



**ADDIS ABABA UNIVERSITY INSTITUTE OF
TECHNOLOGY**

**THE ESTIMATION OF THE IMPACT OF RURAL ROAD
INVESTMENTS ON SOCIO-ECONOMIC DEVELOPMENT: A CASE
STUDY ON NONO BENJA WEREDA IN JIMMA ZONE, OROMIYA
REGION ETHIOPIA**

BY:

ASHENAFI MEHARI

ADVISOR:

ALEMAYEHU AMBO (PhD)

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REGION**

**BY:
ASHENAFI MEHARI**

Approved by Board of Examiners

Alemayehu Ambo (PhD)

Advisor

Signature

Date

Internal Examiner

Signature

Date

Internal Examiner

Signature

Date

Declaration

I, the undersigned, declare that this thesis entitled as *“The Estimation of the Impact of Rural Road (URRAP) Investments on Socio-Economic development: a case study on Nono Benja Wereda in Jimma Zone, Oromiya Region”* is my original work and has not been presented for the award of any degree or diploma in this or any other university. All sources of materials used in the thesis have been accordingly acknowledged.

Declared by: Name: Ashenafi Mehari

Signature: _____

Date: _____

Place of Submission: Addis Ababa University School of Civil and Environmental Engineering,
Addis Ababa, Ethiopia
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Abstract

Roads are constructed to improve the socio-economic status of the beneficiaries. However, the socio-economic benefits of rural roads in Ethiopia had not been critically examined. Hence, the present study aimed to examine the socio-economic benefits of rural roads by focusing on Nono-Benja rural road of Jima Zone.

The study employed quantitative research methodologies to examine the socio-economic benefits of the road. In doing so, household survey questionnaire was developed and data were collected from 196 individuals from three kebelas. In addition, data were collected from different stakeholders for RED Model was computation. For the purpose of analyzing the questionnaire data frequencies, percentage, mean, SD, t-test and ANOVA were computed using SPSS. Internal rate of return (IRR) and net present value(NPV) were computed using the RED Model.

The study had revealed that the constructed road had economic benefits to the households in the area. This is manifested through its positive agricultural impacts, creating job opportunities and improving residents' access to markets. The RED model results had also revealed that the constructed road is the best option among the four options considered for it is characterized by higher net present value and internal rate of return. It was also found that the constructed road had improved the social benefits of the residents in the surrounding area i.e. it had increased social interaction and the mobility of the residents and has improved access to education and health. The RED Model results had also revealed that the constructed road is the one with the best social benefit to population served. One important finding worth mentioning here is that the constructed road was found to benefit urban residents and those who didn't have schooling.

It is then concluded that rural roads in Ethiopia do have socio-economic benefit for those who have the access to the road. Lastly it is recommended that concerned bodies need to examine the socio-economic impact of rural roads, not only before roads are constructed but also right after it is completed and after certain period of time.

Keywords/phrases:- Impact of Rural Road Development ,Socio-economic Benefits ,NPV,IRR..etc

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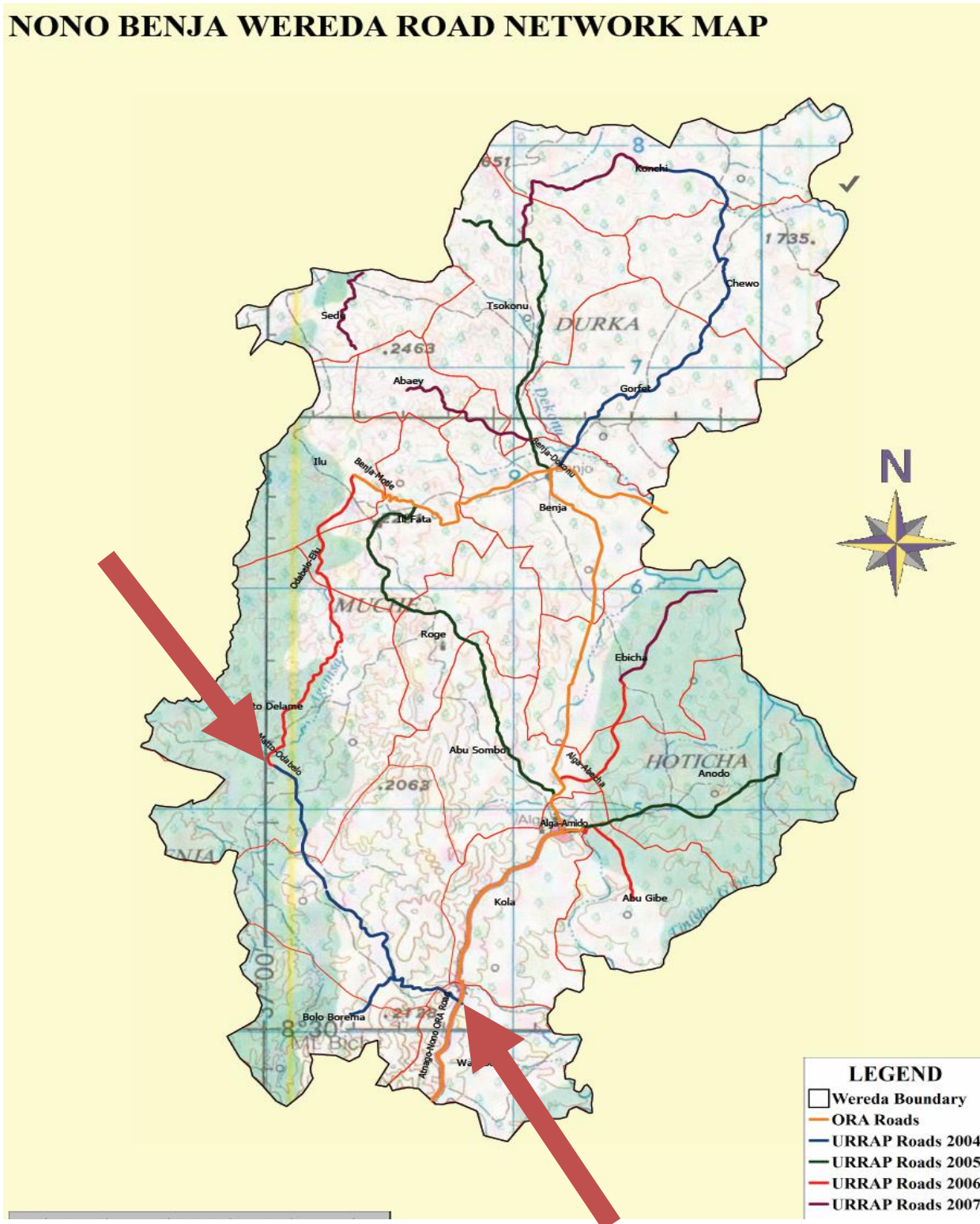
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Acronym

NPV	Net Present Value
IRR	Internal Rate of Return
RED	Road Economic Decision Model
HDM -4	Highway Decision Model
SPSS	Statistic Package for Social Sciences
SADC	South Africa Development Community
URRAP	Universal Rural Road Access Program
GTP	Growth and Transformation Plan

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NONO BENJA WEREDA ROAD NETWORK MAP



CHAPTER ONE

INTRODUCTION

1.1. Background of the Study

It is reasoned that efficient mobility enhances productivity and encourages economic activity, thereby increasing national output and competitiveness. On the contrary, it is argued that in many underdeveloped and developing countries, lack of communication and transportation handicaps all the other prospects of development (Paudel, 2014). Similarly, it is claimed that one of the main reasons for the underdevelopment in many African countries is lack of infrastructure (Buys et al. 2006).

Transportation infrastructure, through its market integration ability, is said to be a determining factor of growth. Several means of exist for both passengers and goods. Of the available transportation infrastructures, road transportation penetrates further into the nooks and cranny of the human environment than other means of transportation (Olamigoke & Emmanuel, 2013). Roads take the highest stake particularly in the African region. Roads have therefore received lion's share of the government budget in developing countries (Bhatta, 2004). Roads are the primary mode of transportation in Africa for both freight and passengers. In the Southern Africa Development Community (SADC) countries road transportation carries over 80% of the region's goods and services (Pinard 2004).

In modern context, roads are taken as a gateway to open up a multitude of opportunities to enhance livelihoods. Road infrastructures play an important role in the socio-economic and cultural development of any region (Paudel, 2014). Hence, development of roads is now increasingly recognized as an essential component of poverty alleviation programs in many African countries (AfDB, 2001). In Sub-Sahara Africa about 36 countries are currently involved in transportation sector development by endorsing the Sub-Saharan African Transportation Policy Program (SSATP) in 2004/2005 (Terefe, 2012)

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Of the roads in African region, rural roads are the least developed ones. Africa's rural road is generally inadequate and underdeveloped, with the lowest density of paved roads of any of the regions in the rest of the world. Rural areas in developing countries do not have a minimum of reliable and efficient access to roads. Rural road is therefore a major priority for reducing rural poverty (Bhatta, 2004).

In rural areas, roads are built to improve people's mobility and connectivity to markets, administrative centers, schools and health posts, and are credited with important socio-economic improvements. Roads increase access to social services and markets for the rural poor - schools, healthcare, labor markets, and credit facilities - services that have a direct impact on socio-economic well-being and human development (Porter, 2003).

A number of studies had examined the relation between rural roads and improved welfare. Though it is believed that rural road construction and poverty reduction are assumed to be related, there is little evidence as to how they are related (ADB, 2006).

Generally speaking, it has been widely argued that roads increase job opportunities and open up new sources of revenue, leading to a more diversified income structure. Thus increased economic activities stimulate demographic changes and thereby alter socio-economic practices. Despite a general consensus on the importance of rural roads for development and living standards, little is known about the size and nature of the benefits of their investments, or their distributional impacts.

Several studies attempt to measure the impact of roads (or lack of roads) on development of a country, although as Worku writes "it is difficult to deal with the socio-economic impact of the sector" (Worku, 2011:2). At the micro-level, evidence shows that rural households in Ethiopia with access to all weather roads to the nearest town have higher consumption expenditures (Shiferawa et al., 2012). At a macro level, it has been noted that transportation costs account for 50% of export value for Africa's fifteen landlocked countries (to which Ethiopia belongs) compared to 8.6% on the average for all developing countries (Biau et al., 2008).

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It is therefore very important to examine empirically the impact of road infrastructure on growth and poverty alleviation.

1.2. Statement of the Problem

Ethiopia is the second most populous country in Africa. It is the land-locked Sub-Saharan African country characterized by mountainous terrain with relatively high poverty rate. Hence, road transportation infrastructure is expected to play a critical role for economic development in the country and to reduce poverty.

Understanding the role of road transportation Ethiopian government had planned and thereby achieved success in constructing roads. In order to achieve Ethiopia's development and growth objectives, one of the "strategic pillars" identified in the Growth and Transformation Plan (GTP) is "enhancing expansion and quality of infrastructure development" (MFED, 2002: 22). Ethiopia has shown great improvement in the road sector through constructing, major maintenance, upgrading and rehabilitating of road networks. Ethiopia has experienced rapid expansion in road infrastructure since 1997 as the result of the Road Sector Development Program (RSDP). The share of population living within 2 km of an all-weather road has increased from 13% in 1997 to 27% in 2011. This shows people have been getting better access to markets and other socio-economic services such as health and education. The road density per thousand square km has doubled from 24km to 49km during the same period (Terefe, 2012).

In Ethiopia, rural roads are seen as "one of the decisive factors that highly contributes to social and economic development" (Emmenegger, 2012:9). Indeed, the aim is increasing accessibility and transportation service in rural areas. The government initiated the Ethiopian Rural Travel and Transportation (sub-) Program in 2002 and the Universal Rural Road Access Program (URRAP, 2011). URRAP is a program running in the period 2011-2015 aims at connecting all *kebeles* (lower administrative units in Ethiopia, part of a district) with all-weather roads. The focus on rural roads development, particularly URRAP, is rather recent in Ethiopia.

The study conducted by Worku (2011) had revealed that the Ethiopian Government in this decade has made sufficient attention in financing of road projects which had reached tenfold of

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the expenditures a decade ago. Massive amount of capital has been invested by the government with the support of international donors for the provision of all-weather roads that improve regional connectivity (Terefe, 2012).

Rural transportation interventions do not solely have positive effects. Inappropriately planned and designed road projects can have negative effects such as involuntary resettlement, increased traffic accidents, deforestation, soil erosion, and the spread of HIV/AIDS. In addition, as transportation being one of the factors of development, complementary investments are necessary to reap the benefits from road transportation. There is still a critical lack of evidence regarding roads' consequences in terms of development (van de Walle, 2002). Short-term and long-term distributive impacts of transportation projects are not well understood (deGrassi 2005). This is particularly true in Ethiopia where universal rural road access programs (URRAP) are new beginnings.

In this study, therefore, attempts were made to examine the development impact of rural road by focusing on the communities of the Nono Benja Wereda in Jimma Zone, Oromia Region. In doing so, detailed socio-economic benefits of rural roads were depicted and comparisons among alternative roads were made. Findings of the presents study have practical implications for rural road programs in the country and future researchers/engineers can use the findings of the presents study as a stepping stone to conduct similar studies at a larger scale.

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1.3. Objectives of the study

1.3.1. General objective

Generally, the objective of the present study is estimate the impact of rural road investment on socio-economic development.

