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College of Social Sciences and Languages, Department of Geography and Environmental Studies

The Role of Rural Infrastructures and Institutions on Agricultural Intensification of Major Crops (Teff and Maize): Tahtay-Koraro Woreda, Tigray

A Thesis Submitted in Partial Fulfillment of the Requirements for the Master of Science Degree in Geography and Environmental Studies: Specialization in GIS and Remote Sensing

By: Tesfalem Mehari Gebre

Major Advisor: Girmay Gebresamuel (PhD)
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Declaration

This is to certify that this thesis entitled " **The Role of Rural Infrastructures and Institutions on Agricultural Intensification of Major Crops (Teff and Maize) in Tahtay-Koraro Woreda, Tigray"** submitted in partial fulfillment of the requirements for the Master of Science degree in Geography and Environmental Studies with specialization in **GIS and Remote Sensing** at Mekelle University, Department of Geography and Environmental Studies done by **Tesfalem Mehari Gebre, CSSL/PSO11/03** is authentic work carried by him under our guidance. The matter embodied in this work has not been submitted earlier for an award for any degree or diploma to the best of our knowledge and belief.

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List of Abbreviations and Acronyms

BoARD	Bureau of Agriculture and Rural Development
E.C	Ethiopian Calendar
FAO	Food and Agriculture Organization
FDRE	Federal Democratic Republic of Ethiopia
FFS	Farmers Field School
FTCs	Farmer Training centers
GCPs	Ground Control Points
GDP	Gross Domestic Product
GIS	Geographic Information System
GPS	Global Position System
GTP	Growth and Transformation Plan
HHs	Households
ICT	Information and Communication Technology
IFAD	International Fund for Agricultural Development
Km	Kilo Meter
m.a.s.l.	Meter Above Sea Level
MoARD	Minister of Agriculture and Rural Development
MDGs	Millennium Development Goals
NGOs	Non Governmental Organizations
PCA	Principal Component Analysis
POPHHs	Population of the Households
PRB	Population Reference Bureau
SPSS	Statistical Package for Social Sciences
US$	United States Dollar

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Abstract

This study aims at assessing the role of rural infrastructures and institutions on agricultural intensification of major crops (Teff and Maize) in three selected Tabias of Tahtay Koraro Woreda, north western Zone of Tigray Region, Ethiopia. The 3 Tabias were selected based on their similarity in agro-ecology (temperature and rainfall and soil type) but are different in infrastructures coverage. A simple random sampling technique was used to select 99 respondents from the study areas. Questionnaire and group discussion methods were used to collect the data. Infrastructures and institutions were identified in the field and their distributions were mapped using GIS. Simple descriptive method, chi-square and principal component analysis (PCA) methods were used to analyze data. Before establishment of infrastractures and institutions farmers were exposed to unnecessary cost, reduction in production especially in Teff and Maize crops because they did not get different traning and education of agricultural intensification skills. After establishment of rural infrastractures and institutions, farmers have saved their time and energy and they are getting different services, like education and traning about different agricultural intensifications (agricultural technologies).Generally, before and after establishment of rural infrastractures and institutions farmers in Tabia Selam have got an average production 11.41 and 22.34 qu/ha respectively. For Maize, 14.84 and 28.13 qu/ha is registered in this Tabia before and after respectively.in Tabia Adigidad before and aftrer establishment of rural infrastractures and institutions farmers have harvested an average production of Teff 7.3 and 14.6 qu/ha respectively while 7.8 and 13.3 qu/ha production of Maize is produced respectively. Furthrmore, in Tabia May-Timket before and after establishment of rural infrastractures and institutions farmers have produced 4.4 and 7.8 qu/ha of Teff; and 5.3 and 9.4 qu/ha production of Maize respectively. In addition to this, after establishment of rural infrastractures and institutions major crops show a significantly change at ($p< 0.005$). The findings of the study imply that access to rural infrastructures and institutions boosts intensifications on production of Teff and Maize crops.

CHAPTER 1

INTRODUCTION

1.1. Background of the Study

Infrastructure is a broad concept linked to every part of the economy and human life. Rural infrastructures are crucial component for agricultural development, economic growth, poverty reduction and rural development in low income (developing) countries (Olagunju et al., 2012). Rural transport, school, market health service, telecommunications, energy, and water have become part and parcel of human existence (Mafusire et al., 2010). In fact, infrastructure has great contribution in trade (export and import) activities, economic development, and social welfare of both governmental and private institutions (Herfindahl and Treat, 2009).

Kandiero (2009) stated that, infrastructures and institutions have influenced economic growth directly and indirectly, directly through capital accumulation and indirectly through enhancing the output or product. In addition to this, infrastructure affects investment. The relationship between investment and infrastructure has bi-directional connection; it means countries with high growth rates have invested too much in infrastructure which consequently provide back into the growth process. Generally, it is believed that, a power full relationship between infrastructure investment and some of the key indicators of social wellbeing, such as health care, water, sanitation, housing, human capital accumulation and electrification, is also recognized. Rural infrastructure is often an underlying critical factor impinging on policy outcomes in such research areas as liberalization of output and input market, diversification of agriculture, macro policy reforms, financial market development, natural resource management, poverty alleviation through employment and various other public policies (World Bank, 1994). African Development Bank recognized that infrastructure investment has played a significant role in every aspect like economic development, minimization of poverty and generally in the achievement of the Millennium Development Goals (MDGs) (Kandiero, 2009).

Infrastructure contributed for about 0.6 percentages to Ethiopia's annual per capita GDP growth over the last decade (Foster and Morella, 2011). They also added that, improving the country's infrastructure endowment to that of the region's middle income countries could add an additional 3 percentage points to infrastructure's contribution to growth.

Similarly, infrastructure plays a great role in realizing economic development in Tigray region (GTP, 2003). It is generally believed that the backbone of any sustainable development is physical infrastructure: roads and bridges, railways, ports and inland waterways, airports, electricity generation and network, irrigation, telecommunications, etc. The improvements in rural infrastructure will have a positive impact on both economic and social development, including education, health, tourism, and trade, as well as on a nation's integration with the region and the world. There is need for infrastructural development in urban and rural areas, especially with the latter (rural) being grossly neglected until more recently as exemplified by literature (Okali et al., 2001). The inadequate provision of such services as electricity supply, transport, water supply, health care services, schools and communication in rural areas will be against prospects for better living standards and prospects for employment and other forms of economic activities. The great importance the issue of rural infrastructure has assumed in recent times is problem solving of the failure of past efforts. An awareness of their importance is a key to rural development (Oguzor, 2011).

Institutions in this context mean economic, social and political organizations, together with the rules that govern their interaction. Public institutions and their rules of the game also determine resource allocation and impose regulatory frameworks that have great impact on the lives of the poor (IFAD, 2003). As a result the rural population has exposed to shortage of access to service like school and health centers, in addition to this about half of the population faced shortage of access to safe drinking water.

This study aims to assess the role of rural infrastructures and institutions on agricultural intensification of major crops (Teff and maize). Specifically, the study addressed different questions related to the study such as; the types of rural infrastructure and institutions available in the selected Tabias, the degree of accessibility of these rural infrastructure and institutions by the local community and also distribution of rural infrastructure and institutions and its impact on agricultural intensification of Teff and Maize. Generally, these questions are incorporating the overall direction of the study in terms of availability, accessibility and distribution of these rural infrastructure and institutions.

Furthermore, the main scope of this thesis has different rural infrastructures and institutions found in the study areas such as, market, rural road, school, health extension, veterinary service, farmer training centers (FTCs) and multipurpose farmers' cooperatives. In addition to this in the study area still there is no clear study related with the role of rural infrastructure and institutions on agricultural intensifications because of this the researcher will initiate to conduct this study. Then, this study focus on the role of rural infrastructure and institution on agricultural intensification is the most critical one to examine its effect on farmer's living standard as well as on the agricultural and rural development.

1.2. Statement of the Problem

Africa's infrastructure networks increasingly lag behind those of other developing continents and are characterized by missing regional links and inactive household access (Foster et al., 2010). Lack of adequate infrastructure, especially in rural areas, results in significant limitations to achieve the MDGs and accelerate poverty alleviation in developing countries (Andersen, 2006). For instance, 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 (Torero and Chowdhury, 2004). Furthermore, for 87% of rural respondents living in countries like Uganda, Burkina Faso and Zambia on foot is the main means of transportation and around 95% of rural households in Africa lead their life on traditional fuels, and little African rural areas have access to a single telephone.

Like the other developing countries, Ethiopia is a predominantly agricultural country whose prospects for development depend on rural progress (Tegegne, 2001). In addition to this, while economic growth is an essential condition for poverty decline, it is not sufficient. Here, infrastructure plays a dual role: it supports higher economic growth and strengthens the sharing of the benefits of growth. Ethiopia faces one of the more challenging infrastructure situations of any country in Africa (Foster and Morella, 2011). The total expenditure to upgrade the infrastructure and export potential the cost needed is very huge relative to size of the economy of the country. Inadequate infrastructure is a great obstacle for wisely utilization of agricultural research and technologies consequently it minimizes the farmer's alternatives and agricultural output (Andersen and Shimokawa, 2006). Infrastructure directly affects human welfare and equity across community and income groups (Olagunju et al., 2012). Shortage of sufficient and reliable infrastructure is main problem of rural poor Africans (Adeoye et al., 2011). Furthermore, sufficient and cost effective infrastructure plays a significant role in development of agriculture and lowers cost of production.

Similarly, whether the distribution and extent of rural infrastructure and institutions between the study areas (selected Tabias) and their outcomes and mechanisms are identical or not, deserve an important place in the development effort of the country. In this regard, the distribution varies spatially and temporally in rural economies and the impact of this on agricultural intensification or production has to be known; but there is scanty of study on this issue in the study area. Therefore, the objective of this study is to examine the role of rural infrastructure and institutions on agricultural intensification of major crop commodities. In addition to this, the study fundamentally focus on role of rural infrastructures and institutions on agricultural intensification of major crops (Teff and Maize) in 3 selected Tabias of wereda Tahtay Koraro, North Western of Tigray for a number of reasons. First, rural infrastructures and institutions are crucial for rural development, poverty reduction and growth and transformation plan. Second, wide range and diversified problems associated with rural infrastructures and institutions, which need to be addressed in order to enhance the production and to make the economy competitive. Third, many of the researches conducted in different countries emphasized on rural infrastructures and institutions are generalized for the whole or emphasized on a single rural infrastructure or institution; but, some serious problems of rural infrastructures and institutions of one Tabia might be not problems to others. Furthermore, the researcher selected this study area because of the interest of sponsoring organizations and the reason for the crops (Teff and Maize) is because these crops are major crops in the study areas. Finally, the role of the rural infrastructure and institutions on the agricultural intensifications needs an investigation as it is an important issue in addressing rural development.

1.3. Objectives

1.3.1. General Objective

The general objective of the study was to examine the role of rural infrastructures and institutions on agricultural intensification of Teff and Maize crops in the study areas.

1.3.2. Specific Objectives

The specific objectives of the study were to:

- Identify and map the spatial distribution of rural infrastructures and institutions available in selected *Tabias.*
- Assess the degree of accessibility of rural infrastructures and institutions to the local community.
- Assess the contribution of the rural infrastructures and institutions on intensification and enhancement of Teff and Maize crops.

1.4. Research Questions

This research is expected to answer the following research question:

1. What types of rural infrastructures and institutions are available in selected Tabias?
2. What is the degree of accessibility of rural infrastructures and institutions to the local community?
3. What type of rural infrastructures and institutions has a significant influence or contribution on productivity of Teff and Maize?

1.5. Hypothesis

(HO) 1: In the study areas (Tabias) productivity of Teff and Maize after access to infrastructures and institutions is similar to before access to infrastructures and institutions.

