Y	1864276.0783	

LEPANTO MINE DIVISION GATE 2 ALONG AMC ROAD

ROAD TO BALILI FROM AMC ROAD

Photo Collection 5: **Intersection of AMC Road and Road to Balili**





KEY MAP (LOC7 AND LOC8)		
X	264831.80254	**CERVANTES-MANKAYAN-ABATAN ROAD AT MUNICIPAL HALL AREA AND INTERSECTION WITH ROAD TO MANKAYAN NATIONAL HIGH SCH**
Y	1865057.1378	

AMC ROAD BELOW THE MUNICIPAL HALL WITH ON-STREET PARKING FOR TRICYCLES, JEEPNEYS AND PRIVATE VEHICLES

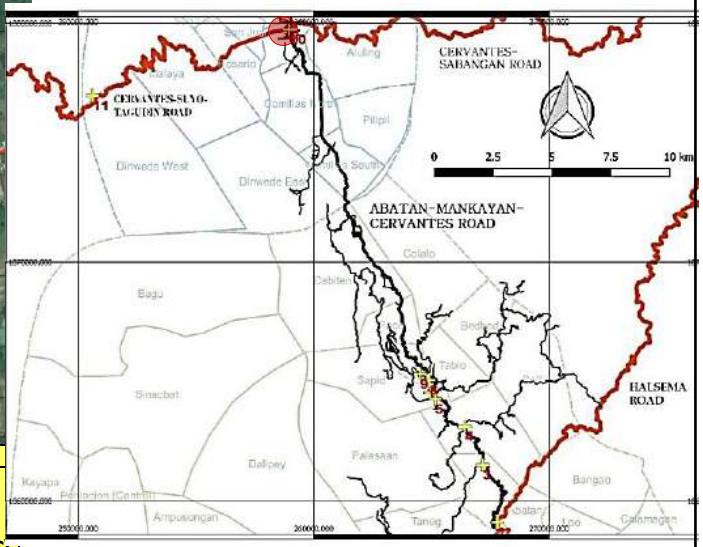
MANKAYAN POLICE PRECINCT ALONG AMC ROAD

MARKET AREA ALONG AMC ROAD

ABATAN MARKET. SIGNBOARD FOR AMC ROAD ON THE RIGHT

AMC ROAD AT MARKET AREA INTERSECTION WITH ROAD LEADING TO MANKAYAN NATIONAL HIGH SCHOOL ON LEFT

Photo Collection 6: **Intersection of AMC Road & Road to Mankayan National High School**



KEY MAP (LOC 10)		
X	264831.80254	**CROSSROADS: CERVANTES-ALULING-BONTOC ROAD, CERVANTES-SUYO-TAGUDIN ROAD AND ABATAN-MANKAYAN-CERVANTES ROAD (AMC)**
Y	1865057.1378	

WAITING SHED AT CERVANTES MARKING THE CROSSROADS TO TAGUDIN, MANKAYAN AND BONTOC

ROAD TO BONTOC FROM CROSSROADS

ROAD TO TAGUDIN FROM CROSSROADS

AMC ROAD TOWARDS MANKAYAN FROM CROSSROADS

ROAD TO CERVANTES POBLACION FROM CROSSROADS

Photo Collection 7: **Crossroads of AMC with Cervantes-Suyo & Cervantes-Sabangan Roads**