1.3.2. Specific objectives

In light of the literature review and gaps identified in the existing literature, the specific objectives of the study were to:

- identify the economic impacts of the rural roads Nono Benja Wereda
- assess the social impact of the constructed rural road in Nono Benja Wereda
- examine the socio-economic impact differences based on demographic variables; and
- investigate unintended impacts of roads on social and cultural life of the project area after accessibility to the road

1.4. Significance of the study

As there are plausible grounds to accomplish research, there are also expected significances to be reaped from it. As a result, the following would be among the main contributions of the study:

- The study will be useful for rural transportation planners, rural road agencies, development partners, local governments, and communities for planning, identifying, designing, maintenance and management of rural road networks so as to maximize benefits from the road transportation.
- Understanding channels through which road access reduces poverty and recognize that economic growth is essential for policy makers and development practitioners. The study will benefit policy makers and development practitioners to appreciate this notion.

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- In spite of its importance, the awareness of researches exploring the direct and indirect impact of the road transportation on socio-economic development has been quite limited in Ethiopia. This study is, therefore envisaged to narrow the knowledge gap in this respect.
- Other researchers who would like to conduct studies on the variables at a larger scale would also benefit. Since no research has been conducted in this area before, the output of this research will likely enable researchers to use the findings as a stepping-stone for further research works.

1.5. Scope of the study

The study is delimited within the communities of the Nono Benja Wereda in Jimma Zone because of financial, time and administrative constraints. And it is acknowledged that, the study would have been better had it covered a wider area.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

The major objective of the study is the examination of the impact of rural road investment on socio-economic development of the nation in general and the subject community in particular. To achieve this objective local and international literatures pertaining to these issues were consulted. Accordingly this chapter is devoted to the presentation of the literatures reviewed.

2.2. Road investment

Roads are the primary mode of transportation in Africa for both freight and passengers. In the Southern Africa Development Community [SADC] region road transportation carries over 80% of the region's goods and services (Pinard 2004).

In modern context, roads are taken as a gateway to open up a multitude of opportunities to enhance livelihoods. Road infrastructures play an important role in the socio-economic and cultural development of any region (Paudel, 2014). Hence, development of roads is now increasingly recognized as an essential component of poverty alleviation programs in many African countries (AfDB, 2001). In Sub-Sahara Africa about 36 countries are currently involved in transportation sector development by endorsing the Sub-Saharan African Transportation Policy Program (SSATP) in 2004/2005 (Terefe, 2012)

However, the road network in Africa is characterized by several constraints that limit economic growth and development within African countries. Work related to New Partnership for Africa's Development (NEPAD) [Food & Agriculture Organization (FAO) of the United Nations 2002] indicates that apart from North Africa, The rest of Africa's rural infrastructure is generally inadequate and underdeveloped, with the lowest density of paved roads of any of the regions in

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the rest of the world. For example, there are an estimated 1.8 million km of roads in Sub-Saharan Africa, of which only 284 000 km (approximately 16 %) are paved.

One of the major constraints in the road infrastructure development and sustainability is the lack of capital funds in developing countries in general and in Africa in particular. External investment in economic infrastructure during 1990-1996 for Sub-Saharan Africa was in the region of US\$26.7 billion, compared to US\$ 41.4 billion for Latin America and the Caribbean and US\$101.9 for Asia [Food & Agriculture Organization (FAO) of the United Nations 2002].

Based on the above reports it is evident that the financing needs with respect to road network development in Ethiopia is quite substantial. The challenge therefore lies firstly in the determination of road financing needs, through the execution of an accurate assessment of the nature and extent of a country's road network, i.e. the road asset value and road network condition, and secondly in the identification of financing sources and attract sound and sustainable road investment.

Inadequate road investment results in new road networks not developed and expanded and existing roads not maintained. The consequences are therefore limited road network and deteriorated existing road infrastructure that not only limits accessibility, mobility and regional connectivity of a country, but also results in increased transportation costs. Deterioration of a road network therefore causes significant ripple effects, ultimately creating a negative impact on the overall macro-economy, and subsequently impeding on poverty alleviation, socio-economic development, and overall macro-economic growth and development. To avoid this, continuous road investment should form the basis of any country's actions in place to address road infrastructure deterioration, development and maintenance.

2.3. Rural transportation

Rural transportation depends on appropriate infrastructure, where rural infrastructure consists mainly of rural roads, tracks, trails and footpaths. These may vary in quality, depending on weather, season, construction and maintenance. As rural households, and in particular women, spend a large amount of time and effort on transportation activities to fulfill their basic needs,

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they are very often severely hampered by the lack of an adequate rural roads network. As a result of this significant limitations of growth and development of rural communities have been experienced in the past, and are also being experienced today. Poverty is very often far worse in rural areas than in urban centers, as a result of lack of integration with urban centers due to lack of adequate accessibility and mobility, and local roads and tracks are often impassable, thereby proving it very difficult and in some cases nearly impossible for rural families to have access to the local rural economy (Wold Bank, 2001).

Because rural communities could potentially play a considerable role in the economic growth and development of a country, and also for purposes of own socio-economic growth and development, it is important that investment in rural roads be supported to provide sustainable rural roads infrastructure network over the long term.

2.4. Poverty alleviation

Poverty alleviation is one of the major challenges of the African countries. The World Bank in its various studies has provided evidence that there is a definitive link between areas with no or insufficient accessibility and poverty, indicating that transportation infrastructure is an essential component of sustained poverty alleviation (World Bank 2001).

In rural areas, roads are built to improve people's mobility and connectivity to markets, administrative centers, schools and health posts, and are credited with important socio-economic improvements. Roads increase access to social services and markets for the rural poor - schools, healthcare, labour markets, and credit facilities - services that have a direct impact on socio-economic well-being and human development (Porter, 2013).

Road infrastructure provides accessibility and mobility, leading to increased transportation operations, economic activity, subsequent economic growth and ultimately a healthy and sound economy. An adequate road infrastructure network also provides an advantage to a country in terms of improved regional integration, which helps to promote regional and international trade

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and significantly enhances the economic growth and development of a country and consequently alleviates poverty (World Bank 2001).

Lack of adequate road infrastructure, especially in rural areas, results in significant limitations for communities. These limitations occur in terms of access to socio-economic and cultural centers such as schools, clinics, markets and other business centers. Limited access to schools hamper educational access for learners, lack of access to clinics hamper health development and limited access and mobility to markets and other business centers places limits on trade opportunities, and subsequently also limits the potential opportunity for earning an income and a subsequent improvement in the day-to-day living standard. The result is a poor socio-economic development standard.

From the afore-mentioned arguments it is evident that economic growth and development in any country can be linked to road network as transportation improvements stimulate economic development. The existence of an adequate and efficient road infrastructure network is crucial and a prerequisite for the provision of accessibility and mobility to the citizens of a country. Rural roads infrastructure is essential and a prerequisite for economic growth and development in Ethiopia, a country aspiring to become middle income country by 2030.

2.5. Benefits of rural roads to the poor

The development of roads has been considered as a precondition for growth, development and poverty alleviation in rural areas as accessibility and mobility creates opportunity (Banjo et al., 2012). The presence of roads has many benefits for the poor as it reduces the prices of inputs, opens up opportunities in new markets and offers seasonal migration for employment (Hettige, 2006). The most common means of transportation in rural areas is walking or head loading and this requires energy and time, as it limits their time to perform more productive tasks that can generate an income (Odaro, 2012). The development of transportation infrastructure can save productive time and energy through the use of local transportation services (Banjo et al., 2012).

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Transportation infrastructure allows governments the opportunity to reach the rural poor and also promote social equality as rural dwellers will no longer feel marginalized from the rest of society. Adequate roads promote the provision of public services such as ambulances and police patrols (Hettige, 2006). Access to transportation is linked to access to healthcare as it is essential for healthcare delivery (Archer et al., 2005; Davis, 2001).

Agriculture is a major source of income and food security in rural areas. The role of transportation is very important in terms of access to markets as farmers with bicycles or carts can carry more products to markets at a quicker pace. This ensures that the products remain fresh and hence farmers could make a substantial profit (Banjo et al., 2012). In addition roads are an essential component for the development of markets, this allows the opportunity for farmers in rural areas to provide products to high value urban markets that could increase profits of the rural poor (Hettige, 2006).

The benefits discussed above, allow the poor to have an opportunity to sustain and diversify their livelihoods which ultimately leads to the reduction of poverty in rural communities. Poverty is a multi-dimensional problem that requires to be addressed by considering all aspects leading to it. Although transportation services are of vital importance, the prices of transportation services are essential as poor people cannot afford access to these services due to transportation fares being too high (Porter, 2002). There is a need for the cheap and reliable provision of transportation in rural areas as the poor face the challenge of having to travel long distances to reach service centers, to receive education and healthcare, and to have market opportunities (Odaro, 2012).

Poor access to education and healthcare contributes to the inability to strengthen human capabilities and improve livelihoods (Starkey, 2002). A lack of access to market opportunities is also a challenge for many rural communities as it has a major impact on potential growth and income, directly increasing rates of poverty. Efficient means of transportation are also important when looking at transportation infrastructure. Poverty assessments have shown that bicycles, carts and wheel barrows are a means of travel for many poor people , however due to poor transportation infrastructure in rural areas such as roads, bridges and paths it becomes a challenge to travel through these areas to reach service centers (Starkey, 2002). Efficient

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transportation services and infrastructure enable people to build up their asset base which will aid in reducing poverty of the rural poor.

2.6. Empirical evidences on the socio-economic benefits of rural roads

Empirical studies here and there had revealed that rural roads had socio-economic benefits to the users of the road.

Road accesses were also found to be associated with economic benefits and lack of it had been associated with economic disadvantages. For example, a study had compared women's incomes that live in rural areas without road access and those women who live along a main road. The study found that women who lived along a main road earned double income compared to women who lived in a rural area far from main roads (Porter, 2002). The reason for this was that women living nearer to main roads accessed potential buyers more effectively in terms of what time they would arrive to sell their goods, and had more time to prepare or collect more products to sell.

Another study conducted among women Nyamana community in South Africa had revealed that people in areas with no road access had very difficult for rural dwellers to access markets (Sewell and Desai, 2016).

Road access had also been associated with agricultural productivity. A qualitative study had compared subsistence farmers in Ghana from areas with road access and without road access and the study found out that the farmers from areas with roads had the highest agricultural benefits for they were able to access farm inputs on time and with lower costs. These benefits in turn had significant effect on the productivity levels of the farmers where those with road access had higher productivity than farmers without road access (Bonsu, 2014).

Similarly a study was conducted in Nigeria which had examined the agricultural productivity of rural areas after residents were provided with rural roads. The study had revealed that the price of fertilizers and seeds had decreased after the roads are constructed for transportation costs had decreased because of the constructed roads. The study had also revealed that the productivity and

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income of the residents had significantly increased after roads were constructed (Abur et al., 2015).

Availability of roads had been found to be associated with social benefits and vice versa. Access to roads was found to influence residents' access to health, access to education. For example, the study in Nyamana community mentioned above had revealed that in areas with no road access, only 7% of the community had access to ambulance services. The study had also found that students drop out of schools due to the long distances travelled daily to reach schools (Sewell and Desai, 2016).

2.7. The socio-economic benefits of rural roads in Ethiopia

Several studies attempt to measure the impact of roads (or of the lack of roads) on development of the country, although as Worku writes “it is difficult to deal with the socio-economic impact of the sector” (Worku, 2011:2). At the micro-level, evidence shows that rural households in Ethiopia with access to all weather roads to the nearest town have higher consumption expenditures (Shiferawa et al., 2012). At a macro level, it has been noted that transportation costs account for 50% of export value for Africa's 15 landlocked countries, to which Ethiopia belongs, compared to 8.6% on the average for all developing countries (Biau et al., 2008).

The study conducted by Worku (2011) had revealed that the government in this decade has made sufficient attention in financing road projects which had reached tenfold of the expenditure a decade ago. The impact of road investments on socio-economic development and economic growth is an important indicator for the justification of the considerable costs involved. Usually, benefits of road investments are direct, indirect or induced. The direct benefits include travel time savings, savings in vehicle operating costs and reduced accidents costs among others while indirect benefits are in form of employment opportunities that are related to the road investment. The induced benefits come from the local economic development – towards poverty alleviation – resulting from the road investment (Olamigoke & Emmanuel, 2013).

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Rural transportation interventions do not solely have positive effects. Inappropriately planned and designed road projects can have negative effects such as involuntary resettlement, increased traffic accidents, deforestation, soil erosion, and the spread of HIV/AIDS. In addition, as transportation being one of the factors of development, complementary investments are necessary to reap the benefits from road transportation.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The estimation of the impact of rural road (URRAP) investments on socio-economic development of Nono Benja Wereda, Jjimma Zone can be done in several ways although it is a complex task as most of the rural road investment benefits in rural communities cannot be measured in monetary terms. This impact of road investments on socio-economic development and economic growth is therefore an important indicator for the justification of the considerable costs involved in road infrastructure investment.

In this research, the following methods have been considered to achieve the objectives of the study.

3.2. Research Design

The main purpose of the current study is to investigate the socio-economic impact of rural roads by focusing on the road constructed in Nono Benja Wereda of Jimmma Zone. To achieve this, *survey design* was developed.

3.3. Setting

The study was conducted Wayu-Baroma-Mato which connects three Kebeles. The construction of the road was completed and opened for traffic since 2013. The road is 19 kilometers long.

3.4. Population of the study

Based upon the data collected from the Wereda transportation bureau, 1150 households residents in the three kebeles. The total population in the three kebeles is recorded as to be 4600 individuals.

3.5. Sample and Sampling Procedure

3.5.1. Area Sampling

The study was conducted at Wayu- Baroma –Matto road. The fact that the road is relatively new and remote and the fact that the researcher had acquaintance with the residents and local administrators were behind the selection of the road. This was done believing that the acquaintance would help the researcher to obtain balanced data from the residents and administrators. It was also believed that conducting the study in a remote area with relatively new road would minimize respondents' recall bias. Therefore, it can be said that purposive sampling had been used in the selection of the rout.