1.6. Significance of the Study

The significance of this study lies in indicating the roles of rural infrastructures and institutions on agricultural intensification and the degree of their influence in providing information and may be important for policy makers like governmental and nongovernmental agencies. The expectation is that policy makers and implementers of rural infrastructure and institutions support programs will use findings of this research for designing interventions. Furthermore, the study will provide current, accurate and reliable information on the states of infrastructure facilities.

It may provide crucial and accurate information about the role of rural infrastructure and institutions on agricultural intensification of Teff and Maize crops. Hence, it could serve as springboard for other studies. Furthermore, it could assist the bureau of rural development and agricultural extension and different governmental and nongovernmental institution in seeing gaps and possible opportunities for rural infrastructure and institutions so that their expansion programs are shaped and existing policy may be revised.

1.7. Scope of the Study

This study was conducted in Tahtay Koraro Woreda, North Western of Tigray Region, Ethiopia in three selected Tabias, to assess the role of rural infrastructures and institutions on agricultural intensification of Teff and Maize crops. Generally, the scope of the study was limited only in one Woreda and three Tabias and was only based on the rural infrastructures and institutions; rural road, school, health extension, veterinary service, farmer's training center (FTCs) and multipurpose cooperative.

1.8. Limitations of the Study

It is known that different issues concerning rural infrastructures and institutions can be studied. But, due to shortage of time and budget constraints, this study is limited only to the role of rural infrastructures and institutions on agricultural intensification of Teff and Maize crops.

Even though large sample size is essential for in-depth understanding of the role of rural infrastructures and institutions on agricultural intensification of Teff and Maize, this study is limited to a sample size of 99 households who were selected from 4858 households. Which may have its own effect on the quality of the research; however, an effort was made to enhance the quality of the

research by conducting in depth interview with relevant stakeholders and triangulating the result of the survey and interview with secondary data sources. In addition, limited empirical information on the rural infrastructure and institution in the country were other limitations.

CHAPTER 2

REVIEW OF RELATED LITRATURE

2.1. Rural Infrastructures and Institutions

Rural Infrastructure is an important aspect in agricultural production as it lowers costs of inputs, increases markets and facilitates trade (Dongers et al., 2006). In addition to this it raises the productivity of factors of production resulting in improved agricultural production and productivity. Infrastructure plays a crucial role in economic growth by minimizing the cost of production and raising profitability, expand markets, facilitate trade, increasing productivity of labor and capital, production and employment (Infrastructure Statics, 2012). Infrastructures are core or fundamental forms of physical, social and institutional capital which improve rural communities' production and consumption activities and ultimately the improved wellbeing (Dongers et al., 2006). Rural infrastructure development, like irrigation, electrification, credit, roads and communication, regulated markets and agricultural research and extension are essential fundamentals for modernization and growth of agriculture in developing countries (Olagunju et al., 2012).

Rural infrastructures can be seen as the compound of physical structures or networks within which social and economic activities are carried out and these structures are not ends and help to achieve the broader goals of poverty reduction and economic growth (Fishbein, 2001). Fishbein also added that rural infrastructure contributes to these goals by providing necessary services such as water and sanitation, energy for cooking, heat and light and employment generating commercial activities; transportation of goods and people; and the transmission and communication of knowledge and information. In addition to this, in Africa, rural infrastructure service delivery models have entered a period of transition, moving away from centrally-controlled public sector provision to more demand-driven and decentralized delivery models.

2.1.1. Rural Road and Agricultural Production

In Africa, rural road construction has been found to be associated with boost in agricultural production, especially in Non-food export crops, extended use of agricultural credit, increases in land values, proliferation of small shops and expansion of rural markets (Anderson et al., 1982). The majority of poor people in the world live in rural areas where the level of public infrastructure especially road is low (Oraboune, 2008). IFPRI (1990), found that in villages with better access to roads, fertilizer costs were 14 percent lower, wages were 12 percent higher and crop output was 32 percent higher. Insufficient roads and poor road access exposed to high cost of transportation, decrease ability to use access high quality inputs, limit the uses of local markets to the sales of their produces, and also limit the purchase of consumer goods and opportunities for off farm employment (Oraboune, 2008).

Road transportation is huge user of space and has high maintenance costs, both for vehicles and infrastructures. Roads are useful for everyday movement of people to their workplaces or to meet Everyday needs in addition to this efficient road transportation we need good quality roads and good traffic regulation (Infrastructure Statistics, 2012). Roads have the potential to improve social networks and political voice of isolated households, which enables them to value and demand education for their children (Shaym, 2007). Quality or paved road is a good supply for physical integration of rural areas with urban, which is also play a significant in access to faster growing urban markets. Furthermore, paved roads are providing connectivity to markets that rural producers and consumers and also it promote investment and reducing unwanted expenditures (Gilberto, 2011).

Rural roads are connection points that connect a village to other village, to the main road accessing to markets, or to connect related production or service to particular centers. Due to the real situation of rural dominant of the country and most of poor people live in rural areas. Rural roads have been considered very important and play significant role in poverty reduction through linking rural farming to market, improve their productivity and increase income level (Oraboune, 2008).

Inadequate road has restriction roles on social opportunities and economic growth and it has an obstacle to integrate with the rest of the country. Moreover in low income developing countries lack of road has the main constraint for accessing basic human and social need and severely restricted their ability to benefit from development (Shyam, 2007). Moreover, (Gwilliam et al., 2008) has investigated Sub Saharan Africa countries spending on roads less than 2 percent of GDP. Even though the level of effort is high relative to the size of Africa's economies, it remains little in absolute terms, low income countries spending on roads infrastructure about US$7 per capita per year. On average, countries spend US$9,000 per kilometer of the main road network. However, low income countries spend 50 percent more per kilometer than do middle-income countries. Obviously, countries with road agencies and high fuel tariff seem to spend somewhat less than those without.

Fishbein (2001) revealed that, rural transport depends on suitable infrastructure, where rural infrastructure consists mainly of rural roads, tracks, trails and footpaths. These rural infrastructures may differ in quality and quantity, depending on weather, season, construction and maintenance. Most of the time rural areas has frequently expose to poverty than urban areas, as a result of lack of integration with urban centers due lack of adequate accessibility and mobility, and local roads and tracks are often impassable, by this means proving it very difficult and in some cases nearly impossible for rural families to have access to the local rural economy.

A study in India discovered that the absence of roads in rural areas leads to stagnation of socio economic conditions of the villagers. The interdependency in change of land use and transportation is not encouraged in rural areas and this keeps the economic system inactive in these areas (Olagunju et al., 2012). In addition to this in most rural households especially women, they spend the majority of their time and effort on transport activities to fulfill their basic needs, they are frequently vulnerable by the lack of an enough rural road network. Consequently this major problem has restrictions of growth and development of rural communities in the past and is also today. Transport infrastructures make easy the transportation of people and goods and provide them access to market, employment and investment opportunities. Therefore transport infrastructure has a crucial actor of the economy. In addition to this a well-organized transportation system can have a

multiplier effect on the economy where as poor transportation system can result in economic loss (Infrastructure Statistics, 2012).

Rural transport infrastructures consist of the rural road, track and path network on which the rural population travels by means of walking and motorized and Non-motorized vehicles. These networks connect the intra and near village network of tracks and paths, as well as the local government network, which links the rural population to the rest of the economy and the outside world (Fishbein, 2001). Additionally, 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.

Deficiencies in transportation, energy, telecommunication, and related infrastructure translate into poorly functioning domestic markets with little spatial and temporal integration, low price transmission, and weak international competitiveness (Olagunju et al., 2012). So far agricultural development is connect on macro and sectoral issues with narrowed focus on input, pricing, institutional and technical innovations alone. These policies were not serving as remedies for farmers who are bounded by mass of problems. Farmers especially the landless youngsters may face challenges in having access to value adding supports services and alternative off-farm employment opportunities due to lack of rural infrastructure and institutions. Where these provide agricultural intensification and enable them to be more risk taking in using productive inputs and alternative technical innovation.

2.1.2. Access to Market and Agricultural Production

Among the major obstacle faced by small holder farmers in Ethiopia are lack of modern inputs and access to markets (Thomas and Fanaye, 2012). Shortage of access to products and factor markets, stop the rural poor to be a part of growth process. Making markets work for poor is the key element in reducing poverty. In addition to this Infrastructure development enables the markets to expand and fall within the reach of the poor, thus making them part of the growth process (Infrastructure Statistics, 2012).

Market integration over space and time requires good infrastructure and effective market institutions. Where spatial market integration is poor, favorable local growing conditions, improved production practices, or adoption of modern technologies that result in increasing marketable surpluses may result in drastic drops in local prices, while other areas may suffer from deficits and rapidly increasing prices. Such large spatial price differences and abrupt inter temporal price changes are common in low-income countries with poor infrastructure and/or poorly functioning markets. For example, maize prices in Ethiopia tripled from 1997-98 to 1999- 00 followed by an 80 % drop from 1999-2000 to 2000-2001 and in Malawi, the price of maize quadrupled between April 2001 and April 2002 (Andersen and Shimokawa, 2006).

Rural markets are locations where agricultural producers, traders and consumers come together for commercial purposes, supplying, selling and buying goods. On the other hand, markets also serve social purposes, playing an important role in the life of rural populations related to use, habit and tradition, and importantly by providing formal and informal temporary income-generating activities for the unemployed (Cecilia, 2009). Majority of low income developing countries, market integration is restricted by poor transport, storage and communication infrastructure, lack of effective competition among market agents, limited rule of law, and restricted access to commercial finance (Andersen and Shimokawa, 2006). In addition to this the price transmission may be low and price changes in urban or world market are not fully transmitted to producers and traders. Without effective competition, economic agents with larger market power may exercise control over pricing strategies that result in a slow and incomplete pass through of price increases and a fast and complete transmission of price decreases. According to the same author, lack of access to both input and output markets has been identified as a significant constraint on agricultural development in sub-Saharan Africa and elsewhere. In rural areas, an agricultural market is often a section of the central market where a variety of local or imported products are sold, including fresh and processed crops, meat, dairy products and fish (Cecilia, 2009).

Good infrastructures boost productivity and minimize production costs. This is in line with the fact that aside from cost savings and/or reduction in urban business transactions, several other externalities could result from encouraging private sector investments in rural roads, rural transport and other rural infrastructure (Uwaize and Obasi, 2010).

Some markets could become centers for collecting and disseminating market information, facilitating the dissemination of price knowledge, information on where and when to collect the commodities and how to reduce transaction costs. A service like this could encourage more middlemen, farmers and wholesalers to collect market information directly from the market area and, as a consequence, increase the number of business (Cecilia, 2009).

2.1.3. Access to Cooperative and Agricultural Production

Agricultural marketing cooperatives have been the most popular traditional mode of cooperative development that has connected developing countries with the rest of the world, through export commodity trading (Chambo, 2009). It must also be recognized that the incidence of agricultural cooperatives in Africa, is not accidental.

According to Thomas and Fanaye (2012), in Ethiopia only 9 percent of smallholders were members of agricultural cooperatives and only 40 percent of rural households have access to cooperatives within their Kebeles. Most developing countries including those in Africa depend on agricultural production for their livelihoods. Farmers producing crops and marketed by cooperatives are gainfully employed because they can account for their labor input by the revenue they earn during the marketing seasons (Chambo, 2009).

An expansion of the banking network to the rural areas makes it easier for the rural population to deposit their savings at a guaranteed rate of interest, thus creating an asset base. More importantly, it also is a conduit for channeling funds to the rural population for agricultural activities such as adoption of high-yielding rice, fertilizers and so on as well as providing easy access to credit for setting up small and medium scale enterprises (Mukherjee, no date). Agricultural cooperatives are rural based organizations. Being rural as such, they are critical in the exclusion of market barriers imposed by low economic growth, negotiation of better commodity prices, influencing cooperative development issues with government, commercialization of smallholder production and access to new productive assets (Chambo, 2009).