3.5.2. Sample size determination

A simplified formula for proportion proposed by Yamane (1967) was used to calculate the sample size. That is:

$$n = \frac{N}{1 + N(e)^2}$$

Where n is the sample size, N is the population size, and e is the level of precision.

A 95% confidence level and P = 0.5 are used for the Equation and the calculation based on the formula will give us 195.4. Consequently 196 were used as the sample size of the present study.

3.5.3. Participant Sampling Techniques

In order to recruit 196 participants for the study, first of all cluster sampling was employed taking the Kebeles as a basis for clustering. Then 65 participants each from two kebeles and 66 participants from one cio were randomly selected using lottery method. Finally a pool of 196 individuals was used as questionnaire respondents.

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3.6. Data Collection Tools

The selections of methods are always based on the research questions to be addressed and the purposes of the study to be fulfilled by the research (Ridenour & Newman, 2008). Hence, for the purpose of collecting important data for the present study, mainly two tools were used: House Hold questionnaire survey which is a primary data and gathered from documents for RED Model secondary data.

3.6.1. Household Questionnaire Survey

The most often used method in assessing socio-economic impacts of rural roads is the execution of socio-economic household surveys. The main benefit of socio-economic household surveys is through questionnaires that can be structured in such a manner that optimal information regarding the perceived benefits of the rural road investment can be obtained.

Based on the above arguments, a questionnaire was developed.

3.6.1.1. Descriptions of the Questionnaire

The questionnaire is composed of four parts (demographic, economic, social, and negative impact measures)

Demographic measure: This measure has six (6) items to collect background information about the participants (i.e. age, sex, marital status, educational status, work and place of residence).

Economic Impact Measure: This measure includes three dimensions of economic impacts of rural roads. These dimensions are:

(1) Agricultural impact dimension which is assessed through twelve (12) items. In this dimension the impact of the road on (a) use of farm inputs (2 items); (b) crop and live stoke production (2 items); (c) market prices of goods and inputs (pesticides, improved seeds and farm equipments) (6 items); (d) visits from agricultural agents (1 item); and (e) investment attraction were assessed (1 item).

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(2) Job opportunity dimension that includes five (5) items. In the job opportunities dimension attempts were made to examine the opportunities to participate within the road project (long-and-short-term opportunities) (2 items), to travel to other places in search of jobs (1 item) and to establish businesses alongside the road (2 items).

(3) Access to markets dimension which is assessed using seven (7) items. Within this dimension, the impact of the road over (a) distance to markets (1 item); (b) availability of goods in markets (2 items); (c) number of visits to markets (2 items); and (d) the price values of assets (land and house) (2 items) were examined.

Finally, a pool of twenty four (24) items was included to assess the economic impacts of the Nono Benja Wereda rural road. Each dimension was rated on a five (5)-point Likert-type scale (ranging from strongly disagree to strongly agree).

Social Impact Measure: This measure includes three (3) dimensions of the social impacts of rural roads.

(1) Social interaction and mobility dimension: Nine (9) items were included to assess the social interaction and mobility dimension. In this dimension the impact of the road on (a) visits to and from other villages (2 items); (b) visits from authorities (1 item); (c) participation at social and public events (2 items); (d) travel time, convenience and waiting time (3 items); and (d) urban-rural links (1 item) were assessed.

(2) Access to education dimension: six (6) items were used to measure access to education dimension and it examined the impact of the constructed road on (a) students' enrollment and dropout rate (2 items); (b) teachers' turnover (1 item); and (c) teachers' and students' absenteeism (3 items).

(3) Access to health dimension: six (6) items were used to measure access to health dimension of the social impacts of roads. In this dimension attempts were made to look in to the impact of the constructed road on (a) child birth and immunization (2 items); (b)

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travel to hospital (2 items); (c) visits from health extension workers (1 item); and (d) emergency services (1 item).

Hence, a pool of twenty one (21) items was used to assess the social impact of the rural road in Nono Benja Wereda. Each dimension was rated on a five (5)-point Likert-type scale (ranging from strongly disagree (1) to strongly agree (5)).

Negative Impact Measure: this measure consists of ten (10) items which measures different negative impacts of rural roads which had been found out by studies in different corners of the globe. In doing so, the impact of the road on forests, HIV incidence, soil erosion, water supply, car accidents, migration, land usage, sex trade and drug use were assessed. This measure uses the same five (5)-point Likert-type scale (ranging from strongly disagree to strongly agree).

3.6.1.2. Validation of the Questionnaire

Great attempts were made to validate the instrument through comments and suggestions from content area experts, language experts and experts in item construction.

The questionnaire was checked forward and backward translation i.e. from English to Afan Oromo and from Afan Oromo to English by two independent evaluators –one is a graduate student in language department at Addis Ababa University and the other is a translator in Medical newspaper.

The translated and the draft questionnaire was given to an expert in measurement and evaluation. Comments (including the ordering of some items and modifications on the language used on some items) were offered by the expert. Hence, modifications were made accordingly.

Taking the comments and suggestions given by these professionals into consideration, the ambiguities, omissions and misunderstandings found in some items were cleared and the length of the questionnaire was minimized. By doing all these, attempts were made to work on the content and face validity of the questionnaire and the questionnaire becomes ready for the pilot study (see Appendix 1 and 2).

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3.6.1.3. Pilot Study of the Questionnaire

The purpose of the pilot study was to check the reliability and practicability of the questionnaire developed and designed to collect the main data. The aim was also to find out difficulties respondents will have in comprehending an item's meaning or format.

The pilot study was conducted on randomly selected 30 residents of a village. The village was selected in the nearby area. Here, this village was not considered as part of the sample in the main study.

After the data is collected from the 30 residents, the Cronbach alpha reliability was established to look in to the internal consistency of the questionnaire. In doing so, inter-item correlation between items and reliability coefficients if item deleted were also calculated. However, the reliability of each scale was found to be high (>0.07), no item was deleted from the questionnaire (see Appendix 3).

3.7. Roads Economic Decision (RED) Model

Data were collected from different sources and RED Model was used to come up with important findings.

By adopting appraisal methods **Roads Economic Decision (RED) Model**, the socio-economic impact of rural road investment can be determined. This model is specifically aimed at improving the decision-making process for the development and maintenance of low-volume roads and can perform an economic evaluation of road investment options (World Bank, 2001).

The model performs an economic evaluation of road investments options using the consumer surplus approach and is customized to the characteristics and needs of low-volume roads such as the high uncertainty of the assessment of the model inputs, particularly the traffic and condition of unpaved roads, the importance of vehicle speeds for model validation, the need for a comprehensive analysis of generated and induced traffic, and the need to clearly define all accrued benefits. RED computes benefits for normal, generated, induced, and diverted traffic,

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and takes into account changes in road length, condition, geometry, type, accidents, and days per year when the passage of vehicles is further disrupted by a highly deteriorated road condition (wet season). Users can add to the analysis other benefits, such as non-motorized traffic, social services and environmental impacts, if computed separately. The model is presented on a series of Excel 2000 workbooks that collect all user inputs, present the results on an efficient manner and performs sensitivity, switching values and risk analyses (Archondo-Callao, 2004).

Inputs used in the present study

While using the RED model, the following inputs collected from different sources were fed in three different sheets. In addition data was fed Project-Alternative Main Features.

1. *Inputs in the Control and Setup worksheet*

The following inputs were fed in this sheet and the summaries are displayed in Table 1 below:

a) Project-Alter. Main Features

This worksheet defines the features of the four project-alternatives to be evaluated. The first

Project-alternative is the without project case that represents a do minimum road agency policy and costs (base case). The other three project-alternatives are the ones being compared against the without project case. For all project-alternatives, you enter first the following.

- b) Duration of the wet season: Based on the data collected from the *Wereda* transportation office, the traffic count for the dry and wet seasons are equal. Thus the duration of the wet season in the present study is considered 0 (zero) which means the constructed road is all weathered road can serve both in wet and dry season.
- c) The evaluation period: based on the data collected from the consultants of the road, the road is constructed to be used for 10 years. Hence the evaluation period used in this study is 10 years but the RED Model forecasts the traffic to 20 years.

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- d) Discount rate: The present discount rate used from Ministry of Finance is 10%. In the present study, therefore, a discount rate of 10% is used.
- e) Population served: As had been reported in the sampling technique, the total populations of the area which are supposed to use the road are 4,600. Hence 4,600 are used as population served in the present study.
- f) Main user inputs: country name, project name, road identification code, road name, currency name, currency symbol, and evaluation date for reporting purposes are fed into the Control Area.
- g) Road Agency Economic Factor: 15% is the value added tax and 85% is the economic cost in case of Ethiopia.
- h) Car medium speed: According to RED model one can choose a speed of a reference vehicle to characterize road roughness condition. Hence the model uses medium cars speed as a reference to estimate roughness of the road. This is done because it is the best way of estimating values of the road conditions.

Thus the medium car speed for this road which is characterized as rolling terrain type is 30km/hr. In the present study, therefore, 30km/hr was set as medium car speed for without project alternative while 45km/hr was set as medium car speed for alternative 1. Besides, 50km/hr and 60km/hr were set as medium car speeds for alternatives 2 and 3 of the present study.

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Table 1

Control and setup

Country Name	Ethiopia
Project Name	Road Management Initiative
Road Identification Code	WBM
Road Name	Wayou-Baroma-Mato
Currency Name	Birr
Currency Symbol	ETB

Duration of the Wet Season (days)	0
Evaluation Date	may11,2017
Road Agency Economic Costs Factor	0.85
Discount Rate (%)	10.0%
Evaluation Period (years)	20
Initial Calendar Year	2015
Population Served (persons)	4600

2. Inputs used in the Time and Accidents worksheet

The following inputs were fed in this sheet and the summaries are displayed in Table 2 below:

- a) Travel time cost: data regarding travel time costs was collected from the Wereda transportation office. In doing so the number of passengers per vehicle was defined and the corresponding value of time per hour was computed. For instance for bus Medium, number of passenger are 25 and the elapsed including wastage time is 2hr and the estimated collected sum amount is 150 birr there for the passengers time coast is 3birr/hr.
- b) Average cost per accident: For the purpose of setting the average cost per accident a series of computations were made. According to the counted average daily traffic in 2013 was found to be 37 and was projected to reach 156 in 2032. The annual traffic for 2013 and 2032 was computed by multiplying the daily traffic by 365 days. Therefore, the annual traffic in 2013 and 2032 were 13,505 and 56,940 respectively.

Again according to the data from the woreda police bureau there was one accident recorded in 2013. From this data the researcher computed the projected car accident in 2032. In other words in a situation where there is 1 accident from 13,505 annual traffic, there would be 4.216 (round to 4 in further computations) accidents from 56,940 annual traffic. Then the average accident per year is computed by summing the number of accidents and dividing by two. That is, the average annual accident per year is 2.5.

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To arrive at the annual cost per accident, the cost incurred in the accident in 2013 was collected from the woreda police bureau. Accordingly the average cost incurred in the accident was reported as 4,000birr. Therefore, if an accident incurred 4,000birr, the average cost per accident would be 10,000birr where the average annual accident rate was 2.5. Needless to say 10,000birr is used as average cost per accident in the present study.

Table 2

Time and accidents

Travel Time Costs

	Number of Passengers (#)	Passengers Time Cost (ETB/pas-hr)	Cargo Holding Time Cost (ETB/veh-hr)
Car Medium	3	6.00	0.00
Four-Wheel Drive	4	6.00	0.00
Bus Light	20	4.00	0.00
Bus Medium	25	3.00	0.00
Animal Cart	3	2.00	0.00
Truck Light	2	0.00	50.00
Truck Medium	2	0.00	50.00
Motorcycle	2	1.00	0.00
Bus Mini	12	5.00	0.00

Accident Costs

	Costs in Birr
Average Cost per Accident	10000
OR	
Costs per Accident Type:	
With Fatality	0
With Injury	0
Damage Only	0

3. Inputs used in the Traffic worksheet

The following inputs were included in this sheet and the summaries are displayed in Table 3 below: (Since the data for the dry and wet seasons are the same, Table 3 below includes the dry season only)

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- a) Normal traffic: the number and rate of traffic accidents were collected from the Wereda Police bureau.
- b) Growth rate: the traffic growth rate the RED Model after every 4 year computes for each car type.
- c) Diverted Traffic: Diverted traffics are from the alternative road that diverts to the project road with the same origin and destination. The same as the normal traffics, diverted traffics are also counted and projected to its design period.
- d) Investment Cost: The project agreement document vividly depicted the total investment cost as well as the percentage of investment costs in three consecutive years. Data on the actual paid costs were also collected from the consultants to ratify the practicality of what was agreed up on. Hence, data on the investment costs used in the present study were directly taken from the document.

Coupled with this data on fixed and variable costs were collected from the Woreda transport bureau which the bureau is responsible for maintain the road.

Table 3: Traffic

Normal Traffic

Dry Season

	Daily Traffic 2013 (veh/day)	Composition 2013 (%)	Daily Traffic 2032 (veh/day)	Composition 2032 (%)
Car Medium	1	3%	3	2%
Four-Wheel Drive	2	5%	6	4%
Bus Light	2	5%	5	3%
Bus Medium	1	3%	3	2%
Animal Cart	10	27%	27	18%
Truck Light	2	5%	4	3%
Truck Medium	2	5%	4	3%
Motorcycle	15	41%	96	61%
Bus Mini	2	5%	7	5%
Total	37	100%	156	100%

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Normal, Generated and Diverted Traffic Growth Rate

Traffic Growth Rate (%)			
2013 – 2017	2018 - 2022	2023 - 2027	2028 - 2032
5.0	6.0	7.0	6.0
5.0	6.0	7.0	6.0
4.0	5.0	6.0	5.0
5.0	6.0	6.0	5.0
6.0	7.0	5.0	4.0
3.0	4.0	5.0	4.0
3.0	4.0	5.0	4.011
10.0	12.0	11.0	8.0
6.0	7.0	8.0	7.0

7.1	8.5	7.8	6.0
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The traffic growth rate in % is based on the reality of that the traffic growth rate increases as road surface roughness is low which is at the new stage (from 2013-2027) and also decreases as the road surface roughness is higher in which the road gates deteriorates(2028-2032).