Microcredit systems are critical in poverty reduction and a way to invest in human capital. Facilitating access to microcredit services for the poorest traders, who are part of the informal economy which represent the majority of market activities, could be considered part of the market development process (Cecilia, 2009). Moreover an appropriate microcredit system could help traders who often turn to informal sources of financing, usually at a very high cost, to start or to continue their commercial activities Agricultural cooperatives create the ability for the supply of required agricultural inputs so that production of commodities is done timely to enhance productivity (Chambo, 2009). According to the same author, provide an assured market for commodities produced by remote small farmers in the rural areas. The existence of cooperatives also has an impact in the generality of rural development defined in terms of availability and access to services that improve the basic conditions of life for the rural people. These include employment creation, rural markets development, and enhancement of rural incomes and the improvement of access to social services.

2.1.4. Access to School and Agricultural Production

Expansion the coverage of education in Tigray region is part of the integrated effort which has been made by the government, the society and donor organizations (GTP, 2003). Education may have both cognitive and Non-cognitive effects upon labor productivity (Weir, 1999). Cognitive outputs of schooling contain the transmission of specific information as well as the formation of general skills and proficiencies. Weir also revealed that, education also produces non cognitive changes in attitudes, beliefs and habits. Increasing literacy and numeracy may help farmers to acquire and understand information and to calculate appropriate input quantities in a modernizing or rapidly changing environment. Furthermore, improved attitudes, beliefs and habits may lead to greater readiness to accept risk, adopt innovations, save for investment and generally to embrace productive practices (Appleton and Arsene, 1996). Education may either boost prior access to external sources of information or improve the ability to acquire information through experience with new technology (Weir, 1999). That is, it may be a substitute for or a complement to farm experience in agricultural production. Schooling enables farmers to master different skill, change attitude and to develop different knowledge. As a result, schooling plays a significant role in increasing agricultural production, poverty reduction and rural development.

Education may directly influence agricultural productivity via one or more of the way described above. Education may also indirectly increase output through its interaction with other institutional variables. Educated farmers are able to interact more effectively with credit agencies, because they can understand financial transactions and keep records, increasing the likelihood of obtaining credit (Weir, 1999).For example, schooling may substitute for access to credit by providing the skills necessary to obtain waged employment, thereby generating cash to finance agricultural investments.

2.1.5. Rural Electricity and Health Sanitation

Electricity consumption is still one of the lowest in the world, however the demand for electricity is tremendous, and the supply is very limited (Dinkelman, 2008). An estimated 1.6 billion people across the globe do not have access to electricity and 75 percent of Africans are without access, sustainable development network (Dinkelman, 2008). Dinkelman also reported that, the arrival of infrastructure for domestic electricity may be characterized as a positive shock to time productivity and also electricity is persistent in all industrialized countries and largely absent in developing ones. Labor saving electrification increases the effective amount of labor available for producing commodities; it reduces the need to fetch wood, speeds up cooking time and allows households to shift activities from daytime into night time the effects of safe water supply and improved sanitation on poverty reduction is examined by (Anderson and Shimokawa, 2006). They examined 43 developing countries and found that differences in access to safe water explain about 25% and 37% of the difference in infant mortality and in child mortality between the poorest and richest quintiles, respectively. These results imply that increasing the level of access to piped water by the poorest quintile to that of the richest quintile (i.e., from 3% to 55%) will eliminate more than 25% (30%) of the difference in infant mortality (in child mortality) between the poorest and richest groups. Similarly, the difference in access to sanitation between the poorest and richest quintiles accounts for 20% of the difference in the prevalence of malnutrition between the richest and poorest quintiles. Weak infrastructure and limited distribution systems in low income countries complicate access to health services, especially in rural areas (Chaya, 2007). Improving access to safe water also contributes to a significant decrease in the average prevalence and duration of diarrhea among children under five (Jalan and Ravallion, 2001), and an increase in women's time allocation for market oriented activity that could contribute to increasing household income.

Ethiopia is a poor country with weak health care systems and infrastructure (Chaya, 2007). Furthermore, Reproductive health, like most aspects of health in Ethiopia, is generally poor, with significant regional disparities in access to services and in health outcomes. When we see the health problem in Tigray region, evidences show that most of the health problems are caused due to lack of clean water (GTP, 2003). In the absence of a solid heath infrastructure, strengthening primary health care and innovative community based health service delivery systems help provide more equitable access to health services (Chaya, 2007).

2.2. Infrastructure and Agricultural Development

Agricultural development is essential for economic growth, rural development, and poverty alleviation in low income developing countries. Productivity increase in agriculture is an effective driver of economic growth and poverty reduction both within and outside agricultural sectors. Such productivity increase depends on good rural infrastructures, well functioning domestic markets, appropriate institutions, and access to appropriate technology. While the state of rural infrastructure varies widely among developing countries, lower income countries including Nigeria, suffer severe rural infrastructure deficiencies (Olagunju et al., 2012).

The quality of infrastructure is an important determinant of the effects of infrastructure on agricultural growth and poverty reduction (Fan and Chan-Kang, 2005). Good and well organized infrastructure play a significant role in agricultural development. Investment in infrastructure is a crucial to boost farmers' access to input and output markets, to encourage the rural Non-farm economy and also motivate the rural towns, to enhance consumer demand in rural areas, and to make smooth the linkage of less favored rural areas in to national and international economies (Anderson Shimokawa, 2006). Rising agricultural productivity is the central part of any government growth and poverty reduction strategy. A sustained increase in agricultural productivity bring about lower food prices and benefits both urban and rural people who are net food buyers. Aside from its growth benefits, agricultural productivity also has significant poverty reduction effects (Gilberto, 2011). According to FAO (2005), rural infrastructure is plays a crucial role in different aspect of economic growth, poverty reduction and empowerment for the rural poor in Africa.

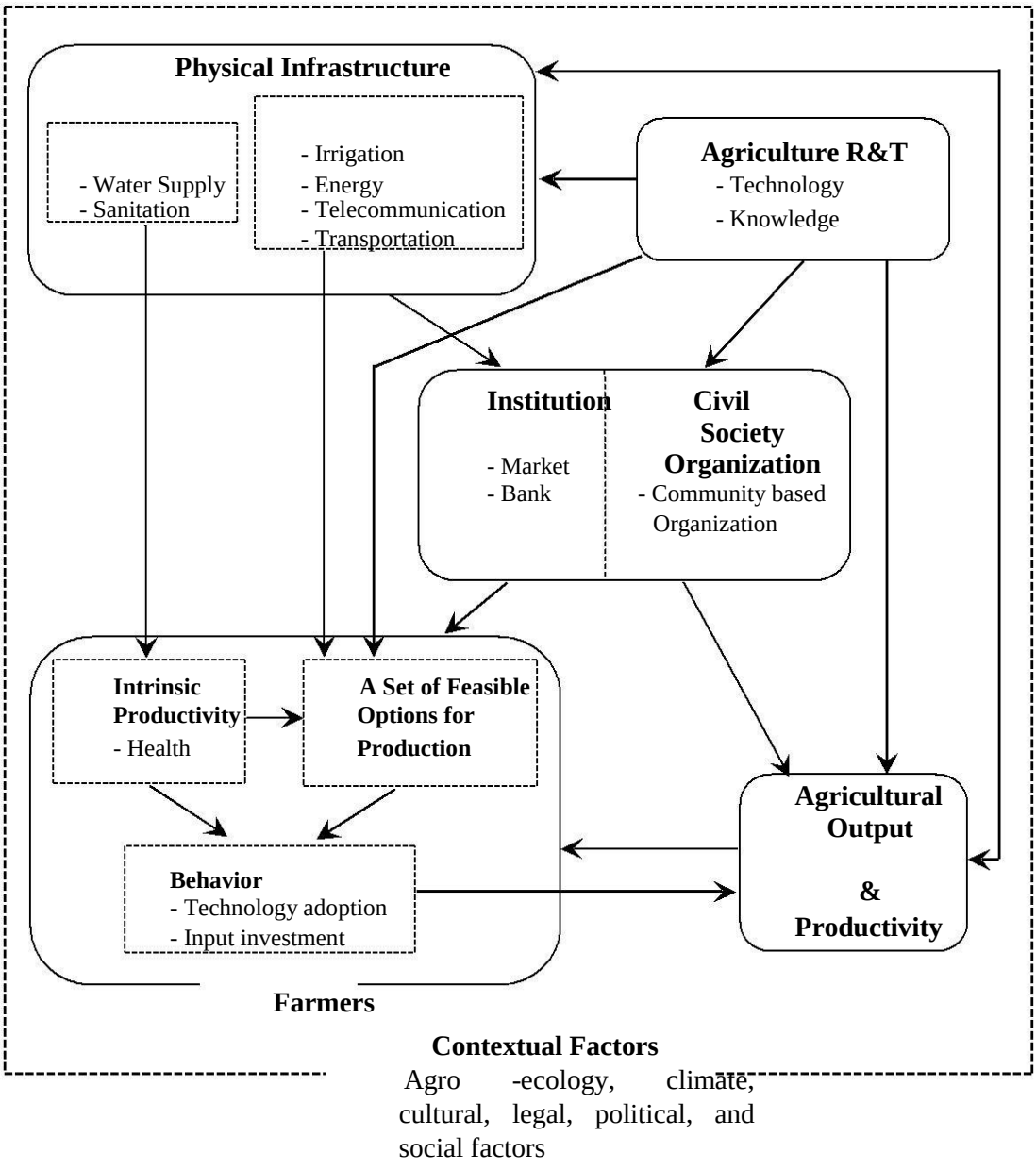

Figure 2.1: Promotion of Infrastructures to Agricultural Development

Source: Andersen and Shimokawa (2006).

Infrastructure has a positive effect in both agriculture and Non-agriculture sectors contribute to poverty reduction. In addition to this infrastructure also directly contributes to poverty alleviation by providing and supporting the delivery of key services such as access to safe water and basic

sanitation, particularly in very early stage of development (Anderson and Shimokawa, 2006). It has been imagine that rural infrastructure raise up agricultural productivity, which in turn encourage growth in the rural areas and brings about higher agricultural wages and improved opportunities for Non-farm labor (Gilberto, 2011). Gilberto also added that, one of the factors behind the successful integration and rapid economic growth of East Asian economies into the global economy was the high quality of infrastructure in these East Asian countries. This has given them a competitive edge over other countries in Asia which have not invested in good infrastructure.

The growth of agriculture, in turn, results not only in increasing the productivity and income of all class of farmers, but also in providing greater employment to rural labor (Olagunju et al., 2012). To sustain and enhance the current level of productivity, direct public investment in agricultural research has to be supported by other forms of infrastructure like farmers access to inputs such as water, make efficient use of modern inputs such as fertilizers, and to facilitate the marketing of the produce and take initiatives for investment in future technologies (Mukherjee and Kuroda, no date). Infrastructure is especially important in the context of achieving the Millennium Development Goals (MDGs). In addition, human development (e.g., education and health) rely on services that require supportive infrastructure water and sanitation to prevent disease, electricity to serve schools and health clinics, and roads to access the facilities (Anderson and Shimokawa, 2006).

2.3. Agricultural Intensification

2.3.1. Definition of Intensification

In simple terms intensification can be defined as producing more units of output per units of all inputs and through new combinations of inputs and related innovations. Conventionally, intensification has aimed to raise production, yields and/or income per unit of land, through greater investment of capital or labor and higher use of inputs such as fertilizer or pesticides, but intensification can take many forms dependent on climate and land, household resource endowment and socio-economic states, individual choice and market demands (Montpellier Panel report, 2013).

Table 2.1: Definitions and Sources of Three Outputs of Agricultural Intensification

Production	Income	Nutrition
Definition *Total amount or yields of food per unit input*	**Definition** *Amount of net income generated per unit input*	**Definition** *Human consumption of nutrients per unit input*
Resulting from: • Improved high yielding, drought, pest and disease tolerant crop varieties or livestock breeds • Better crop cultivation or livestock husbandry: - More effective inputs of water, nutrients or means of control of pests, diseases and weeds -Exploiting synergies between crops and livestock	Resulting from: • Access to fair and efficient output markets • Greater market and price information • Shifts from low value to high value crops or livestock • Diversification of income generating activities, including: - Adjustment of the farm or household enterprise - Exploiting new market opportunities - Increasing non-farm income	Resulting from: • New varieties of staple crops or breeds of livestock with improved nutritive value • Diversification of production towards higher overall nutritive value

Source: *Montpellier Panel report*, 2013

Furthermore, agricultural intensification has been defined as 'improved average inputs of labor or capital on a smallholding, either cultivated land alone, or on cultivated and grazing land, for the purpose of increasing the value of output per hectare' (Tiffen et al., 1994). Agricultural intensification may occur as a result of a) an increase in the gross output in fixed proportions due to inputs expanding proportionately, without technological changes, b) a shift towards more valuable outputs or c) technical progress that raises land productivity. In practice the intensification process may occur as a combination of these, but the relative feasibility of the three components is likely to vary greatly in different areas (Carswell**,** 1997). Land use intensity refers to any practice (system of land use) that increases productivity per unit land area and also viewed as any practice that raises the cost of labor or capital inputs per unit land (Dixon et al., 2001). Agricultural intensification can lead enhance production and income, which enhanced the economic conditions of the farmers (Adeoye et al., 2011). Furthermore, the processes associated with agricultural intensification include an increased (per fixed unit of land) frequency of cultivation; an increase in labor inputs; or a change in technologies. Evidence of the increased use of natural or artificial fertilizer, improved seeds, animal traction, mechanization, multi cropping and changes to the landscape such as irrigation, or soil conservation measures would suggest that intensification was occurring.

Agricultural intensification is an increase in the productivity of existing land and water resources in the production of food and cash crops, livestock and forestry. Generally associated with increased use of external inputs, intensification is now defined as the more efficient use of production inputs. Increased productivity comes from the use of improved varieties and breeds, more efficient use of labor, and better farm management. Samuel (2006) reported that, a sustainable utilization of modern farm inputs (agricultural intensification) is a function of financial incentives to farmers, affordability and availability of modern farm inputs. Moreover, production (environmental) and market risks are affecting sustainable technology adoption in Ethiopian agriculture. And also he added that technology promotion among poverty suffering farmers who work under risky environment is a highly challenging activity technologies should be tested both for their technical performance and economical profitability. In addition, institutionalized support to risk management and sharing is important especially for smallholders in the Ethiopian highlands where both production (weather) and market risks are high. Rural infrastructure services play a significant role

in poverty reduction, economic growth and empowerment for the African rural poor (Fishbein, 2001). Furthermore the provision of rural infrastructure has been a core priority of governments for many decades to improve the welfare of rural populations and increase the productivity and value added from agriculture and other economic activities in rural areas. Insufficient and unreliable infrastructure services are common in the majority of rural communities in Africa. Rural households do not have access to safe drinking water, electricity, reliable transportation or modern communication services (Rural Infrastructure in Africa, 2012). The Ethiopian government's development strategy centers on 'Agricultural Development Led Industrialization'. A 'green revolution' like intensification of smallholder agriculture was seen as key. Policymakers assumed that significant productivity growth could be easily achieved by improving farmers' access to technologies which would narrow the yield gap (Samuel, 2006).

Agricultural intensification is already the main source of increased food production. Intensive use of chemical fertilizers, pesticides, and irrigation technology, in combination with higher yielding crop varieties, has led to enough food being produced in the world such that if it were evenly distributed, no one would go hungry (Andersen et al., 1994). Sustainable crop production intensification must not only reduce the impact of climate change on crop production but also mitigate the factors that cause climate change by reducing emissions and by contributing to carbon sequestration in soils. Intensification should also enhance biodiversity in crop production systems above and below the ground to improve ecosystem services for better productivity and healthier environment (Derpsch and Friedrich, 2010).

CHAPTER 3

MATERIALS AND METHODOS

3.1. Physical-background of the Study Area

3.1.1. Location

Tahtay-Koraro is located at 14^0 10’ 30 " N and 38 º 10’ 30" E. It is about 1040 Km North of Addis Ababa and 320 Km North West of Mekelle the capital city of Tigray regional state. Specifically, the study was conducted in three selected Tabias (Selam, Adigidad and May-Timket).The average altitude of the area is about 1800 m.a.s.l.

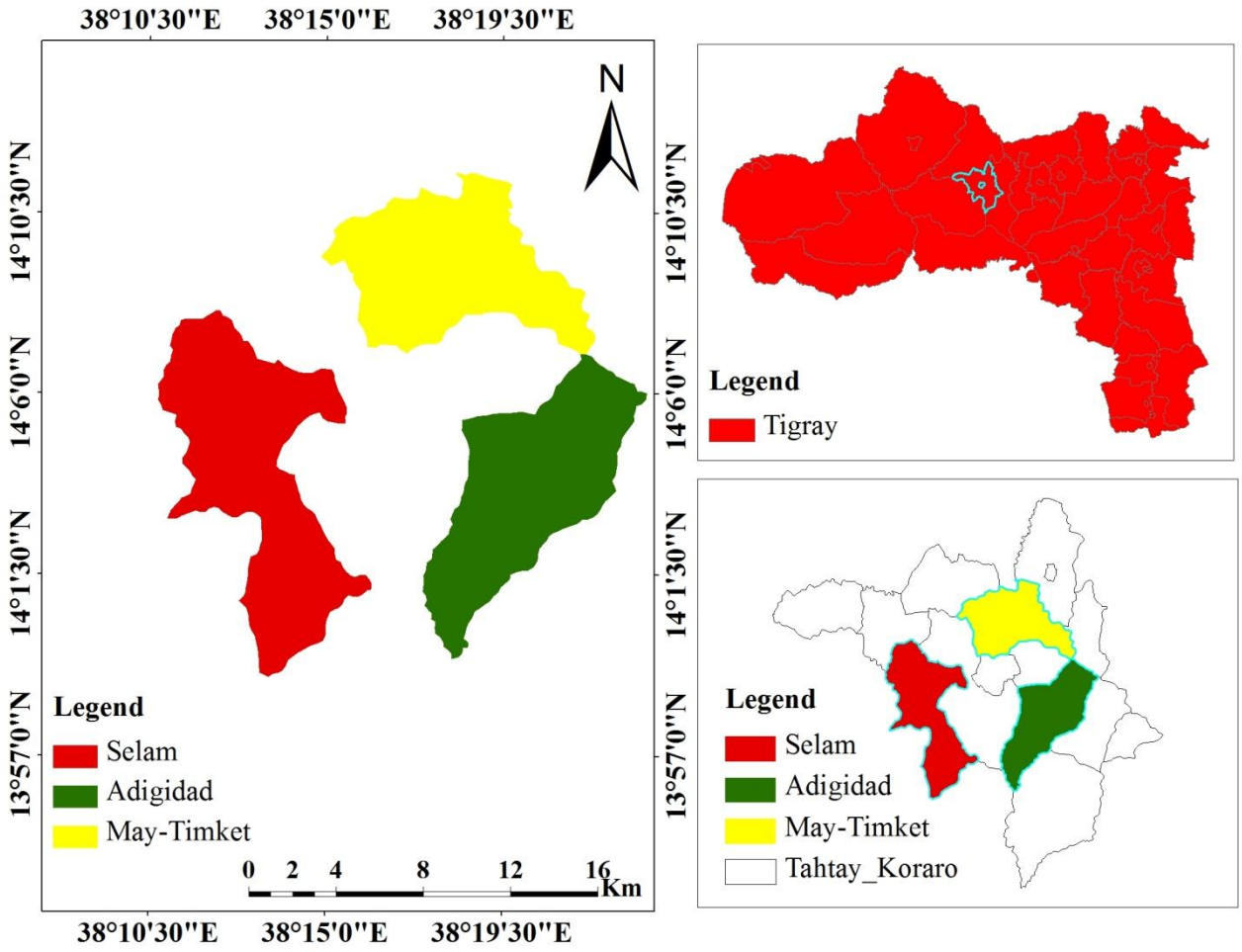

Figure 3.1 Location Map of the Study Area (Tabias).

3.1.2. Climate

Climate, in the broad sense, is a major determinant of the geographical distribution of species and vegetation types. In agricultural terms, however, within any particular region, it is the microclimate, which is greatly influenced by local topography that is of most direct concern. Within any area of general climatic uniformity, the local condition of temperature, light, humidity, moisture vary greatly, and it is these factors which play an important role in the production and survival of plants (Tainton, 1999).

Rainfall is the most important single factor determining the type and productivity of vegetation in specific areas (Pratt and Gwynne, 1977). Temperature is another climatic factor that influences evaporation, which determines the proportion of the precipitation that is retained in the soil (Pierper, 2000).

Climatic zone of the study areas belong to Weyna-Dega (cool sub-humid) agro-climatic zone. The main rainy season of study areas extend from June to September. The mean annual rain fall of the study areas (Tahtay-Koraro) is about 1000 mm and rainfall distribution of the study areas are characterized by uni-modal pattern where more than 90% concentrate in the period between July and August. The mean annual temperature of the study is about 24 ^{o}c (Tahtay-Koraro BoARD, 2008).

3.1.3. Topography and Soil

Topography has climatic influence with respect to prevailing sunshine, air currents and water bodies. According to the Bureau of rural development and agricultural extension of Wereda Tahtay-Koraro (2008), the dominant soil type of the selected Tabias is Vertisol. In addition to this, a research conducted by Tsegay and Kahsa (2000), revealed that soil type of the study areas (Tabias) are Vertisol. Whereas the major crops of the study areas (Tabias) are Teff and Maize (WeredaTahtay-Koraro office of plan and finance, 2012).

Table 3.1 Experimental Soil Type of the Study Areas

Tabias	Experimental soil type		
	Sand (%)	Silt (%)	Clay (%)
Selam *	30	26	44
Adigidad **	29	33	38
May-Timket *	30	26	44

Source: * (Teklay et al., 2012).

Source: ** (Shire Soil Laboratory Analysis, 2012).

3.2. Demographic Background

3.2.1. Population

According to the Bureau of Plan and Finance of Tahtay-KororaWoreda (2012), the total population of the study woredas is 156,922 (78,420 are males and 78,502 are females). From this total population, the population of May-Timket (male is 3935, female is 3995 and the total population is 7930), Adigdad (male is 4382 female is 4459 and the total population is 8841) and Selam (male is 3818, female is 3734 and the total population is 7552). Generally, the total population of the selected Tabias is 12,135 males and 12,188 females. Tahtay-Koraro woreda is characterized by densely populated an agglomeration of economic activities (both formal and informal) with approximately 156,922 people, spread over the 14 Tabias.

3.3. Research Methods and Materials

GIS tools were used to map and analyze the location and distribution of the rural infrastructures and institutions available in the study area. ARC GIS 9.3 was used for data preparation, analysis and map composition, and GPS was used to gather ground control point and specific location of each rural infrastructures and institutions available in the study areas and also questionnaires and focus-group discussion were used to collect data.

3.3.1. Data Collection Procedure and Source of Data

The study made use of primary data and secondary data sources. Primary data were collected with the aid of focus-group discussion and semi structured questionnaires designed for collecting information on the socio economic characteristics of the farm households, availability and role of infrastructures and institutions etc. and the secondary data were collected from different bureaus (Bureau of Rural Development and Agricultural Extension, Bureau of Planning and Finance and Bureau of Central Statics Shire Branch), In addition to this, the ground control points of each infrastructures and institution availability in the study areas were collected using Garmin GPS which was processed using Arc map.