4. Inputs included in the Project-Alternative Main Features

The following inputs were included in the Project-Alternative Main Features and the summaries are displayed in Table 4 below:

- a) Percent of investment: It is the total project cost in percent of each year. Data about the percent of investment within three years on alternative 0 and 1 were collected from the payment sheets. And data for alternative 2 and 3 was predicted (for the roads to be considered).
- b) Maintenance costs: Both fixed and variable financial maintenance costs for alternative 0 and 1 was collected from the Wereda transportation bureau. Plus data on maintenance costs for alternative 2 and 3 was predicted.

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- c) Accident rates: Data on the number of accidents per 100 million vehicle –km was collected from Wereda Police bureau.
- d) Alternative road data: The characteristics of the alternative road and the diverted traffic from the alternative road were collected from consultants.

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Table 4: Project-Alternatives Main Features

Project-Alternatives Main Features				
	Without Project Alternative	Project Alternatives		
	Alternative 0	Alternative 1	Alternative 2	Alternative 3
Alternative Description	Gradings Every 120 Days	Gradings Every 120 Days	Gradings Every 45 Days	Surface Treatment Standard
Terrain Type (A/B/C)	B	B	B	B
A: Flat				
B: Rolling				
C: Mountainous				
Road Type (X/Y/Z)	Z	Y	Y	X
X: Paved				
Y: Gravel				
Z: Earth				
<u>Dry Season</u>				
Road Length (km)	19.0	19.0	19.0	19.0
N.A.				
Car Medium Speed (km/hr)	30.0	45.0	50.0	60.0
Investment Duration in Years (0/1/2/3)	1	2	2	3
Percent of Investment Costs in Year 1 (%)	100%	40%	40%	30%
Percent of Investment Costs in Year 2 (%)	0%	60%	60%	30%
Percent of Investment Costs in Year 3 (%)	0%	0%	0%	40%
Financial Investment Costs ('000ETB/km)	50.00	650.00	700.00	1700.00
Fixed Financial Maintenance Costs ('000ETB/km/year)	11.00	12.00	30.00	60.00
Variable Financial Maintenance Costs ('000ETB/km/year/ADT)	0.750	0.750	3.000	3.000
Accidents Rate (Accidents per 100 million vehicle-km)	3.0	3.0	2.0	2.0
And Optionally				
Percent With Fatality (%)	1%	1%	1%	1%
Percent With Injury (%)	4%	3%	2%	5%
Percent Damage Only (%)	10%	9%	8%	7%
Diverted Traffic from Alternative Road (veh/day):				
Car Medium		1	2	1
Four-Wheel Drive		3	4	3
Bus Light		1	2	1
Bus Medium		1	2	1
Animal Cart		4	5	4
Truck Light				
Truck Medium				
Motorcycle		7	8	7
Bus Mini		5	6	5
Alternative Road Characteristics:				
Road Terrain Type (A/B/C)		B	B	B
Road Type (X/Y/Z)		Y	Y	X
Road Length (km)		19.0	19.0	19.0
Road Roughness (IRI)		6.5	3.5	2.7

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3.8. Procedure of data collection

Before administrating the final instrument for data collection, a short training was provided to two research assistants on how to conduct the questionnaire survey. The researcher also established an appropriate rapport with the participants to facilitate situations for the research activities. All the respondents were informed about the purpose of the study and how to complete the questionnaires. During administrating the questionnaires, they were shown a model example that would help them to easily complete the questionnaire. No time limit was made for the completion of the questionnaire. Respondents were also asked to give their own responses and were informed that there is no right or wrong answers. Similarly chances for clarification of any item were given during the administration of the questionnaire.

Coupled with that data were collected from the Wereda Transportation Bureau, Wereda Police Office and consultants of the road project. Later on data was collected from insurance companies and Commercial banks.

3.9. Methods of data analysis

Before data analysis had been undertaken, reliability of each of the scale questionnaire was re-established. After the data were collected from 196 residents, the Cronbach alpha reliability was re-established. Hence ,the reliability for Economic impact measure ,social impact measure ,and Negative impact measure where 0.950, 0.971, and 0.861 respectively. In doing so, inter-item correlation between items and reliability coefficients if item deleted were also calculated. However, the reliability of each scale was found to be high (>0.07), no item was deleted from the questionnaire (see Appendix 4).

After the reliability is re-established, relevant statistical techniques were employed depending on the nature of the collected data.

Specifically:

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- Descriptive statistics was used for the purpose of assessing the socio-economic impacts. In this particular case, percentages, means, standard deviations and scores below and above the average for each scale were computed.
- Independent sample t-tests examined mean differences in socio-economic impact scores when a variable has two categories (e.g. gender is categorized in to two as male and female). Independent sample t-tests were used to look in to the mean differences in socio-economic impacts of the road based on gender, educational status and place of residence.
- One-way analysis of variance (ANOVA) examined mean differences in socio-economic impact scores among categories within a variable where the categories are more than two (e.g. marital status is categorized in two three as single, married and divorced). One-way ANOVA was computed to examine mean differences in the socioeconomic impacts of the road based on respondents' marital status and occupation.
- Frequencies and percentages were used in analyzing data from the negative impact measure.
- Net Present Value and Internal Rate of Return were computed to examine economic benefits of the road.
- Present Value of Society Costs was employed to examine the social benefits of the road.

All the data analysis of the data collected through the questionnaire was computed using SPSS (Statistical Package for Social Sciences) version 20. In addition RED Model Software was used to analyze Net Present Value, Internal Rate of Return and Present Value Society Costs.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1. Questionnaire Survey Outputs

4.1.1. Demographic characteristics of the respondents

Frequencies and percentages were computed on demographic variables and the summaries of the computations are presented in Table 5 below.

Table5: Description of participants based on demographic variables

R/N _o	Demographic Variable	Category	N _o	%
1	Sex	Female	139	70.9
		Male	57	29.1
		Total	196	100.0
2	Marital Status	Married	92	46.9
		Single	96	49.0
		Divorced	8	4.1
		Total	196	100.0
3	Education	Attend	144	73.5
		Don't attend	52	26.5
		Total	196	100.0
4	Place of residence	Urban	17	8.7
		Rural	179	91.3
		Total	196	100.0
5	Occupation	Farmer	82	41.8
		Merchant	16	8.2
		Student	49	25.0
		Teacher	40	20.4
		Government Worker	5	2.6
		Cashier	2	1.0
		Secretary	2	1.0
		Total	196	100.0

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Table 5 above depicts that 139 female (70.9%) and 57 male (29.1%) individuals were included in the present study. With regard to the participants' marital status, 46.9% of them (92 in number) were married, 49.0% of them (96 in number) were single and the remaining 4.1% of them (8 in number) were divorced. Looking in to the respondents' educational status, Table 1 informs that 144 of the respondents (73.5%) didn't get schooling where as the remaining 52 of them (26.5%) did get some form of schooling. Of all the respondents, 91.3% (179 in number) live in rural areas while the remaining 8.7% (17 in number) live in urban areas. Table 1 also tells that 82 respondents (41.8%) were farmers, 49 (25%) were students, 40 (20.4%) were teachers, 16 (8.2%) were merchants, 5 (2.6%) were government workers, 2 (1%) were cashiers and the remaining 2 (1%) were secretaries.

4.1.2. The Socio-economic Impact of the Road

The first research question was related to the assessment of the socioeconomic impact of the road. In relation to this research question, scores below and above the average, mean and standard deviation were computed for both the economic and social impact of the road. These computations are summarized and presented in Table 6.

Table 6: Descriptive statistics of socio-economic impacts of the road

Measure	Scores below the mean		Scores above the mean		Mean	Standard deviation
	N	%	N	%		
Economic Impact	78	39.80	118	60.20	85.53	21.43
Social Impact	76	38.80	120	61.20	77.65	21.13

Table 6 above shows that participants scored mean scores of 85.53 (SD= 21.43) and 77.65 (SD= 21.13) in the economic impact measure and social impact measure respectively. Hypothetically,

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in a 5- point-Likert type scale, 3 or (3 x 24 items which equals to 72 mean score) can be considered as average in the economic impact measure and 3 or (3 x 21 items which equals to 63 mean score) can be considered as average in the social impact measure. Therefore, the mean scores in Table 6 implied that participants gained higher levels of economic and social impact from the constructed road.

In addition, the table above indicates that 60.2% and 61.2% of the participants scored above the mean on economic impact and social impact scales respectively. On the other hand 39.8% and 38.8% of the respondents scored below the average on the economic and social impact scales respectively. The mean score of participants in the economic impact scale is 85.53 with SD of 21.43 and the mean score of the participants in the social impact scale is 77.65 with SD of 21.13.

4.1.3. Economic impact of the road

The analysis above depicted the overall economic and social impacts of the road. For the purpose of describing the specific economic and social impacts of the road detailed analysis were conducted on each impact.

Let's begin by describing the detailed economic impacts of the road. In doing so, descriptive statistics (mean, standard deviations, scores below and above the mean) on the three subscales of the economic impact measure were computed. And Table 7 below presents the summaries of the descriptive statistics on the economic impacts measure.

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Table 7: Descriptive statistics of economic impacts of the road

subscales	Scores below the mean		Scores above the mean		Mean	Standard deviation
	N	%	N	%		
Agricultural Impact	77	39.30	119	60.70	42.84	11.07
Job Opportunities	85	43.40	111	56.60	16.66	5.49
Access to Markets	86	43.90	110	56.10	26.03	6.71

As can be seen from Table 7 participants mean score in the agricultural impact subscale, job opportunity subscale and access to market subscale were 42.84 (SD= 11.07), 16.66 (SD= 5.49) and 26.03 (SD= 6.71) respectively. The averages in the in the agricultural impact subscale (3 x 12items), job opportunity subscale (3 x 5 items) and access to market subscale (3 x 7 items) are 36, 15 and 21 respectively. Hence, the mean score values implied that respondents sought higher level of agricultural impact, job opportunity and access to markets because of the constructed road.

The table above informs us that 60.7%, 56.6% and 56.1% of the respondents scored above the mean regarding the agricultural impact, job opportunity and access to market measures respectively. The table also explains that 39.3%, 43.4% and 43.9% of the respondents scored below the mean regarding the agricultural impact, job opportunity and access to market measures respectively.

4.1.2.2. Social Impact of the road

In order to describe the details, descriptive statistics (mean, standard deviations, scores below and above the mean) on the three subscales of the social impact measure were computed. And Table 8 below presents the summaries of the descriptive statistics on the social impacts measure.

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Table 8: Descriptive statistics of social impacts of the road

Area	Scores below the mean		Scores above the mean		Mean	Standard deviation
	N	%	N	%		
Social Interaction and Mobility	70	35.70	126	64.30	33.46	9.46
Access to Education	79	40.30	117	59.70	21.28	6.66
Access to Health	74	37.80	122	62.20	22.91	6.48

Table 8 indicate that participants mean score in the social interaction and mobility subscale, access to education subscale and access to health subscale were 33.46(SD= 9.46), 21.28 (SD= 6.66) and 22.91 (SD= 6.48) respectively. The averages in the in the social interaction and mobility subscale (3 x 9 items), access to education subscale (3 x 6 items) and access to health subscale (3 x 6 items) are 27, 18 and 18 respectively. Hence, the mean score values implied that respondents sought higher level of social interaction and mobility, access to education and access to health as a result of the constructed road.

The table above informs that 64.3%, 59.7% and 62.2% of the respondents scored above the mean in the social interaction and mobility, access to education and access to health measures respectively. The table also explains that 35.7%, 40.3% and 37.8% of the respondents scored below the mean in the social interaction and mobility, access to education and access to health measures respectively.

4.1.3. Differences in socioeconomic impacts of the road based on demographic variables

For the purpose of examining the differences in the socioeconomic impacts of the road based on demographic variables, the economic and the social impacts were analyzed separately. The analyses are presented in the following consecutive sub-sections.

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4.1.3.1. Differences in the economic impacts of the road based on demographic variables

Independent sample t-tests were conducted to look into the mean difference on the economic impact of the road' based on the respondents' sex, education and places of residents. The results of the analysis are summarized in Table 9 below.

Table 9: Independent sample t-test for sex, education and place of residence on the economic impact scale

Demographic Variables	Category	No	Mean	SD	t - values	P-values
Sex	Female	139	85.05	22.35	-.489	.625
	Male	57	86.70	19.14		
Education	Attend	144	82.60	21.72	-3.267	.001
	Don't Attend	52	93.65	18.49		
Place of residence	Urban	17	97.82	11.83	2.508	.013
	Rural	179	84.36	21.79		

As one can see from Table 9 above, the mean economic impact of the road for male respondents (M= 86.70, SD=19.138) is higher than female respondents (M= 85.05, SD=22.349) but the difference is not statistically significant (t= -0.489, p= .625). On the other hand, the mean economic impact of the road for respondents who didn't attend schooling (M= 93.65, SD=18.492) is higher than respondents who attend schooling (M=82.60 SD=21.716) and the mean difference is statistically significant (t= -3.267, p<0.01). Similarly the mean economic benefit of the road for urban residents (M= 97.82, SD=11.828) is higher than for the rural

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residents (M=84.36 SD=21.788) and the mean difference is statistically significant ($t= 2.508$, $p<0.05$).