3.3.1.1. Sample Size and Sampling Procedure

With regard to sample size, the researcher believes that more sample households could have better representation of the whole population. However, to make the research more manageable (both in time and resources) a total of 99 sample households have been selected from the selected sample areas (Tabias) having a total population size of 4858 Households (see Table 3.2). Distribution of sample respondents by their location and size is shown on Table 3.2.It is taken through simple random sampling or lottery method from the prepared household list. The 3 Tabias were selected by with a direct guidance of the Woreda Office of Rural Development experts. In addition to this, these Tabias have similar temperature, rainfall and soil type (Tahtay-Koraro BoARD, 2008). According to similar sources, the study areas are located at different distances from Shire-Indaslassie town (Tabia Selam 5Km, Adigidad 12Km and May-Timket 20Km) and they have also different distribution of rural infrastructures and institutions.

The sample size sampled from each Tabia is determined by applying a scientific formula that is given below (Kothari, 1990).Using the following formula, with precision level of 10 %, a total of 99 households were randomly selected from three Tabias.

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

Equation 3.1 Sample Size Selection Formula

Where;

n is the sample size to be computed,

N is the total number of households in the study area, and

e is the level of precision.

According to the sample size determination formula mentioned earlier, the overall sample from all the three Tabias is given below.

$$n = \frac{4858}{1 + 4858(0.1^2)}$$

n = 99

To distribute the sample size for each Tabias, the researcher used the following formula or equation: (Kothari, 1990).

$$n = \frac{POPHHs}{N} X\ 100\%$$

Where;

n is the number of questionnaires to be distributed,

POPHHs is the population of the households, and

N is number of households in the study area.

$$n = \frac{1539}{4858} X\ 100\%$$

n =32, questionnaires for Tabia Selam

$$n = \frac{1567}{4858} X\ 100\%$$

n= 33, questionnaires for Tabia Adigidad and,

$$n = \frac{1752}{4858} X\ 100\%$$

n=34 questionnaires for Tabia May-Timket

Table 3.2 Distribution of Sample Respondents by their Location and Size

Sample area (Tabias)	Total population of households	Sample taken
Selam	1539	32
Adigidad	1567	33
May-Timket	1752	34
Total	4858	99

Source: *Woreda Tahtay-Koraro office of plan and finance statistical report, 2012/13*

3.3.1.2. Focus-group Discussion

Focus-group discussion was conducted in the study areas (in three selected Tabias) where, 4-5 members of sample respondents have participated in the focus group discussion. The researcher selected participants in the group discussion from each Kushet (the smallest administrative area) to make it representative. In addition to this, the compositions of the participants were selected from different category such as model farmers, local administrators and farmers. In addition to this, the size of group in each Tabia was 4 (from all Kushet of the Tabias).

Source: *researcher photo* 2013/14

Figure 3.2 Focus-group Discussions with Respondents

3.3.1.3. Field Observation

Field observation was conducted to collect the ground control points, observe the distribution of rural infrastructures and institutions and also to conduct focus-group discussion.

Source: *researcher photo* 2013/14

Figure 3.3 Field Observations and Data Gathering

3.4. Data Analysis and Presentation

Descriptive and principal component analyses (PCA) are used to analyze the data. The Descriptive statistics such as percentages and frequency were computed by using statistical package for social science (SPSS) software, while PCA model was employed to assess the perception of farmers on the role of rural infrastructures and institutions on agricultural intensification and to reconstruct the most contributing indicator to the increasing productivity of major crops (Teff and Maize). Furthermore, the GIS (ARC GIS 9.3) were used to show the map of spatial distribution and accessibility of rural infrastructures and institutions available in the study area. And also, the result is presented in the form of maps, tables and figures. The chi-square test was applied to see the association between rural infrastructures and institutions and intensification of crops.

CHAPTER 4

RESULTS AND DISCUSSION

4.1. Socio-economic Back-ground of Sample Respondents

4.1.1. Age of the Sample Respondents

Age is the most basic characteristics of a population. The number and proportion of males and females in each age group as well as the structure can have considerable impact on the population's current and future social and economic situation (Population Reference Bureau (PRB), 2011).

It is known that age is an important factor for the success or failure of farming business. Hence, understanding the age of the household head with respect to their perception toward the role of infrastructures and institutions is important. Communities that access to infrastructure and institutions have better opportunity for investment and marketing.

Table 4.1: Age of the Sample Respondents in the Study Area

Tabias	Age of the HHs	Frequency	Percent	χ^2 value
Selam	19-29	12	37.5	0.030
	30-44	16	50.0	
	45-56	4	12.5	
	Total	32	100.0	
Adigidad	19-29	3	9.1	0.000
	30-44	19	57.6	
	45-56	11	33.3	
	Total	33	100.0	
May-Timket	19-29	2	5.9	0.000
	30-44	21	61.8	
	45-56	11	32.4	
	Total	34	100.0	

Source: *Self-Compiled 2013/14*

Table 4.1 shows, in Tabia Selam about 50 percent of sample respondents were at the age of 30-44 years old, while about 37.5 and 12.5 percent are in the age19-29 and 45-64 years old respectively. The minimum and maximum age of the sample respondents were 19 and 64 respectively. The average age level of the sample respondents was 41.5 years old. In Tabia Adigidad, about 57.6 percent of sample respondents were in found at the age of 30-44 years old, while about 9.1 and 33.3 percent found in 19-29 and 45-64 years old respectively. The minimum and maximum age of the

sample respondents were 19 and 64 respectively. The average age level of the sample respondents was 41.5 years old. Similarly, Table 4.1 shows, 61.8 percent of sample respondents in Tabia May-Timket have age ranging between 30-44 years old, while about 5.9 and 32.4 percent were in the age of 19-29 and 45-64 years old respectively. The minimum and maximum age of the sample respondents were 19 and 64 respectively. The average age level of the sample respondents was 41.5 years old. Generally, from this it can be said that, the age categories found in 19-29 were participated (involved) in different agricultural intensification activities (e.g. row planting and soil and water conservation activities) rather than the rest age categories. Similarly, the categories found 19-29 have productive age. Olagunju et al., (2012) reported that, active age (older than 45) is the active age when farmers can carry out the physical severity farm activities. This has implication for agricultural production because farm work requires physical energy and strength.

4.1.2. Sex of Sample Distribution

Table 4.2 reveals that, in Tabia Selam about 65.6 percent of the total respondents were male and about 34.4 percent female. In Tabia Adigidad, about 72.7 percent of the total respondents were male and about 27.3 percent of the total respondents were female. In addition to this the above Table 4.2 reveals that, in Tabia May-Timket about 70.6 percent of the total respondents were male and about 29.4 percent of the total respondents were female. It can be gleaned from this the proportion of male is higher than female in all Tabias. Similarly, majority of the sample respondents of the study areas are male and they are participated in agricultural intensification activities rather than females. Furthermore, most of the female respondents are performing or doing different home activities, which mean they have little opportunities to participate in agricultural intensification activities.

Table 4.2 Sex of Sample Households

Tabia	Sex	Frequency	%	χ^2 value
Selam	Male	21	65.6	0.077
	Female	11	34.4	
	Total	32	100.0	
Adigidad	Male	24	72.7	0.009
	Female	9	27.3	
	Total	33	100.0	
May-Timket	Male	24	70.6	0.016
	Female	10	29.4	
	Total	34	100.0	

Source: *Self-Compiled 2013/14*

4.1.3. Family Size

Table 4.3 illustrates, in TabiaSelam, the minimum and maximum family size of respondents was found 3 and 8 respectively. The average family size of sample household was 5.19. In TabiaAdigidad and May-Timket the minimum and maximum family size of the sample households was 3 and 11 respectively. But average family size of sample household in TabiaAdigidad and May-Timket was 6.58 and 6.71 respectively. In all, most of the households have at least 6.58 members which are higher than the national average and regional for all respondents. The national and regional average household size is 4.7 and 4.3 respectively (CSA, 2007). The size of the household is an important variable especially in a situation where human power is a major source of power for carrying out farming activities (Olagunju, et al., 2012).

Table 4.3 Distribution of Sample Households by Family Size

Tabias	Number of households	Minimum	Maximum	Mean
Selam	32	3	8	5.19
Adigidad	33	3	11	6.58
May-Timket	34	3	11	6.71

Source: *Self-Compiled 2013/14*

4.1.4. Educational Background

Level of education affects households' socio-economic status for example, adoption of new technologies, demographic and health situations of the family. Education has an important implication particularly for the adoption of new technology and practice (Akinbile and Ndaghu, 2000). Education level of farmers is assumed to increase the ability to obtain process and use agriculture related information in a better way. Farmers' education is pivotal for effect work of extension system and technology use.

Table 4.4 Distribution of Sample Respondents by Level of Education

Tabias	Educational level	Frequency	Percent	χ^2 value
Selam	Illiterate	16	50.0	0.002
	Read and write	11	34.4	
	Elementary completed	4	12.5	
	Secondary completed	1	3.1	
	Total	32	100.0	
Adigidad	Illiterate	25	75.8	0.000
	Read and write	7	21.2	
	Elementary completed	1	3.0	
	Secondary completed	-	-	
	Total	33	100.0	
May-Timket	Illiterate	27	79.4	0.000
	Read and write	6	17.6	
	Elementary completed	1	2.9	
	Secondary completed	-	-	
	Total	34	100.0	

Source: *Self-Compiled 2013/14*

Evident from Table 4.4 explain, in Tabia Selam majority of the respondents (around 50 percent) were illiterate, 34.4 percent can read and write, about 12.5 percent were elementary school completed and around 3.1 percent of the total respondents were secondary school completed. In Tabia Adigidad, about 75.8 percent were illiterate, 21.2 percent can read and write, and 3 percent

were completed elementary school. Furthermore, as the survey result represented in table 4.4, the majority portion of sample households of Tabia May-Timket (about 79.4 percent) were illiterate, 17.6 percent can read and write, about 2.9 percent were completed elementary school. Generally, the education level in the study areas is low characterized by high level of illiterates; and this is found to be due to lack of access to education (school) in the study areas. Consequently, they are exposed to unnecessary costs to get access to education, especially secondary school and above. In Tabia May-Timket, the illiteracy rate is higher than the rest of the Tabias under study; and this may indicate that educational infrastructures are fewer in this Tabia than the others, holding other things constant.

Weir (1999) discovered that, education may either boost prior access to external sources of information or improve the ability to acquire information through experience with new technology. In addition to this, level of education may help to improve knowledge, skill and attitude and this may show the way to greater readiness to accept risks, adoption innovations, save for investment and generally to embrace productive practices.

4.1.5. Marital Status

As the data obtained from the focus-group discussion, the total consumption and sales of production of married households are different from those single and divorced.

Table 4.5 Distribution of Sample Respondents by Marital Status

Tabias	Marital status	Frequency	Percent
Selam	Single	6	18.8
	Married	22	68.8
	Divorced	4	12.5
	Total	32	100.0
Adigidad	Single	4	12.1
	Married	21	63.6
	Divorced	8	24.2
	Total	33	100.0
May-Timket	Single	1	2.9
	Married	26	76.5
	Divorced	7	20.6
	Total	34	100.0

Source: *Self-Compiled 2013/14*

As indicated in Table 4.5, in Tabia Selam 68.8 % of the respondents are married while about 18.8 and 12.5 % of the sample households are single and divorced respectively. In Tabia Adigidad, about 63.6 percent of the sample households are married; and 12.1 and 24.2 percent of the sample households are single and divorced respectively. In addition, in Tabia May-Timket about 76.5 percent of the sample households are married. And also about 2.9 and 20.6 percent of the sample households are single and divorced respectively.

4.2. Distribution of Rural Infrastructures and Institutions in the Study Areas

Infrastructure investments in Africa have not kept pace with growth in demand, creating a huge deficit (Mafusire et al., 2010). But, infrastructures and institutions are an important element in agricultural production as it lowers costs of inputs, enlarges markets and facilitates trade. It raises the productivity of factors of production resulting in increased agricultural production and productivity.