One way ANOVA was applied to look into the mean difference in the economic impact of the road based on respondents' marital status and occupation. The summaries of the findings are presented in Table 10 below.

Table 10: One-Way ANOVA for economic impact of the road based on respondents' marital status and occupation

Demographic Variables	Category	No	Mean	SD	F- values	P-Values
Marital status	Married	92	86.35	20.91	0.664	.516
	Single	96	84.18	22.30		
	Divorced	8	92.38	16.51		
Occupations	Farmer	82	94.54	16.71	14.260	.000
	Merchant	16	90.88	17.00		
	Student	49	85.02	18.90		
	Teacher	40	63.35	20.47		
	Government Worker	5	91.20	16.87		
	Cashier	2	104.00	2.83		
	Secretary	2	97.00	8.49		

As can be seen in Table 10 respondents' marital status is not statistically significant [$F(2,193) = 0.664$, $p= .516$] over the economic impact of the road according to information provided by the respondents. On the other hand, the type of occupation was found to be statistically significant [$F(6,189) = 14.260$, $p<0.01$] over the economic benefit that respondents acquired from the construction of the road.

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To further investigate the in-group differences in the economic impact of the road, Tukey HSD was computed. Based on the computations significant differences (each at $p < 0.05$) were found between teachers ($M = 63.35$, $SD = 20.467$) and farmers ($M = 94.54$, $SD = 16.705$); teachers and merchants ($M = 90.88$, $SD = 16.998$); and teachers and students ($M = 85.02$, $SD = 18.902$).

4.1.3.2. Differences in the social impacts of the road based on demographic variables

Independent sample t-tests were computed to look into the mean difference on the social impact of the road based on the respondents' sex, education and place of residence. The results of the analysis are summarized in Table 11 below.

Table 11: Independent sample t-test for sex, education and place of residence on the social impact scale

Demographic Variables	Category	N ₀	Mean	SD	t - values	P-Values
Sex	Female	139	77.83	21.59	0.185	.853
	Male	57	77.21	20.14		
Education	Attend	144	73.88	22.02	-4.347	.000
	Don't Attend	52	88.10	13.98		
Place of residence	Urban	17	88.82	11.55	2.307	.022
	Rural	179	76.59	21.54		

Table 11 above displays that the mean social impact of the road for female respondents is higher ($M = 77.83$, $SD = 21.589$) than the male respondents ($M = 77.21$, $SD = 20.144$), but the difference is not statistically significant ($t = 0.185$, $p = .853$). On the contrary, the mean social impact of the road for respondents who didn't attend schooling is higher ($M = 88.10$, $SD = 13.979$) than the mean social impact of the road for respondents who attend schooling ($M = 73.88$, $SD = 22.024$) and

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the mean difference is statistically significant ($t = -4.347$, $p < 0.01$). Similarly, the mean social benefit of the road for urban residents is higher ($M = 88.82$, $SD = 11.550$) than the mean social benefit of the road for the rural residents ($M = 76.59$, $SD = 21.542$) and the mean difference is statistically significant ($t = 2.307$, $p < 0.05$).

To look into the mean difference in the social impact of the road based on respondents' marital status and occupation, one way ANOVA was employed. The summaries of the findings are presented in Table 12 below.

Table 12: One-Way ANOVA results for social impact of the road based on respondents' marital status and occupation

Demographic Variables	Category	No	Mean	SD	F- values	P-Values
Marital status	Married	92	79.25	21.41	1.455	.236
	Single	96	75.41	21.18		
	Divorced	8	86.13	14.22		
Occupations	Farmer	82	85.87	16.34	12.573	.000
	Merchant	16	85.88	14.37		
	Student	49	77.27	19.45		
	Teacher	40	57.13	20.79		
	Government Worker	5	71.00	24.63		
	Cashier	2	93.50	7.78		
	Secretary	2	95.50	2.12		

Table 12 above show that respondents' marital status does not have statistical significance [$F(2,193) = 1.455$, $p = .236$] on the social impact of the road. On the other hand, the type of occupation had been found to be statistically significant [$F(6,189) = 12.573$, $p < 0.01$] over the economic benefits that respondents have acquired from the constructed road.

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To further investigate the in-group differences on the economic impact of the road, Tukey HSD was computed. Based on the computations significant differences (each at $p < 0.05$) have been observed between teachers ($M = 57.13$, $SD = 20.79$) and farmers ($M = 85.87$, $SD = 16.34$); teachers and merchants ($M = 85.88$, $SD = 14.37$); and teachers and students ($M = 77.27$, $SD = 19.45$).

4.1.4. Negative Impacts of the Road

Examining the negative impacts of the constructed road was one of the objectives of the present study. In this regard, respondents were asked to rate on a five point scale on their agreement or disagreement on the presented 10 items. For the purpose of analyzing their replies, frequencies and percentages were computed and the summary is presented in Table 13 below.

Table 13: Frequency and percentage of responses for the negative impact measure

R/ N o	Items	Response Category									
		Strongly Disagree		Disagree		Undecided		Agree		Strongly agree	
		No	%	No	%	No	%	No	%	No	%
1	Forests/trees were lost	57	29.1	42	21.4	36	18.4	48	24.5	13	6.6
2	HIV/AIDS incidences increased	92	46.9	47	24.0	31	15.8	18	9.2	8	4.1
3	Ease of soil erosion	74	37.8	53	27.0	35	17.9	22	11.2	12	6.1
4	Negatively effect on the water supply	85	43.4	43	21.9	36	18.4	27	13.8	5	2.6
5	Car accidents among live stokes increased.	109	55.6	40	20.4	31	15.8	15	7.7	1	.5
6	Car accidents among living residents increased	113	57.7	42	21.4	25	12.8	13	6.6	3	1.5
7	Resident migration	105	53.6	34	17.3	30	15.3	20	10.2	7	3.6
8	Lands were used for quarry sites, camp construction and road widening	103	52.6	29	14.8	27	13.8	27	13.8	10	5.1
9	Spread sex trade	116	59.2	31	15.8	25	12.8	14	7.1	10	5.1
10	Increased use of drugs	117	59.7	33	16.8	23	11.7	12	6.1	11	5.6

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As reflected in Table 13, 50.5% (disagree plus strongly disagree) replied that forests/trees were not lost while the road was under construction and 31.1% (agree plus strongly agree) replied the opposite. Of all the respondents, 139 of them feel like the presence of road construction workers had not increased HIV/AIDS infections in their surroundings. With regard to soil erosion, 64.8% of the respondents replied that the road construction hadn't made the surrounding soil to be easily eroded. Similarly, 65.3% of the respondents replied that the road construction hadn't negatively affected the water supply of the area. In relation to car accidents, 76.0% and 79.1% of the respondents, respectively replied that the constructed road hadn't increased accidents of live-stocks and residents in the area. Of all 196 respondents, 70.9% of them replied that the number of residents hadn't increased after the road has been constructed.

4.2. Results of the RED Model

The major objective of the present study was examining the socio-economic benefits of the constructed road. Although the RED model had come up with a host of results (see Appendix 6), results of the economic benefit and the social benefit of the road are included in this section. In doing so, computations of the Net Present Value vis-à-vis the Internal Rate of Return was used to assess the economic benefits of the road. In addition, computations of the Present Value of Society Costs are used to look in to the social benefits of the constructed road.

For the purpose of comparing the four project-alternatives, Net Present Value at 10% discount rate was computed and the summaries are presented in Table 14 below.

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Table 14: Net Present Value

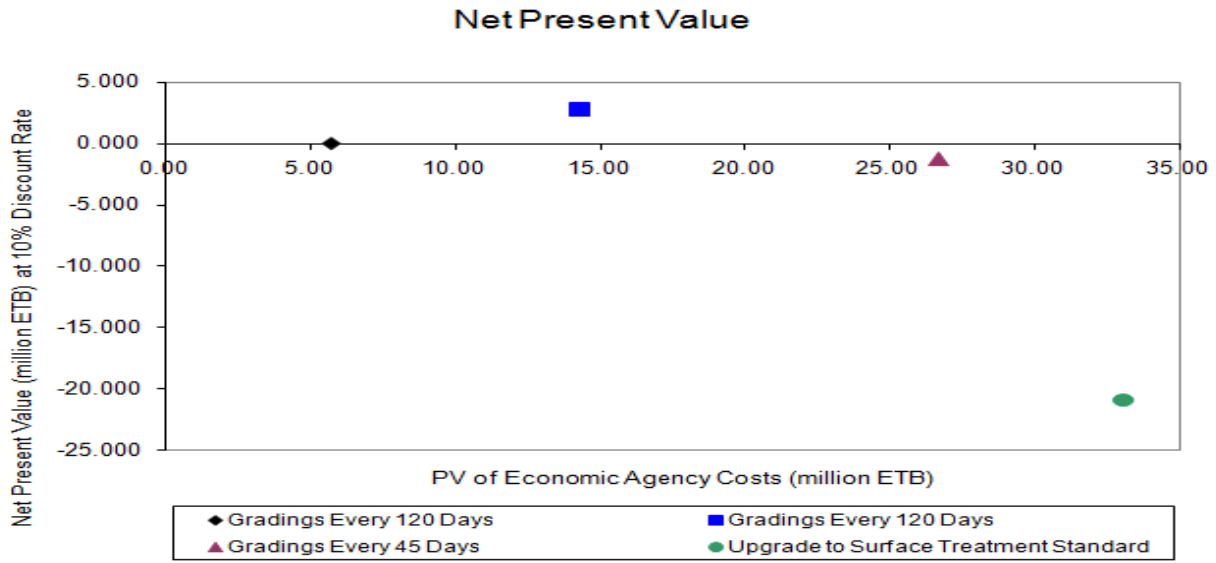
	Without Project Alternative	Possible Project Alternatives		
	Alternative 0	Alternative 1	Alternative 2	Alternative 3
	Gradings Every 120 Days	Gradings Every 120 Days	Gradings Every 45 Days	Upgrade to Surface Treatment Standard
Net Present Value (million ETB) at 10% Discount Rate	0.000	2.790	-1.244	-20.839
Internal Rate of Return (%)	#N/A	17%	7%	#DIV/0!
Equivalent Annual Net Benefits (ETB/km) at 10% Discount Rate	0	21723	-9686	-162268
Modified Rate of Return at 10% Reinvestment Rate (%)	#N/A	13%	8%	-10%

As can be seen from Table 14 above, it is only alternative 1 that yields a net present value greater than zero with 13% internal rate of return. The table also depicts alternatives 2 and 3 yield net present value less than zero. In addition, the table inform us that alternative 2 have positive (8%) and alternative 3 have negative (-10%) internal rate of return.

These indicate that economically alternatives 2 and 3 are not justified at 10% discount rate while alternative 1 (the constructed road) is the best option among the three options considered for it is characterized by higher net present value and internal rate of return.

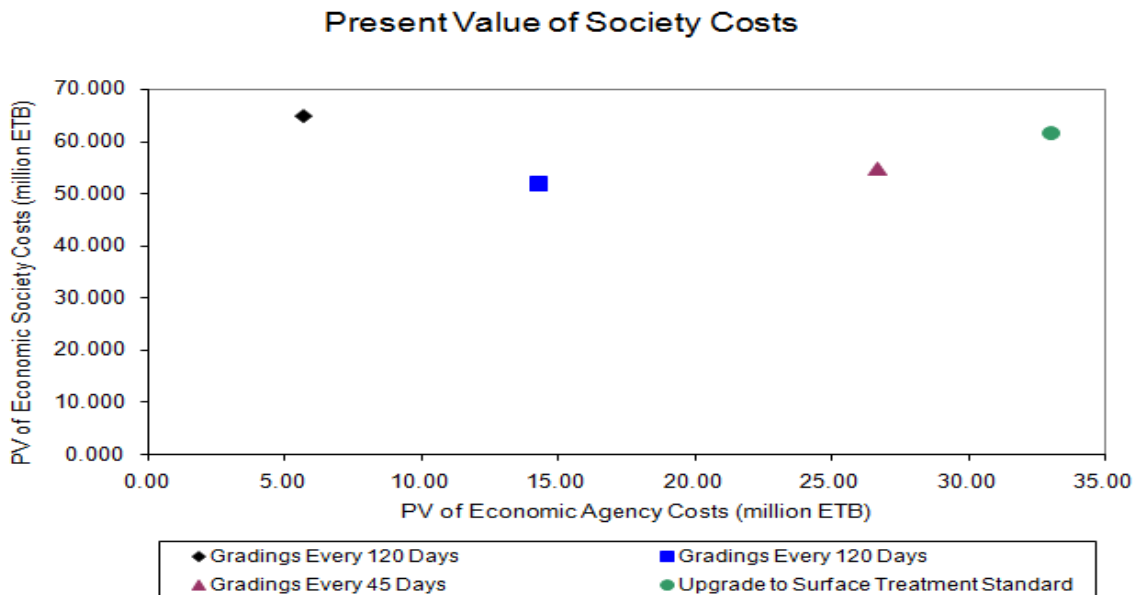
These ideas can best be pictorially presented in the graph below

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Graph 1: Net Present Value

For the purpose of examining the social benefits of the constructed road, the present value of society costs were computed and the summaries are presented in the Graph 2 below



Graph 2: Present Value of society costs

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

A project with the least present value of society cost is assumed to be with a best social benefit. As can be observed from the graph above the project with grading every 120 days (the constructed road) had the least present value of society cost. This indicates that compared to other alternatives, the cost invested for the road construction had come up with larger social benefit.

4.3. Discussions

The very objective of the present study was to examine the socio-economic benefits of the constructed road for residents in the surrounding community. In this regard the findings of the study had revealed that the constructed road had economic benefits to the households in the area. The economic benefits of the road had been visibly manifested through its positive agricultural impacts (e.g. improved productivity, use of pesticides, etc), creating job opportunities and improving residents' access to markets. The RED model results had also revealed that the constructed road is the best option among the four options considered for it is characterized by higher net present value and internal rate of return.

Similar findings had been reported in other studies conducted in Ethiopia and elsewhere. For example the study in Ethiopia by Wondimu and Weiss (2012) had revealed that the constructed roads had increased the household incomes in the surrounding communities. A study in Northern Ethiopia had revealed that road access had increased income of the residents by helping them have better access to credits and fertilizers (Bhatta, 2004). Another study in Ethiopia by Terefe (2012) had found out that improvement in road access to rural villages reduced poverty level of the residents. A study in Ghana had revealed that farmers with access to roads were able to access farm inputs on time and with lower costs. Similarly a study in Nepal by Paudel (2014) had found out that improved access to roads is associated with improvement in agricultural development. Like the findings of the present study, the study by Terefe (2012) revealed that access to road had opened access to use of modern fertilizers, made residents to intensively use fertilizers and increased agricultural productivity. Similarly a study in Nigeria had revealed that

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the productivity and income of the residents had significantly increased after roads were constructed (Abur et al., 2015).

Unlike the study by Terefe (2012) that focused on agricultural benefits only, this study focused on three economic benefits of road (agriculture, job opportunity and access to market) and the outputs of the study showed that the constructed road had created both short- and long-term job opportunities and the road had improved residents' access to markets. Another study in Kenya by Wanjaku (2014), had found that newly constructed roads created more jobs.

In the present study, it was also found that the constructed road had improved the social benefits of the residents in the surrounding area. Of particular importance is the fact that the constructed road had increased social interaction and the mobility of the residents. The construction of the road has improved access to education and health. The RED Model results had also revealed that the constructed road is the one with the best social benefit to population served.

Similar findings had also been reported from different studies in different corners of the globe. For example the study by ADB (2006) had revealed that roads constructed had social benefits through increasing access to health facilities; increasing school enrollments; decreasing travel time and cost; decreasing travel time to clinics or hospitals; and increasing frequency of visits to clinics or hospitals. Similarly the study in Nepal by Paudel (2014) had found out that access to roads help residents through better access to education, health and markets.

In this study, differences in economic and social benefits had been found based up on residents' educational status, place of residence and occupation. It was revealed that residents who didn't attend school and who reside in urban areas had gained the higher economic and social benefits from the constructed road than their counter parts. At the same time, it was visible that compared to farmers, merchants and students, teachers had gained the least economic and social benefits because of the constructed road (see table 10 & 12). In contrast, gender and marital status had been found to have no significant effect over the economic and social benefits of residents due to the constructed road. In this study, it was found that the non-school attendants gained the highest economic and social benefits from the constructed road.

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Though studies which compare economic and social benefits are scarce the available ones come up with contrasting findings to the findings of the present study. For example the study by ADB (2006) conducted in different Asian countries had revealed that roads constructed had benefited teachers a lot. This is in contradiction to the findings of this study that had found that teachers gain the least benefits. The possible explanation for the difference could be attributed to the small number of teachers included in the present study because of population limitation.

Contrary to the findings of the present study which revealed that residents without education had the highest benefits, the study conducted in Nigeria revealed that educated farmers benefit more than their counter parts (Abur et al., 2015). Similarly in the study by ADB (2006) it was revealed that residents with higher educational level benefited a lot from the constructed roads in different countries in Asia. The possible explanation for the difference in the findings is that the number of respondents who had got education in this study were small in number; in rural Ethiopia, there are less number of educated people compared to Asia.

Cognizant of this fact the present study revealed that there is no gender difference in the economic and social benefits residents have got from the constructed road. However, the study in South Africa had found gender differences where women were more affected by the lack of roads (Sewell and Desai, 2016).

In this study, it was revealed that the majority of the residents believed that the constructed road didn't increase HIV/AIDS incidences, soil erosion, accidents, sex trade and drug use. Most had also believed that forests were not lost, farm lands were not used during the road construction and the road construction didn't negatively affect the water supply. On the other hand significant number of the residents acknowledged the fact that forests/trees were lost during the road construction. From these findings, one may conclude that the constructed road have minor negative impacts on the socio-economic livelihood of the surrounding community.

These findings seem to contradict with findings elsewhere that had revealed the prevalence of negative impacts of rural roads construction. Studies had revealed that during road construction, there are cutting of trees and negative effects on wildlife (Wanjiku, 2014). Similarly, studies

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revealed that road constructions are related with migration (ADB, 2006), environmental degradation, increased road accidents, exclusion of local products for they would be replaced by imported products (Paudel, 2014). Erosions because of road constructions were also reported in studies. For example Leibundgut and colleagues (2016) had surveyed 129 km of earthen roads in Nepal and they have found that 179 erosions were caused by road constructions. However, in the present study these negative effects of roads were not mentioned except for significant number of residents mentioned cutting of trees/forest as a negative impact of the road.

Such differences in findings could be attributed to the fact that the constructed road (the focus the present study) is new and people in the surrounding area are not sensing the negative impacts of the constructed road. For example, increase in HIV/AIDS incidence would be felt after some time but for the time being the residents may claim like it did not increase. The other possible explanation for favorable attitude of residents of this area is that people are new to such roads and hence they may be blind on the negative impacts.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

Based on the findings of the present study, the following important conclusions are made:

- ✎ Rural roads in Ethiopia do have economic benefit for those who have the access to the road. Specifically, rural roads increase agricultural productivity, widen the short and long term job opportunities and improved access to markets.
- ✎ The effects of background variables on the economic benefits were minimally addressed in the present study. The findings so far inform us that some variables (like residence and educational status) had significant influence while other variables seem to have less influence (e.g. gender) over the economic benefits to be gained from rural roads constructed.
- ✎ Rural road construction in Ethiopia does have a host of social impacts. Constructing roads within and between villages improves social interactions and mobility among and between village residents. Doing so will also improve children's access to education and could contribute towards the quality of education (for example it could help students to have comfortable travel to their schools). Access to health is improved because of roads constructed. Constructed roads help pregnant mothers reach health facilities easily, contribute towards immunization of children, etc.
- ✎ In this study, it was found that teachers got less socio-economic benefits from the constructed road. Since the number of teachers who participated in the present study were small, it seems there is a need to critically examine at a wider scale.
- ✎ Even if the participants reported that there are minimal negative impacts of the road, some of the impacts need closer and critical examinations.

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Generally speaking, it can be concluded that the construction of the rural road in Nono Benja Wereda, Jimma Zone does have positive socio-economic impact to those who have access to such roads.

5.2. Recommendations

Based on the conclusions made from the findings, the following short and long term recommendations are given:

- As the scale of rural road construction in the country is expanding, there is a timely need of examining the effects of rural roads on the socio-economic impacts of the roads.
- Concerned bodies, including the Ethiopian Roads Authority and regional head quarters of the authority, need to examine the socio-economic impact of rural roads, not only before roads are constructed but also right after it is completed and after certain period of time. In this regard, preparation of project completion reports and post-evaluation studies should be initiated and carried out. Doing so will help to compare the socio-economic and cultural changes observed in communities who are offered road access. This in turn will help to design future rural road works.
- The effects of distance from the constructed road are not addressed in the present study. Hence, researchers who are interested on the socio-economic impact of rural roads need to include such important variables.
- The long term negative impacts of rural roads over the community in the surrounding area need to be critical assessed so that preventive measures could be taken.
- Researches on the socio-economic impacts of rural roads and the negative impacts of such roads need to be conducted at a large scale.

5.3. Implication and future research direction

In the present study it was revealed that the Nono Benja road had brought economic and social benefits over the user of the road. One of the implications of the findings of the present study is that rural roads do in practice benefit the users. However, the study is conducted over the

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beneficiaries of a single road. Therefore, future researchers can examine the socio-economic impacts of rural roads at a larger scale.

In the present study alternative roads had been compared with RED model. The findings from the present research will serve as a reference guide for practicing Civil Engineers and researchers who want to use alternative impact assessment to the future development programs in the construction sector. Hence, examining alternative roads using the RED model is an area of future research.

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Appendix 1: Questionnaire – English Version

**ADDIS ABABA UNIVERSITY
INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ROAD AND TRANSPORTATION ENGINEERING
GRADUATE PROGRAM**

Household Survey Questionnaire

Dear Participant!

Thank you for agreeing to take part in this study. The purpose of this questionnaire is to gather information for a study leading to MA degree in road and transportation engineering. Information you provide would be very crucial for the success of the study. Therefore, you are kindly requested to be honest towards all the items provided in this questionnaire.

General Instructions

- ☞ Read the instructions in each section of the questionnaire and respond accordingly.
- ☞ The information you supply will be kept confidential. Thus you are not required to write your name.
- ☞ If you are not clear with or uncertain about an item/question, feel free to ask the person who is helping you fill the questionnaire.

Thank you in advance for your kind cooperation!

Part I: Demographic Variables

Read the following items and fill the appropriate words or encircle the letter of your choice.

1. How old are you? _____

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S/N	Items	1	2	3	4	5
	increased after the road is constructed.					
8	After the road is constructed the unit price of farm inputs had decreased.					
9	The local market prices of key crops in the area had increased after the road is constructed.					
10	The local market prices of live stoke had increased after the road is constructed.					
11	I am able to transportation my goods at cheaper transportation price to market places.					
12	The constructed road had attracted investments in agriculture					
13	While the road was constructed, several people in my village had got job opportunities.					
14	People in my village had got the opportunity to work in the road maintenance after the road construction is over.					
15	We are able to travel to other towns in search of jobs after the road was built.					
16	The road construction helped people in my village to establish small businesses alongside the road.					
17	After the road is constructed. people begun to sell goods (e.g. charcoals, firewood, etc) at the road side to passing vehicles.					
18	The road constructed had decreased the distance to markets.					
19	After the road is constructed, the number of sellers/shops in the nearest market had increased.					
20	After the road is constructed, the number of products available in the market had decreased.					
21	After the road is constructed, the number of my visits to markets as consumer had increased.					
22	After the road is constructed, the number of my visits to markets as producer had increased.					

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

S/N	Items	1	2	3	4	5
23	The price of the land I own is increased because of the constructed road.					
24	After the road is constructed, the price of my house had increased.					

Part III: Social Impact Measure

Instruction: Please indicate how much you agree or disagree with the following statements about your views about the road constructed around your village by ticking (X) in the appropriate box. Here please bear in your mind that what we need is your view. Since views hold by human beings are different, there is no such thing as correct and incorrect view. Therefore please indicate how much you agree or disagree with each statement. Please use the following rating scale.

The rating scale is as follows:

1. Strongly disagree 2. Disagree 3. Undecided
4. Agree 5. Strongly agree

S/N	Items	1	2	3	4	5
1	Because of the constructed road the authority are able to visit our community more regularly.					
2	The number of my visits to other villages and cities had increased after the road is constructed.					
3	The number of visits I received from friends or relatives in other villages or cities had increased since the road is constructed.					
4	My attendance at social events (e.g. funeral, wedding, etc) in					

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

S/N	Items	1	2	3	4	5
	other villages or cities had increased because of the constructed road.					
5	Since the road is constructed, I could be able to attend at public meetings not in my village.					
6	The road constructed had tightened rural-urban links.					
7	I spend less time waiting for transportation service than before the construction of the road.					
8	Travel time to the next town/village substantially reduced because of the constructed road.					
9	Travel convenience had improved since the road is constructed.					
10	The number of school enrollment rate had increased since the road was constructed.					
11	The constructed road had decreased the number of students who drop out of school.					
12	Missing classes because transportation related problems is resolved now than before the road was constructed					
13	After the road was constructed, students are able to travel to secondary schools by buses					
14	After the road is constructed teachers are able to stay longer in a school.					
15	The rate of teachers' absenteeism had decreased because of the constructed road					
16	Before the road was constructed, I had missed appointments because of transportation related problems.					
17	The difficulty to travel to a hospital is resolved after the road is constructed.					
18	After the road is constructed women are able to access health					

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

S/N	Items	1	2	3	4	5
	facilities during child birth.					
19	It is because of the constructed road that the immunization of children in our village had increased.					
20	The road had helped the community in my village to reach health facilities in time of emergency.					
21	The constructed road had helped health extension workers to cover their areas of responsibility more quickly and efficiently.					

Part IV: Negative Impact of the Road Measure

Instruction: Please indicate how much you agree or disagree with the following statements about your views about the road constructed around your village by ticking (X) in the appropriate box. Here please bear in your mind that what we need is your view. Since views hold by human beings are different, there is no such thing as correct and incorrect view. Therefore please indicate how much you agree or disagree with each statement. Please use the following rating scale.

The rating scale is as follows:

1. Strongly disagree 2. Disagree 3. Undecided
4. Agree 5. Strongly agree

S/N	Items	1	2	3	4	5
1	While the road was under constructions, a lot of forests/trees were lost					
2	I feel like the presence of road construction workers had					

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

S/N	Items	1	2	3	4	5
	increase HIV/AIDS incidences in our community					
3	The road construction had made the surrounding soil to be easily eroded.					
4	The road construction negatively affects the water supply of the area.					
5	The constructed road had increased car accidents among live stokes.					
6	The constructed road had increased car accidents among living residents of the area.					
7	Since the road is constructed, a number of residents had migrated to other areas.					
8	While the road was under construction, farm lands were used for quarry sites, camp construction and road widening for the project.					
9	The road construction had spread sex trade in the area.					
10	Use of drugs had increased since the road construction begun.					

Dear participant!

This is the end of the questionnaire. Hence please make sure that you work out on all the items.

Thank you again for taking your time to fill the questionnaire!