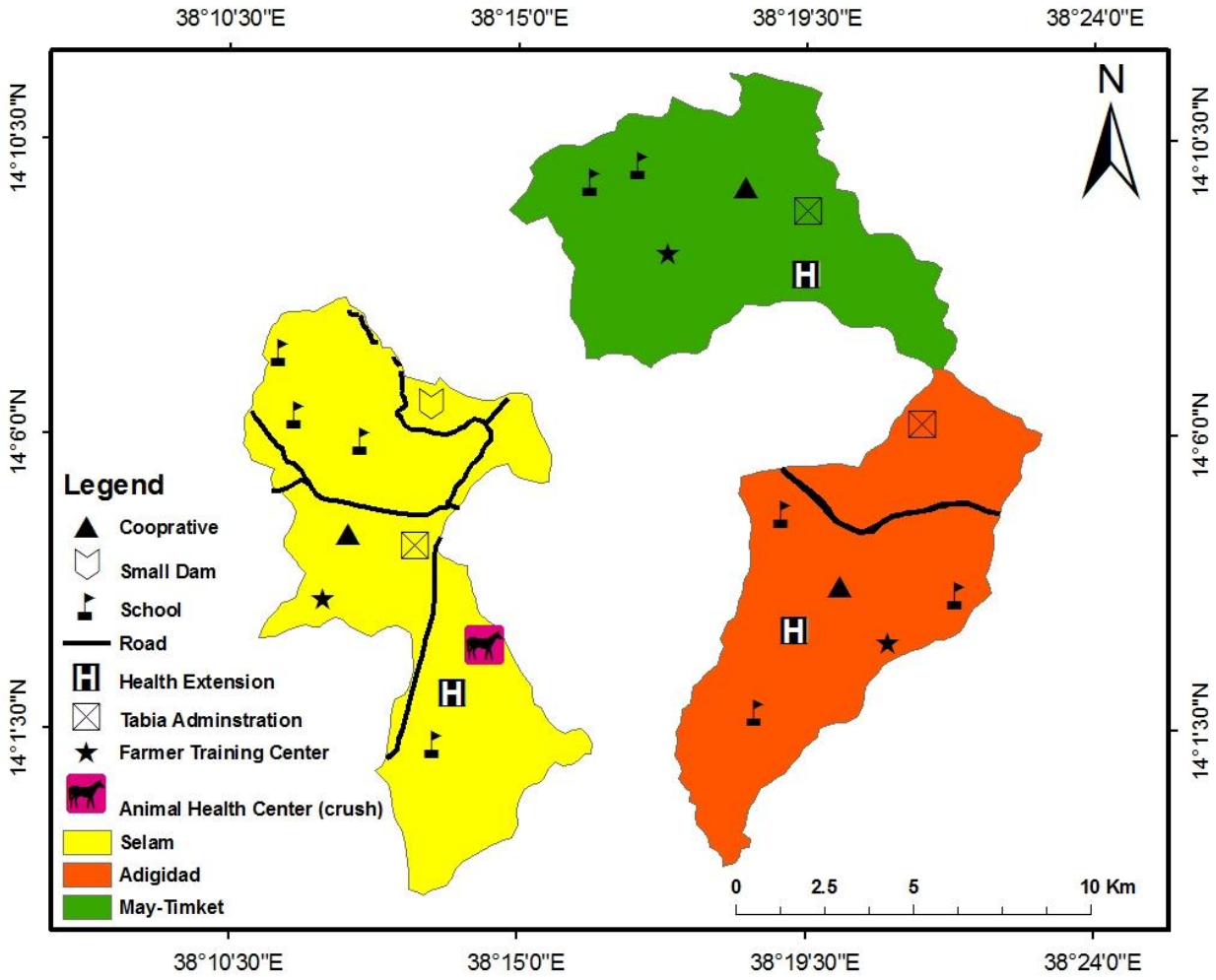

Figure 4.1 Spatial Distributions of Rural Infrastructures and Institutions in the Study Areas

Source: *Self-Compiled* 2013/14

As it is depicted in Figure 4.1 and the data obtained from group discussion and field observation, the availability of rural infrastructures and institutions in Tabia Selam was higher than the other Tabias (Tabia Adigidad and Tabia May-Timket). Furthermore, this Tabia is the nearest Tabia to

Shire Indaslassie (5 Km) and the respondents have an access to different services (for example, agricultural inputs) and also they may get higher agricultural production particularly in Teff and Maize than Tabia Adigidad and May-Timket because of intensive use of chemical fertilizers. This finding is corresponds with Hine and Ellis (2001), the nearest distance to rural infrastructures has a good opportunity or access to different commodity type, transport, marketing sectors and travel distance.

Irrigation has the potential to contribute immensely towards rural communities' ability to generate income. Its direct impacts can include higher incomes through higher yields, cropping intensity and diversification towards higher value crops; higher rural employment and lower food prices. Its indirect impacts can comprise higher production, consumption and labor demands in the surrounding upstream and downstream nonfarm economy (Musa et al., 2010). Despite its potential, it has not played a key role in African agriculture thus far. Improving agriculture can only be attained with sustainable land management and reliable water control systems (Rural Infrastructure in Africa, 2012).Moreover the multi-purpose cooperative available in this Tabia is supported by one non-governmental organization (the well foundation) and it provides different agricultural inputs (improved animal breeds and crop varieties) and different home consumptions for the respondents. In addition to this, multipurpose cooperative has a great role in change of major agricultural production (Teff and Maize) because of it provides different agricultural inputs and services (credit) this is in line with the findings conducted in Tanzania by Chambo (2009) and Thomas and Fanaye, (2012) a finding conducted in Ethiopia.

Furthermore, in Tabia Adigidad as the data obtained from focus-group discussion and field observation, the spatial distribution of rural infrastructures and institutions was less in availability (as compared to Tabia Selam). In this Tabia (Adigidad) there were no rural market and animal health care (veterinary service). Consequently, less agricultural production both crop production (particularly Teff and Maize) and livestock production. For example, they walk a long distance (an average 10 Km) to Shire-Indaslassie town to get veterinary service (medicine for their animals), inputs for their crops (fertilizer, pesticide, and herbicide) and other home consumptions. As a result, the absence of rural infrastructures and institutions has a direct effect on farmers' livelihood and agricultural intensification activities because they are exposed to unnecessary cost, reduction in

production and they haven't get support and supervision by experts. Furthermore, this findings is in line with the(Rural infrastructure in Africa, 2010), absence or poor infrastructures and institutions has loss production and farmers productive time while searching for water, firewood, feeds, veterinary services and other essentials that are required for production and home use but are not readily available. Access to rural infrastructures and institutions are vital for improving the conditions of the rural poor: they represent the mechanism through which rural poor people can gain access to resources and services; they establish and maintain the 'rules of the game' in many crucial relations affecting the rural poor; and it is through them that influence is organized and articulated (IFAD, 2003). In this Tabia (Adigidad), multipurpose cooperative is creating an opportunity for the supply of required agricultural inputs so that production of commodities is done timely to enhance productivity.

Based on the data obtained from focus-group discussion and field observation in Tabia May-Timket, most of the sampled farmers viewed infrastructures and institutions facilities are low in their areas. The weak (compare with the rest Tabias) rural infrastructures including, market, electricity, veterinary service and comfortable transportation (road) etc., affect the agricultural productions in the area. And also, the distance to market and poor access to road had a negative impact on agricultural production (for example perishable agricultural products). In addition to this, availability of rural infrastructure and institutions in Tabia May-Timket was very less in number (compared to Tabia Selam and Adigidad). Tabia May-Timket is far (average 17 Km) from Shire-Indaslassie town compared to the rest of the study areas. Consequently, distance has negative impact on the farmers' income, agricultural production (agricultural intensification activities) and their livelihood this finding corresponds with Riverson et al., (1990) conducted in Sub-Saharan Africa. But, as information obtained from focus group discussion FTCs has a serve as center of research projects about new crop and animal breeds, farm inputs and mass education.

4.3. Agricultural Extension (FTCs)

In the study areas agricultural extension services (FTCs) serve as a center of information and agricultural technology demonstrations. Additionally, it helps the farmers to develop their know-how, to master their skill and to change their attitude by providing different training and educations. MoARD, (2005) reported that, agricultural extension service (FTCs) would give training for 60 farmers in one in-take. The duration of training also vary depending on the type of module, the maximum time limit would be 6 months. The training would be carried out in non-boarding basis and directed towards specific fields of agriculture. Farmers would be awarded a green certificate upon completion. Fisseha, (2009) reported that, access to FTCs was a critical facilitator for agricultural intensification activities, agricultural production and rural development. People involved in agricultural extension service helps to improve skills, information, and ideas in order to develop an agriculture that will meet complex demand patterns, reduce poverty, and preserve or enhance ecological resources. One very popular extension and education program worldwide is the farmer field school (FFS) approach, (Braun et al., 2006).

According to the Bureau of Agricultural and Rural Development of Wereda Tahtay-Koraro (2012), the main objective of agricultural extension services (farmer training centers) is to create farmers, who are business oriented, environmentally conscious, can make use of modern technologies and produce quality farm products. In order to achieve the above mentioned objectives, the role of farmers training centers would be:

- Give specialized training this enables the farmers to get “Green certificate."
- Provide agricultural extension services.
- Provide computer and tele services.
- Provide information on market price standards.
- Provide advisory service on entrepreneurship.
- Serve as permanent exhibition center.

4.4. Distance to Rural Infrastructures and Institutions in the Study Areas

Access to rural infrastructures and institutions is important factor for farmers to use improved agricultural technologies. If farmers are closer and having access to rural infrastructures and institutions services, they can easily purchase improved agricultural inputs and sell their agricultural outputs without travelling long distance.

Table 4.6 Distances to Rural Infrastructures and Institutions in the Study Areas

Variables	Tabias								
	Selam			Adigidad			May-Timket		
	Mean	SD	t-test	Mean	SD	t-test	Mean	SD	t-test
Distance to market (Km)	5.28	0.729	0.000	10.21	1.883	0.000	17.71	2.444	0.000
Distance to school (Km)	0.42094	0.48096	0.000	2.445	1.1330	0.000	5.882	2.4091	0.000
Distance to health extension (Km)	0.43734	0.54115	0.000	2.3424	.89827	0.000	5.852	2.2310	0.000
Distance to veterinary service (Km)	0.34125	0.37145	0.000	2.4121	0.8813	0.000	4.897	1.8739	0.000
Distance to road(Km)	0.39656	0.31957	0.000	1.1581	0.8371	0.000	4.558	2.1061	0.000
Distance to be FTC (Km)	0.44719	0.49329	0.000	2.6757	1.0529	0.000	4.588	1.4998	0.000
Distance to multipurpose cooperative (Km)	0.49687	0.66315	0.000	2.6193	1.4721	0.000	5.323	2.7822	0.000

Source: *Self-Compiled* 2013/14

It is evident from Table 4.6 that, in Tabia Selam (5.28 Km), Adigidad (10.09 Km) and Tabia May-Timket has (17.71 Km) far from the nearest market (Shire-Indaslassie). Distance to market, poor access had a negative impact on agricultural production (for example perishable agricultural

products). Kamara (2004), from a research in Kenya reported that, market access (time taken to the market) has a negative effect on productivity, which indicates that aggregate productivity increases with 'decreasing time to markets' (improving market access).

This means that improved market access increases agricultural productivity. Physical access to market determines the frequency households going to local markets. This physical access to market is affected by the distance of the market place, infrastructure available (all weather roads) and access to transportation facilities. Distance of a market place from the household home is measured in hours taken to reach the nearest market place and hence it is continuous variable. The distance to market of households has negative and significant influence on adoption decisions. The longer the time taken to reach to rural infrastructures and institutions was the lesser intensity of the households to agricultural intensification activities in the study areas. According to World Bank (2009), lack of development infrastructures and institutions, and hence greater limitation in the kinds of livelihoods that can be pursued by the rural population, leads to broad based "geographical" poverty.

Distance has its own effect on agricultural intensification as well as agricultural production. For instance, when compared the average distance to multi-purpose cooperative among the study areas farmers was walking an average 0.4, 2.6 and 5.3Km in Tabia Selam, Adigidad and May-Timket respectively. Consequently, those farmers who walking long distance to get service of multi-purpose cooperative has exposed to un necessary costs (wastage of resources) thus, it is a direct negative impact on agricultural production and agricultural intensification activities. And also, those farmers who are near to service of rural infrastructures and institutions spend their time on income generating activities. Infrastructure access can raise the value of the assets of the poor.

Commonly, distance to rural infrastructures and institutions have its own difficulty on farmers' livelihood and agricultural production. For example, lack of understanding of market information, lack of business and negotiation skill, health problem (child and maternal death) and less know-how about agricultural technologies (intensifications).

4.5. Density of Rural Road in the Study Areas

Rural roads open and link markets to the centers of production for many economic sectors such as agriculture. Africa currently has about a million kilometers of rural roads. Their density (tertiary and unclassified) ranges from 0.1 km per 1,000 people (Rural Infrastructure in Africa, 2012). Additionally, only 34 % of the African rural population lives within 2 Km of rural road, compared to 90 % in East Asia and the Pacific countries.

The proper level of road network is assessed by road density, which is measured by road length per 1000 persons or by road length per 1000 $km^{2.}$ The formula (equation) was applied to calculate the road density is;

$$\text{Road Denesity} = \frac{\text{Road Length}}{\text{Total Population or, Area}} * 1000$$

24.901/1539*1000=16.2Km per 1000 population, for Tabia Selam and 14.026/1567*1000=8.9 Km per 1000 population for Tabia Adigidad. Or, 24.901/73.863*1000= 337.1Km per 1000 km^2 for Tabia Selam and 14.026/62.608* 1000=224 Km per 1000 km^2 for Tabia Adigidad. In the study areas the density of the rural road in Tabia Selam was 16.2Km per 1000 people, with a mean of 8.6 Km and in Tabia Adigidad 8.9 Km per 1000 people with a mean of 4.15 Km. when compared the rural road density among the study areas Tabia Selam (16.2Km) was the highest rural road density than Tabia Adigidad (8.9Km).

Foster et al., (2010) stated that, rural road accessibility is very low in Ethiopia. They reported that, only 10 percent of Ethiopia's rural population lives within two kilometers of an all-weather road. This is only half of the benchmark level for low-income countries in Sub-Saharan Africa.

Moreover, in Tabia Selam (farmers' perception) the rural road creates a good linkage between urban and rural and it facilitate transportation of (agricultural inputs and products) easily and this has a positive contribution on agricultural intensification activities. Distance and inadequate rural roads has a negative impact on agricultural production, rural development and generally they are obstacles in achieving the MDGs and invest on rural road is a critical for rural development. This is corresponds with Adeoye et al., (2011), they stated that, rural households' efforts to escape poverty and lift themselves above subsistence levels are limited by the poor access to market, supplies and

vital information, investments in rural infrastructure, particularly rural roads, storage, processing and marketing facilities will therefore be required to support the anticipated growth in agricultural production and rural development. Improvements in communication and road services imply capital gains for these poor farmers (Jacoby, 2000).

Furthermore, a research conducted by Lyngby (2008), in Nicaragua; Latin America stated that, rural roads access has some influence on household consumption. For example, the impact of distance to main road on household consumption is positive and highly significant. In addition to this, nearness and availability of rural road facilitate the adoption rates and intensive use of resources and hence intensity of adoption decision would be significantly and positively related with agricultural intensification activities.

4.6. Production of Teff and Maize Before and After Rural Infrastructures and Institutions Development in the Study Areas

Research in Asia found that in villages with better access to rural infrastructures and institutions, fertilizer costs were 14 percent lower, wages were 12 percent higher and crop output was 32 percent higher (IFPRI,1990).

Table 4.7 Comparison of Productivity of Teff and Maize Before and After Rural Infrastructures and Institutions Development in the Study Areas

Tabias	Crops	Productivity before & after infrastructures & institutions provision	N	Minimum quintals per hectare	Maximum quintals per hectare	Mean	Standard deviation	X^2 Value
Selam	Teff	Before	32	10	16	11.41	1.701	0.025***
		After		18	29	22.34	2.881	
	Maize	Before		12	18	14.84	1.706	0.027***
		After		22	36	28.13	3.791	
Adigidad	Teff	Before	33	6	9	7.3333	0.69222	0.006**
		After		12	16	14.6364	1.05529	
	Maize	Before		6	10	7.8182	1.01411	0.006**
		After		11	18	13.3030	1.89547	
May-Timket	Teff	Before	34	3	6	4.4706	0.82518	0.000*
		After		5	10	7.8529	1.10460	
	Maize	Before		4	7	5.3235	0.68404	0.295
		After		7	11	9.4118	1.04787	

*Significant at p<0.000; ** p<0.001; ***p<0.05

Source: *Self-Compiled* 2013/14

As shown in Table 4.7, the yield in Teff in TabiaSelam before and after rural infrastructures and institutions development shows significant increase in productivity ($P < 0.05$). Provision of rural infrastructures and institutions in the three Tabias showed significant increase in Teff and Maize yield except at May-Timket where maize yield didn't change significantly. This could be due to less access of the improved varieties and lack of technical support from experts. Additionally, this Tabia (May-Timket) has less development (provision) of rural infrastructures and institutions compare with the rest two Tabias and this Tabia has far to market (Shire-Indaslassie). Consequently, this Tabia has a little

access to different agricultural inputs compare with rest Tabias. This corresponds with the finding of Adeoye et al., (2011) who stated that better access to various infrastructural facilities provided and they were found to be significantly in a number of areas, including agricultural production, household incomes and health. Furthermore, the change in production of Maize in Tabia May-Timket was not significant probably due to the fact that the coverage of rural infrastructures and institutions is limited compare to other study areas (Tabias). But, the overall result clearly demonstrates that after access to rural infrastructures and institution the production and productivity showed a significant change. Generally, after access to rural infrastructures and institutions production of Teff and Maize shows a significant change in the study areas so, the null hypothesis is rejected.

4.7. Perception of the Farmers on the Contribution (Role) of Rural Infrastructures and Institutions on Changing Major Agricultural Production of (Teff and Maize) in the Study Areas

As the information obtained from focus-group discussion, the respondents said that rural infrastructures and institutions have a great importance on their livelihood and different agricultural activities.

Those farmers who are illiterate and have less exposure to society and institutions may not easily consider management practices compared with literate farmers (Mehta and Killert, 1998; Rauniyar, 1998).

Table 4.8 Perception of the Farmers on the Contribution (Role) of Rural Infrastructures and Institutions on Changing Major Agricultural Production in the Study Areas.

Total variance explained Tabia Selam						
Component	Initial Eigenvalues			Kaiser-Meyer-Olkin and Bartlett's Test		
	Total	% of Variance	Cumulative %	KMO Measure of Sampling Adequacy	Bartlett's Test of Sphericity	Sig
1. Road	2.599	37.130	37.130	0.699	48.171	0.001
2. FTCs	1.321	18.872	56.002			
3. M.coop	0.964	13.767	69.770			
4.Veterinary	0.893	12.761	82.531			
5.School	0.550	7.861	90.392			
6.Healthex	0.401	5.726	96.118			
7.Market	0.272	3.882	100.000			
Tabia Adigidad						
Component	Initial Eigenvalues			Kaiser-Meyer-Olkin and Bartlett's Test		
	Total	% of Variance	Cumulative %	KMO Measure of Sampling Adequacy	Bartlett's Test of Sphericity	Sig
1.M.coop	2.181	31.162	31.162	0.601	39.161	0.009
2.FTCs	1.584	22.624	53.786			
3.Healthex	0.978	13.969	67.755			
4.Road	0.757	10.820	78.575			
5.Veterinary	0.741	10.583	89.159			
6.School	0.465	6.650	95.808			
7.Market	0.293	4.192	100.000			

Tabia May-Timket						
component	Initial Eigenvalues			Kaiser-Meyer-Olkin and Bartlett's Test		
	Total	% of Variance	Cumulative %	KMO Measure of Sampling Adequacy	Bartlett's Test of Sphericity	Sig
1.FTCs	3.131	44.724	44.724	0.758	86.695	0.000
2.M.coop	1.274	18.203	62.928			
3.Healthex	0.916	13.083	76.010			
4.Veterinary	0.742	10.602	86.612			
5.School	0.535	7.636	94.248			
6.Market	0.254	3.630	97.878			
7.Road	0.149	2.122	100.000			
Extraction Method: Principal Component Analysis.						

Source: *self-Compiled* 2013/14

Table 4.8 illustrates that, percentage of production of major crops (Teff and Maize) variation explained by of the institutional and infrastructure factors. It means that, in Tabia Selam road alone explains 37% of production variation followed by FTCs which accounts 18.8%. Two of the variables all together explain 56% of agricultural production while and also in Tabia Adigidad multi-purpose cooperative alone explains 31% of production variation followed by FTCs which accounts 22% jointly explains 53% of agricultural production. Furthermore, in Tabia May-Timket FTCs explains 44% of production variation followed by multi-purpose cooperative which scores 18 % both of the variables explains 62 % of agricultural production. The extracted component explains nearly 62% of the variability in the original 7 variables, so the complexity of the data set by using these components with only 18% loss of information. Generally, the threshold value is 0.70. KMO value > 0.70 implies that the variables have 70% in common to justify a factorial analysis following Kaiser approach.

Rural roads have been considered very important and play significant role in poverty reduction, rural development through linking rural farming to market, improve their productivity and increase income level this finding is in line with Oraboune, 2008; Gilberto, 2011). Furthermore, rural road play a crucial role in increment of agricultural production as well as in improving the living standard of villagers summary report of (Anderson et al., 1982). Generally, Ashagidigbi et al., (2011) reported that, rural infrastructures and institutions have played a significant role in agricultural production and livelihood of farmers.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

This chapter presents the conclusions drawn based on the findings obtained in the analysis and discussion part. The recommendation guided by the research finding is also part of this chapter.

5.1. Conclusion

The distribution (coverage) and distance to rural infrastructures and institutions in the study areas (Tabias) is differ as a result, the production and productivity of (major crops) is also differ. The overall result of this study implies rural infrastructures and institutions were a connection point for agricultural intensification and development of the society as well as the country.

The other important conclusion that can be drawn from this study is that, improving access to rural infrastructures and institutions can increase the opportunity of households to agricultural intensification activities (agricultural productivity). Generally, before and after establishment of rural infrastractures and institutions farmers in Tabia Selam have got an average production 11.41 and 22.34 qu/ha respectively. For Maize, 14.84 and 28.13 qu/ha is registered in this Tabia before and after respectively.in Tabia Adigidad before and aftrer establishment of rural infrastractures and institutions farmers have harvested an average production of Teff 7.3 and 14.6 qu/ha respectively while 7.8 and 13.3 qu/ha production of Maize is produced respectively. Furthrmore, in Tabia May-Timket before and after establishment of rural infrastractures and institutions farmers have produced 4.4 and 7.8 qu/ha of Teff; and 5.3 and 9.4 qu/ha production of Maize respectively. In addition to this, after establishment of rural infrastractures and institutions major crops show a significantly change at ($p< 0.005$).