Appendix 2: Questionnaire – Afan Oromo Version

Yuuniversitii Finfinee

Muumee Barnoota Teekinoolojjii

Dipartimentii Ijaarsa Daandii Fi Geejjiba

Sagantaa Eebbifamtoota

Uunka Gaaffii Manaa Manatti Guutamuu

Hirmaatoota hundaaf dursa gaaffiin qo'anaan qopha'ee kun akka isiin biratti fudhatama argatuu gochuun waan nu simataniif galatooma jecha, qo'anoon gaaffii kun kan qopha'ee barnoota digirii lammaaffaa gosa barnoota ijaarsa dandii fi geejiba irratti ragaa qabatammaa hawaasni dandicha irra fayyadama ta'e qo'anaa keenyaan gaaffii qopha'een sassabachuun adda baasuu akkasumasii hojiin qo'anaa keenyaan akka milka'uu abdi keenya.

Qajeelfama waliigala

- 1) Gaaffiiwwaan qophaa'an tokkoon tokkoon isan uulaga isa dursii dubbisi deebii sirri kenni,
- 2) Deebii deebistuu hunda raga qulqulluu irra dhaabadhuu ofitti ammanuun guutii, maqaa kee hin guutiin,
- 3) Gaaffiiwwaan tarreeffaman yoo si galuu hafan qaama gargaara si bukkee jiru gaafadhu,
- 4) Gaaffiiwwaan qophaa'an qooqa afaan Oromoo fi Ingiliffaan waan qopha'eef akkaata isinii galuu danda'uun dubbisuun deebii sirri kennu ni dandeessuu.

Kutaa I: Haala waliigalaa oddeeffannoo dhuunfaa

- 1) Umurii= _____
- 2) Saala= a/_____dhiira b/____dubara
- 3) Haala ga'eela? a/kan fuudhe b/ kan hin fune c/kan hiikee
- 4) Barumsa barataniiru? a/Eeyyee b/Hin barannee
- 5) Hojiin keessan maali? _____
- 6) Bakka jirreenyaa? a/Magaala b/Baadiyaa

Kutaa II: Haala Dinagdee Irratti Dhiiba Fide

Gosa filannoo gaaffiiwwaanif qopha'ee

Bayyee isa itti walii hin galu

1. Itti Waliin hin galu
2. Hin murteesine
3. Waliin gala
4. Baayee itti walii gala

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

5. Baayee waliigala

S/N	Items	1	2	3	4	5
1	☞ Daandiin hojjetame omisha naannoof gahee taphatera?					
2	☞ Daandiin hojjetame omishaf farra ilbisotaa fayyadamuu irratti bu'aa fideera?					
3	☞ Daandiin hojjetame sanyii filatame akka fayyadamu taasisera?					
4	☞ Daandiin hojjetame booda qulqullinni omishaa akka dhufu taasisera?					
5	☞ Sababa Daandiin hojjetameef Omishinii fi gabaan akka jiratu ta'era?					
6	☞ Tiraakterii fayyadamu jalqabdetaa?					
7	☞ Erga daandiin bahee booda Oggeessonna qonna gara maasii qonna bulatti adeemu jalqabaniru?					
8	☞ Erga daandiin hojjetame booda dhiyeesi qonnaaf baarbaachisan gaatiin gadi bu'eera?					
9	☞ Erga daandiin hojjetame booda gaheen omishinni gabaa keessatti qabu dabaleera?					
10	☞ Erga daandiin hojjetame booda dabalatan gabaa omisha irratti dabalera?					
11	☞ Omisha gatii salphaan gabaaf dhiyyeessuf danda'amera?					
12	☞ Hojiin investmentii qonna dabaleera?					
13	☞ Daandiin hojjetamu isaatiin carra hojii argataniru?					
14	☞ Suphaa daandiitin carraa hojii uumameera?					
15	☞ Ganda gara gandaatti adeemuf haala gaarii umera?					
16	☞ Carrawwan hojii xixxiqoo uumamera?					
17	☞ Erga daandiin hojjetame booda Wantootni gara garaa daandii daarii/Fkn=kasala, qoraan, kkf/ irra fayyadama ta'aniruu?					
18	☞ Fageenyi gabaara jiru xiqatera?					
19	☞ Baayinni gabaa naannoo dabaleera?					
20	☞ Erga daandiin hojjetame booda Omishinni gabaatti dhiyaatu baayatera?					

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

S/N	Items	1	2	3	4	5
21	☞ Erga daandiin hojjetame booda Gara gabaatti kan baasan ol-guddatera?					
22	☞ Erga daandiin hojjetame booda Gara gabaatti waa gurgurachuu kan adeeman baayataniruu?					
23	☞ Bakka itti hojjeetametti gatiin dabaleera?					
24	☞ Erga daandiin hojjetame booda Kiraan mana dabaleera?					

Kutaa III: Hawaasummaa ilaalchise

Gosa filannoo gaaffiiwwaanif qopha'ee/the rating scale is as follows/:

- | | |
|-------------------------|---------------------------|
| 2. Itti Waliin hin galu | 2. Hin murteesine |
| 4. Waliin gala | 4. Baayee itti walii gala |
| 5. Baayee waliigala | |

S/N	Items	1	2	3	4	5
1	☞ Daanditti fayyadamuu hoggantotni ganda ilaalu jalqabaniru?					
2	☞ Gara ganda baadiyaati adeemuf carra gaarii ta'era?					
3	☞ Erga daandiin hojjetame booda firootan walii iddoo gara gara keessa jiraatan walitti adeemuun Baayinaan wal-dubbisuun baayatera?					
4	☞ Sababa daandiin hojjetameef iddo Cidhaa fi walitti dhufeenya hawaasumma irratti hirmachun danda'amera?					
5	☞ Erga daandiin hojjetame booda walgahii uummata adda addaa jiru bakka fageenya qabu deemuun danda'amera?					
6	☞ Daandiin hojjetamuu isaan Walitti hidhaminsi magaala fi baadiyaa dabaleera?					
7	☞ Daandiin bahuudhaan duratti yeroo konkolaata fayyadamuuf gubataa ture yeroo amma hir'ateera?					
8	☞ Sababa Daandiin hojjetame jiraachuun isaan iddoo gara gara					

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

S/N	Items	1	2	3	4	5
	magaala fi baadiyyaa deemuun yeroo qusateera?					
9	☞ Daandiin hojjetame haala mijataa nuuf dabaleera?					
10	☞ Daandiin hojjetame manneen barnootaaf haala mijataa uumuun dabaleera?					
11	☞ Daandiin hojjetamuu isaan lakkoofsi oolmaa baratoota hir'ateera?					
12	☞ Sababa Daandiin duraan hin hojjetamnef harcaatiin baratoota ture, yeroo amma furameera?					
13	☞ Erga daandiin hojjetame booda baratan gara mana barumsa sadarkaa lammaffaa konkolaata adeemu egaleera?					
14	☞ Erga daandiin hojjetame booda barsiisan moora mannetti barnoota keessa yeroo dheeraaf turu danda'eera?					
15	☞ Lakkoosi barsiisa hojii irra hafuu sababa daandiin hojjetameef yeroo amma hir'ateera?					
16	☞ Sababa daandiin hin hojjetamneef yeroo beelamaa irratti argamuu hin dandeenye, hanqinna daandii irraan kan ka'eedha?					
17	☞ Erga daandiin hojjetame booda rakkoon buufata fayyaa deemuuf ture yeroo amma furameera?					
18	☞ Erga daandiin hojjetame booda dubartoonni ulfaa gara buufata fayyaa deemuun danda'amera?					
19	☞ Sababa daandiin hojjetamu danda'een dhukkubboota ijoolle hir'isuun danda'ameen faayida isaan dabaleera?					
20	☞ Daandii hojjetamuun isa balaa tasaa uumamu dandamachuuf tajaajila fayyaa safisaa argachuuf yeroo itti danda'ameedha?					
21	☞ Dandiin hojjetamu isaan gargartuu hojjetoota exteshinii fayyaa gahee itti gaafatamuma isaan karaa sirri ta'een yeroon tajaajila					

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

S/N	Items	1	2	3	4	5
	jiru?					

Kutaa IV: Dhiiba Fide

Gosa filannoo gaaffiiwwaanif qopha'ee:

- 1) Bayyee isa itti waliin hin galu
- 2) Waliin hin galu
- 3) Hin murteesine
- 4) Waliin gala
- 5) Baayee itti waliin gala

S/N	Items	1	2	3	4	5
1	☞ Daandiin hojjetamu isaan biqilooni/mukketiin baayeen muramaniruu?					
2	☞ Yeroo daandiin hojjetamu keessatti karaa hojjetoota daandiin uummata keessatti dhukkuubni HIV/AIDS babalachuu danda'a jete ni yaada?					
3	☞ Daandiin hojjetamuu isaan lafti akka salphaatti akka dhiqamuu godheera?					
4	☞ Daandiin hojjetamu isaan rakkoon bishaan dhugaatti naannoo keenyatti argamu hafuu isaatti?					
5	☞ Daandiin hojjetamu isaan qabeenya naannoo irratti balaan konkolaataa umamuun qabeenyii badu dabala dhufeera?					
6	☞ Daandiin hojjetamu isaan balaan konkolaata ga'a jira?					
7	☞ Daandiin hojjetamu isaa irraan kan ka'ee lakkoofsi godaantota dabaleera?					
8	☞ Yeroo daandiin hojjetamu keessa lafti qonna bulaa cirracha barbaacha, bakka hojii ijaaruu fi daandii hojjechuuf itti fayyadama turameera?					
9	☞ Daandiin kun hojjetamuun isa naannoo keenyatti daldala saala akka jiraatu gochuuf?					
10	☞ Erga daandiin hojjetame booda amala badaadhaan saaxilamuun dabaleera?					

Hirmaatoota keenya gaaffii kun isa dhumaa irra jirtu, deebii hunda hojjechuu keessan adda baafadha.

Galatooma!

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

Appendix 3: Reliability Statistics for the Pilot Data

3.1. Reliability statistics for the Economic Impact Measure

Reliability Statistics

Cronbach's Alpha	N of Items
.969	24

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Elm1	82.53	588.533	.933	.966
Elm2	83.33	599.609	.471	.970
Elm3	82.37	589.137	.866	.966
Elm4	82.63	583.620	.896	.966
Elm5	82.47	595.085	.614	.968
Elm6	82.77	586.530	.611	.969
Elm7	82.13	572.464	.924	.966
Elm8	82.43	573.220	.851	.966
Elm9	82.30	588.493	.803	.967
Elm10	82.27	582.409	.791	.967
Elm11	82.83	584.902	.645	.968
Elm12	83.40	602.731	.400	.971
Elm13	82.80	595.614	.660	.968
Elm14	83.17	593.454	.625	.968
Elm15	82.60	577.145	.906	.966
Elm16	83.13	609.706	.364	.971
Elm17	82.53	583.982	.799	.967
Elm18	82.67	581.816	.734	.967
Elm19	82.37	584.240	.827	.967
Elm20	82.17	586.213	.835	.967
Elm21	82.07	582.340	.873	.966
Elm22	82.07	576.616	.930	.966

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

Elm23	82.13	575.637	.926	.966
Elm24	81.90	590.921	.856	.967

3.2. Reliability statistics for the Social Impact Measure

Reliability Statistics

Cronbach's Alpha	N of Items
.982	21

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Slm1	76.10	546.093	.861	.981
Slm2	76.23	536.875	.867	.981
Slm3	76.30	534.355	.880	.981
Slm4	76.40	535.421	.884	.981
Slm5	76.17	544.764	.864	.981
Slm6	76.43	541.426	.765	.982
Slm7	76.50	537.983	.801	.981
Slm8	76.23	542.599	.887	.981
Slm9	76.27	540.478	.874	.981
Slm10	76.33	536.299	.916	.980
Slm11	76.53	527.292	.939	.980
Slm12	76.40	524.800	.925	.980
Slm13	76.33	539.195	.865	.981
Slm14	76.60	529.697	.843	.981
Slm15	76.43	541.909	.742	.982
Slm16	76.07	572.202	.369	.984
Slm17	76.20	531.476	.894	.981
Slm18	76.30	538.217	.772	.982
Slm19	76.07	526.823	.918	.980
Slm20	76.13	528.809	.903	.980

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

Slm21	75.97	532.792	.900	.980
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3.3. Reliability statistics for the Negative Impact Measure

Reliability Statistics

Cronbach's Alpha	N of Items
.815	10

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
NIm1	14.67	37.816	-.159	.860
NIm2	16.30	29.114	.522	.796
NIm3	16.27	30.961	.341	.820
NIm4	16.33	29.747	.440	.807
NIm5	16.93	31.444	.518	.798
NIm6	17.03	31.689	.636	.792
NIm7	16.87	28.464	.717	.775
NIm8	16.87	28.257	.678	.778
NIm9	17.03	28.585	.753	.772
NIm10	17.00	28.621	.782	.771

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

Appendix 4: Reliability Statistics for the Final Data

4.1. Reliability statistics for the Economic Impact Measure

Reliability Statistics

Cronbach's Alpha	N of Items
.950	24

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
The road contracted had increased the live stoke production of the area.	81.79	424.218	.691	.948
The contracted road had improved my use of pesticides to my production.	82.05	427.844	.533	.949
The contracted road had increased my access to improved seeds.	81.65	429.982	.582	.949
The qualities of my crop production had increased after the road is constructed.	81.95	417.654	.760	.947