5.2. Recommendation

Based on the findings of this study, the following recommendations are forwarded:

- Based on the findings of this study, it is recommended that, distribution of rural infrastructures and institutions in the study areas (Tabias) are varies. As a result, the production is also varying. Thus, policy makers, governmental and non-governmental organizations must consider on balance of distribution of rural infrastructures and institutions.
- Rural infrastructures and institutions has play a great role in agricultural intensification activities and productivity but, distance to rural infrastructures and institutions have its own negative effect on agricultural intensification activities and productivity so, the government should be consider on development (expansion) of rural infrastructures and institutions.
- Special attention or intervention on monitoring and evaluation of rural infrastructures and institutions should be the most critical one.
- Finally, the above recommendations have indicated for 3 selected Tabias (study areas) but there are not represent the rest Tabias of the Woreda so; further socio-economic research should be done by other researchers.

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Appendix

MEKELLE UNIVERSITY

COLLEGE OF SOCIAL SCIENCE AND LANGUGES

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

SPECIALIZATION GIS AND REMOTE SENSING

QUESTIONNAIRE: To be filled by Respondents

A survey questionnaire to study "*Role of Rural Infrastructures and Institutions on Agricultural Intensification of Major Crops (Teff and Maize)"*

The objective of this questionnaire is to seek data on role of rural infrastructures and institutions on agricultural intensification of Teff and Maize, and is prepared by a post graduate student in Mekelle University.

Your response to this questionnaire will serve as source of information to the research paper which is to be done for the partial fulfillment of Master Science of degree in geography and environmental studies: Specialization in GIS and remote sensing in Mekelle University.

Dear respondents, any response you provide here is strictly confidential and will be used only for academic purpose. And your honesty in responding the right answer is vital for the research outcome to be reliable.

Therefore, I would be very grateful if you could complete the following questions honestly and sincerely.

Kindly I want to thank you for your full support and patience in advance.

<u>General Instructions</u>

1) Writing your name is optional.
2) Before you attempt to answer, please read the instructions.
3) Then read each question which requires responses from you and give your answer according to the instructions given on each category.
4) If you have any question, please try to ask the enumerator.
5) You can choose multiple answers by ranking where necessary.

Thank you in advance

Questionnaire

Role of Rural Infrastructure and Institutions on Agricultural Intensifications

Region	Zone	Woreda	Kebele /Kushet	Name of the Tabia
Date of survey(Ethiopian calendar)			-------/--------/-------- (dd/mm/yy)	

Part one: Demographic Characteristics

1. Respondent's sex □ Male □ Female			
2. Education □ Illiterate □ read and write □ elementary school □ high school□ college□ university			
3. Occupation Major			
Minor			
4. Tabia □ May dimu □ May Liham □ Adi gidad			
5. Marital status			
□ Single □ Married □ Divorce □ Widow/er □ Separated □ Other			
6. Respondent's relationship to the head of household			
□ Head of HH □ Husband/Wife □ Son □ Daughter □ Extended family □ sex of the household			
7. Respondent's age			
□ Less than 18 □ 19-29 □ 30-44 □ 45-64 □ Above 64			
8. Family size by age, including respondents (number of each)			
Age	Male	Female	Total
Under 5			
5-18			
19-64			
Above 64			
Total			

Part two: Rural infrastructures

1. What types of rural infrastructure are available in your Tabias?

Tabia ……	Infrastructure	Yes	No	Distance from residence (in Km)
	Road			
	School			
	Market			
	Multipurpose cooperative			
	FTCs			
	Extension organization			
	Veterinary service			

2. Is the distance of rural infrastructure influence on your production? □ Yes □ No, if yes mention the reason?

Infrastructure	Yes	No	Reason (if the answer is < Yes>)	Rank
Road			Failure to avail products on time	
			unavailability of input on time	
			Exposed to unnecessary costs	
Market			lack of current market information	
			Failure to avail products on time	
			Exposed to unnecessary costs	
FTCs			lack of timely training	
			lack of support and supervision of experts	
			lack of improved technology on time	
Veterinary service			lack of availability of livestock medicine on time	
			lack of support and supervision of experts	
			lack of improved technology on time (animal breed)	
Health extension			lack of support and supervision of experts	
			Exposed to unnecessary costs	
			Lack of productive man power	
School			lack of productive man power (skilled man power)	
			Exposed tom unnecessary costs	
			wastage of time and energy	

3. Which type of rural infrastructure plays a great role in your livelihood?

Rural infrastructures	Rank
Road	
Market	
Extension organization	
FTCs	
Veterinary service	
Health extension	
School	
Other	

6. Do you think that there are problems facing because of absence or distance of rural infrastructures and institutions in your production? Yes □ No □

7. If your answer to question number 7 is yes, please list these problems in their order of severity (from very sever to less sever) and their impact?

Rural infrastructure	Yes	No	List of the problems	Rank
Road			Reduction in production	
			Lack of access to input	
			Lack of market	
			lack of information & expert support	
Market			Reduction in production	
			Lack of access to input	
			lack of demand in products due to absence of market place	
			lack of information & expert support	
FTCs			reduction in production	
			lack of access to input	
			lack of market to product	
			lack of information & expert support in the field	
Veterinary service			reduction in production	
			lack of access to input &improved breed	
			lack of demand in products (animal production)	
			lack of information & expert support in the field	
Health extension			lack of active man power	
			wastage of time and energy	
School			lack of educated man power	
			wastage of time and energy	

4. How much quintal per hectare of Teff and Maize you get before and after access to rural infrastructure?

Rural infrastructure	Production per hectare of Teff in quintal		Production per hectare of Maize in quintal	
	Before access	After access	Before access	After access
Quintal per hectare				

5. How do you perceive contribution (role) of rural infrastructures and institutions on productivity and agricultural intensification activities?

Rural infrastructures and institutions related questions	Agricultural intensifications (scale) 1-5				
	Strongly agree (1)	Agree (2)	Indifferent (3)	Dis agree (4)	Strongly dis agree (5)
1. Provision of rural road has a positive effect on agricultural intensification and productivity of major crops?					
2. Provision of rural market has a positive effect on agricultural intensification productivity of major crops?					
3. Provision of rural FTCs has a positive effect on agricultural intensification and productivity of major crops?					
4. Provision of rural veterinary service has a positive effect on productivity of major crops?					
5. Provision of Multipurpose farmers cooperative has a positive effect on agricultural intensification and productivity of major crops?					
6. Provision rural health extension has a positive effect on agricultural intensification and productivity of major crops?					
7. Provision of rural school has a positive effect on agricultural intensification productivity of major crops?					

Part four: Crop production

1. What was the source and quality of improved varieties of seeds? □ Farmer to farmer □ From market □ From cooperatives (union) □ from government others □
2. Did you produce enough food (crops) to feed your family throughout the year? □ Yes □ No if not, what are the reasons? □ Shortage of farmland □ Shortage of rain □ Shortage of oxen □ Shortage of labor □ Shortage of fertilizer □ All of the above
3. How much is the positive impact of the rural infrastructures on your crop production?

Item	Very high(5)	High(4)	Moderate (3)	Low (2)	Very low (1)
Increase in Sales					
Access to input					
Reduction in cost					
If others, please specify					

4. The demand for your product is

   Increasing □ About the same □ Declining □

5. If the demand for your product is either about the same or declining, what reasons can you specify?

Part seven. Attitude, perception and Knowledge

7.1. Attitude towards rural infrastructure, institutions and agricultural intensification

No	Questions	Yes	No
1.	Rural infrastructure and institution play a big role in increasing agricultural productivity?		
2.	Rural infrastructure and institution helps to increase the income of farmers?		
3.	It is easy to use the service of rural infrastructure and institutions by the farmers?		
4.	Rural infrastructure and institutions play a big role in improving the living standard of farmers?		
5.	Rural infrastructure and institutions have a positive impact on your production?		
6.	Agricultural intensification activities playing a crucial role in increase your production?		
7.	Agricultural intensification activities are important to introduce farmers with new technologies?		
8.	Agricultural intensification activities in your Tabias are adequate?		

Suggestion

Please add your suggestion that you thought to be relevant for the sub-sector and the involvement of government for support services.

_____
_____
_____

I appreciate the efforts you have put in completing this questionnaire

Thank you!!!

Year of Establishment of Rural Infrastructures and Institutions in the Study Areas

Infrastructures & institutions	Tabias		
	Selam	Adigidad	May timket
	year of establishment	year of establishment	year of establishment
Road *	1964	1964/65	-
School **	1964/89/98/99	1984/95/99/	1996/99
Market	-	-	-
Health extension ***	98	97	97
FTCs ***	96	97	97
Multipurpose cooperative ***	97	97	97
Veterinary service ***	96	97	97

Source: * (Focus-group discussion, 2013)

Source: ** (Bureau of education Woreda Tahtay-Koraro, 2013)

Source: *** (BoARD, Woreda Tahtay-Koraro, 2013)

Fertilizer Application in the Study Areas in 2013

Crops	Tabias								
	Selam			Adigidad			May-Timket		
	Urea /qu	DAP /qu	Total	Urea/qu	DAP /qu	Total	Urea /qu	DAP /qu	Total
Teff	440	540	980	449	449	898	360	370	730
Maize	315	400	715	260	260	520	130	120	250

Source: (BoARD, Woreda Tahtay-Koraro, 2013)

Results of PCA analysis

PCA Analysis of Tabia Selam

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.699
Bartlett's Test of Sphericity	Approx. Chi-Square	48.171
	Df	21
	Sig.	.001

Total variance explained

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative
1	2.599	37.130	37.130
2	1.321	18.872	56.002
3	.964	13.767	69.770
4	.893	12.761	82.531
5	.550	7.861	90.392
6	.401	5.726	96.118
7	.272	3.882	100.000

Extraction Method: Principal Component Analysis.

Alternatives
Rural road has a positive effect on the change of productivity of major crops.
FTCs has a positive effect on the change of productivity of major crops.
Multipurpose cooperative has a positive effect on the change of productivity of major crops.
Veterinary service has a positive effect on the change of productivity of major crops.
Rural school has a positive effect on the change of productivity of major crops.
Rural health extension has a positive effect on the change productivity of major crops.
Rural market has a positive effect on productivity of major crops.

PCA Analysis of Tabia Adigidad

KMO and Bartlett's Test[a]

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.601
Bartlett's Test of Sphericity	Approx. Chi-Square	39.161
	Df	21
	Sig.	.009

Total variance explained

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative
1	2.181	31.162	31.162
2	1.584	22.624	53.786
3	.978	13.969	67.755
4	.757	10.820	78.575
5	.741	10.583	89.159
6	.465	6.650	95.808
7	.293	4.192	100.000

Extraction Method: Principal Component Analysis.

Alternatives
Multipurpose cooperative has a positive effect on the change of productivity of major crops.
Rural FTCs has a positive effect on the change of productivity of major crops.
Rural health extension has a positive effect on the change of productivity of major crops.
Rural road has a positive effect on the change of productivity of major crops.
Veterinary service has a positive effect on the change of productivity of major crops.
Rural school extension has a positive effect on the change productivity of major crops.
Rural market has a positive effect on productivity of major crops.

PCA Analysis of Tabia May-Timket

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.758
Bartlett's Test of Sphericity	Approx. Chi-Square	86.695
	Df	21
	Sig.	.000

Total variance explained			
Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative
1	3.131	44.724	44.724
2	1.274	18.203	62.928
3	.916	13.083	76.010
4	.742	10.602	86.612
5	.535	7.636	94.248
6	.254	3.630	97.878
7	.149	2.122	100.000
Extraction Method: Principal Component Analysis.			

Alternatives
Rural FTCs has a positive effect on the change of productivity of major crops.
Multipurpose cooperative has a positive effect on the change of productivity of major crops.
Rural health extension has a positive effect on the change of productivity of major crops.
Veterinary service has a positive effect on the change of productivity of major crops.
Rural school has a positive effect on the change of productivity of major crops.
Rural market extension has a positive effect on the change productivity of major crops.
Rural road has a positive effect on productivity of major crops.