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

The amount of harvest I sell in the markets had increased because the road is constructed.	81.77	426.106	.638	.948
Since the road is constructed, I began to access farm equipments (tractors, machines, etc).	82.47	423.112	.546	.950
The number of visits of agricultural extension agents had increased after the road is constructed.	81.85	419.689	.689	.948
After the road is constructed the unit price of farm inputs had decreased.	81.99	416.277	.721	.947
The local market prices of key crops in the area had increased after the road is constructed.	81.70	426.056	.649	.948
The local market prices of live stoke had increased after the road is constructed.	81.75	425.881	.629	.948
I am able to transportation my goods at cheaper transportation price to market places.	82.23	418.875	.661	.948
The constructed road had attracted investments in agriculture	82.31	422.359	.595	.949
While the road was constructed, several people in my village had got job opportunities.	82.19	422.441	.633	.948
People in my village had got the opportunity to work in the road maintenance after the road construction is over.	82.38	418.566	.586	.949

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

We are able to travel to other towns in search of jobs after the road was built.	82.03	417.661	.703	.947
The road construction helped people in my village to establish small businesses alongside the road.	82.20	428.714	.504	.950
After the road is constructed. people begun to sell goods (e.g. charcoals, firewood, etc) at the road side to passing vehicles.	82.19	417.172	.712	.947
The road constructed had decreased the distance to markets.	82.00	415.805	.745	.947
After the road is constructed, the number of sellers/shops in the nearest market had increased.	81.90	422.201	.702	.948
After the road is constructed, the number of products available in the market had decreased.	81.81	420.862	.758	.947
After the road is constructed, the number of my visits to markets as consumer had increased.	81.90	419.497	.731	.947
After the road is constructed, the number of my visits to markets as producer had increased.	81.68	426.217	.692	.948
The price of the land I own is increased because of the constructed road.	81.80	425.497	.650	.948

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

After the road is constructed, the price of my house had increased.	81.59	431.330	.545	.949
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4.2. Reliability statistics for the Social Impact Measure

Reliability Statistics

Cronbach's Alpha	N of Items
.971	21

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Because of the constructed road the authority are able to visit our community more regularly.	74.04	406.327	.718	.970

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

The number of my visits to other villages and cities had increased after the road is constructed.	74.06	403.274	.768	.969
The number of visits I received from friends or relatives in other villages or cities had increased since the road is constructed.	73.94	405.606	.789	.969
My attendance at social events (e.g. funeral, wedding, etc) in other villages or cities had increased because of the constructed road.	73.90	407.333	.793	.969
Since the road is constructed, I could be able to attend at public meetings not in my village.	73.86	409.063	.752	.969
The road constructed had tightened rural-urban links.	73.90	406.888	.764	.969
I spend less time waiting for transportation service than before the construction of the road.	73.98	406.856	.720	.970
Travel time to the next town/village substantially reduced because of the constructed road.	73.83	404.636	.803	.969
Travel convenience had improved since the road is constructed.	73.86	404.068	.839	.968
The number of school enrollment rate had increased since the road was constructed.	73.85	409.070	.739	.969

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

The constructed road had decreased the number of students who drop out of school.	74.23	402.222	.785	.969
Missing classes because transportation related problems is resolved now than before the road was constructed	74.11	401.475	.782	.969
After the road was constructed, students are able to travel to secondary schools by buses	74.12	406.364	.770	.969
After the road is constructed teachers are able to stay longer in a school.	74.14	403.750	.786	.969
The rate of teachers' absenteeism had decreased because of the constructed road	74.15	403.884	.788	.969
Before the road was constructed, I had missed appointments because of transportation related problems.	73.92	415.292	.612	.971
The difficulty to travel to a hospital is resolved after the road is constructed.	73.77	405.850	.783	.969
After the road is constructed women are able to access health facilities during child birth.	73.72	405.688	.761	.969
It is because of the constructed road that the immunization of children in our village had increased.	73.74	404.037	.812	.969

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

The road had helped the community in my village to reach health facilities in time of emergency.	73.80	406.215	.796	.969
The constructed road had helped health extension workers to cover their areas of responsibility more quickly and efficiently.	74.02	398.528	.814	.969

4.3. Reliability statistics for the Negative Impact Measure

Reliability Statistics

Cronbach's Alpha	N of Items
.861	10

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
While the road was under constructions, a lot of forests/trees were lost	17.42	56.911	.188	.881
I feel like the presence of road construction workers had increase HIV/AIDS incidences in our community	18.01	50.908	.603	.845
The road construction had made the surrounding soil to be easily eroded.	17.79	49.961	.624	.843
The road construction negatively affects the water supply of the area.	17.90	52.246	.510	.853
The constructed road had increased car accidents among live stokes.	18.23	50.855	.728	.837
The constructed road had increased car accidents among living residents of the area.	18.27	51.398	.678	.840
Since the road is constructed, a number of residents had migrated to other areas.	18.07	50.067	.644	.841
While the road was under construction, farm lands were used for quarry sites, camp construction and road widening for the project.	17.96	48.727	.660	.840
The road construction had spread sex trade in the area.	18.17	50.223	.627	.843

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

Use of drugs had increased since the road construction begun.	18.19	51.539	.545	.850
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Appendix 5: RED Model Cash Flow

Benefits Distribution: Gradings Every 60 Days

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

Country	Ethiopia
Road	Wayou-Baroma-Mato

Project	Road Management Initiative
Alternative	Gradings Every 60 Days

Alternatives	Description	Terrain Type	Road Type
Without Project	Gradings Every 120 Days	B: Rolling	Z: Earth
Project	Gradings Every 60 Days	B: Rolling	Y: Gravel

Alternatives	Dry Season		Wet Season		Car Medium	Four-Wheel Drive	Bus Light	Bus Medium	Animal Cart
	Length (km)	Roughness (IRI)	Length (km)	Roughness (IRI)					
Without Project	19.0	19.6	0.0	26.2	29.0	28.8	28.0	28.0	0.7
Project	19.0	13.8	0.0	25.6	43.4	43.0	41.9	41.7	1.4

Alternatives	Eco. Investment (years) ('000ETB/km)		E. Maintenance ('000ETB/km/year)	Accidents (#/m veh-km)	Traffic Composition in 2				
	1	2			3%	5%	5%	3%	27%
Without Project	1	42.50	9.35	0.03	0:39	0:39	0:40	0:40	3:14
Project	2	552.50	10.20	0.03	0:26	0:26	0:27	0:27	13:49

Present Value (million ETB) at 10%	Net Economic Benefits							
	Agency Benefits		User Benefits					
	Investment Costs (METB/year)	Maintenance Costs (METB/year)	Normal Traffic		Generated Traffic		Road Safety (METB/year)	Other Benefits (METB/year)
			VOC (METB/year)	Time (METB/year)	VOC (METB/year)	Time (METB/year)		
	-9.161	-4.869	27.006	4.320	0.690	0.115	0.000	-9.581
	-14.031		22.550					

Total User Benefits	22.550					
User Benefits Components	27.006	4.320	0.690	0.115	0.000	-9.581
User Benefits Percent	120%	19%	3%	1%	0%	-42%

User Benefits Components	27.006	4.320	0.690	0.115	0.000	-9.581
Car Medium	0.079	0.003	0.002	0.000	0.000	-0.202

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

Four-Wheel Drive	0.203	0.009	0.004	0.000	0.000	-0.401
Bus Light	0.217	0.241	0.010	0.011	0.000	-0.377
Bus Medium	0.138	0.133	0.003	0.003	0.000	-0.195
Animal Cart	27.497	4.024	0.687	0.101	0.000	-2.022
Truck Light	0.314	0.090	0.008	0.002	0.000	-0.327
Truck Medium	0.339	0.090	0.010	0.003	0.000	-0.330
Motorcycle	0.730	0.050	0.026	0.002	0.000	-5.257
Bus Mini	0.190	0.112	0.009	0.005	0.000	-0.469
Car Medium	0%	0%	0%	0%	0%	2%
Four-Wheel Drive	1%	0%	1%	0%	0%	4%
Bus Light	1%	6%	1%	9%	0%	4%
Bus Medium	1%	3%	1%	3%	0%	2%
Animal Cart	102%	93%	100%	87%	0%	21%
Truck Light	1%	2%	1%	2%	0%	3%
Truck Medium	1%	2%	1%	2%	0%	3%
Motorcycle	3%	1%	4%	2%	0%	55%
Bus Mini	1%	3%	1%	4%	0%	5%

Economic Feasibility: Gradings Every 60 Days

Country	Ethiopia
Road	Wayou-Baroma-Mato

Project	Road Management Initiative
Alternative	Gradings Every 60 Days

Alternatives	Description	Terrain	Road Type
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The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

		Type	
Without Project	Gradings Every 120 Days	B: Rolling	Z: Earth
Project	Gradings Every 60 Days	B: Rolling	Y: Gravel

Alternatives	Dry Season		Wet Season		Car	Four-Wheel Medium	Bus Drive	Bus		Animal Ca
	Length (km)	Roughness (IRI)	Length (km)	Roughness (IRI)				Light	Medium	
Without Project	19.0	19.6	0.0	26.2		29.0	28.8	28.0	28.0	0.
Project	19.0	13.8	0.0	25.6		43.4	43.0	41.9	41.7	1.

Alternatives	Eco. Investment		E. Maintenance		Accidents (#/m veh- km)	3%	5%	5%	3%	27
	(years)	('000ETB/km)	('000ETB/km/year)	Average						
Without Project	1	42.50	9.35	0.03		0:39	0:39	0:40	0:40	3
Project	2	552.50	10.20	0.03		0:26	0:26	0:27	0:27	13

Net economic benefits in terms of vehicle operation costs and time in each forecasted years separately (cash flow)

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

Year	Annual Normal Traffic	Annual Generated Traffic	Annual Induced Traffic	Net Economic Benefits					
	Daily Traffic (veh/day)	Daily Traffic (veh/day)	Daily Traffic (veh/day)	Agency Benefits	User Benefits				
				Investment Costs (METB/year)	Maintenance Costs (METB/year)	Normal Traffic		Generated Traffic	
						VOC (METB/year)	Time (METB/year)	VOC (METB/year)	Time (METB/year)
2013	37	0	0	-3.876	0.000	0.000	0.000	0.000	0.000
2014	40	0	0	-5.814	0.000	0.000	0.000	0.000	0.000
2015	42	3	0	0.000	-0.380	2.427	0.392	0.062	0.010
2016	46	3	0	0.000	-0.407	2.572	0.414	0.066	0.011
2017	49	3	0	0.000	-0.435	2.725	0.438	0.069	0.012
2018	53	3	0	0.000	-0.472	2.916	0.468	0.074	0.012
2019	58	4	0	0.000	-0.512	3.120	0.500	0.080	0.013
2020	63	4	0	0.000	-0.557	3.338	0.534	0.085	0.014
2021	69	4	0	0.000	-0.606	3.573	0.570	0.091	0.015
2022	75	5	0	0.000	-0.660	3.823	0.609	0.098	0.016
2023	81	5	0	0.000	-0.714	4.022	0.641	0.103	0.017
2024	88	6	0	0.000	-0.774	4.231	0.674	0.108	0.018
2025	96	6	0	0.000	-0.839	4.451	0.709	0.114	0.019
2026	104	7	0	0.000	-0.910	4.683	0.746	0.120	0.020
2027	113	7	0	0.000	-0.988	4.927	0.785	0.126	0.021
2028	121	8	0	0.000	-1.052	5.133	0.818	0.131	0.022
2029	129	8	0	0.000	-1.121	5.347	0.853	0.137	0.023
2030	137	9	0	0.000	-1.195	5.571	0.889	0.143	0.024
2031	146	10	0	0.000	-1.275	5.805	0.927	0.149	0.025
2032	156	10	0	0.000	-1.360	6.048	0.966	0.155	0.026

	0	Net Present Value (million ETB) at 10% Discount Rate Internal Rate of Return (%)
7.9% Growth		Equivalent Annual Net Benefits (ETB/km) at 10% Discount Rate Modified Rate of Return at 10% Reinvestment Rate (%) Net Present Value per Financial Investment Costs (ratio) First-Year Benefits per Economic Investment Cost (ratio)
	Evaluation Period (years) 20	

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

Appendix 6: RED Model Outputs

Project-Alternatives Solution

Country	Ethiopia
Project	Road Management Initiative
Road	Wayou-Baroma-Mato

	Without Project Alternative	Possible Project Alternatives		
	Alternative 0	Alternative 1	Alternative 2	Alternative 3
	Gradings Every 120 Days	Gradings Every 60 Days	Gradings Every 45 Days	Upgrade to Surface Treatment Standard
Net Present Value (million ETB) at 10% Discount Rate	0.000	8.520	-2.471	-15.706
Internal Rate of Return (%)	#N/A	20%	6%	-1%
Equivalent Annual Net Benefits (ETB/km) at 10% Discount Rate	0	47880	-13886	-88267
Modified Rate of Return at 10% Reinvestment Rate (%)	#N/A	14%	8%	4%
Net Present Value per Financial Investment Costs (ratio)	0.00	0.81	-0.22	-0.57
Net Present Value per PV of Economic Agency Costs (ratio)	0.00	0.33	-0.05	-0.30
First-Year Benefits per Economic Investment Cost (ratio)	0.00	0.21	0.33	-0.43
Financial Investment Costs (million ETB)	0.95	12.35	13.30	32.30

The Estimation of The Impact of Rural Road Investments On Socio-Economic Development

PV of Economic Agency Costs (million ETB)	12.41	25.62	52.29	52.15
PV of Economic Normal Traffic User Costs (million ETB)	99.72	67.38	50.56	55.34
PV of Economic Generated Traffic User Costs (million ETB)	5.19	3.53	2.67	2.96
PV of Economic Society Costs (million ETB)	117.32	96.53	105.52	110.44
Number of Fatalities per km-year After Investment	0.0000	0.0000	0.0000	0.0000
Investment per Population Served (ETB/person)	206.5217391	2684.782609	2891.304348	7021.73913
Population Served per Investment (persons/1000ETB)	4.8	0.4	0.3	0.1