



SCHOOL OF GRADUATE STUDIES

THE ROLE OF ROAD TRANSPORT SERVICES ON SMALL-HOLDER
FARMERS' AGRICULTURAL PRODUCTIVITY IN CASE OF
ABESHIGEWOREDA GURAGE ZONE, CENTRAL ETHIOPIA

MA THESIS

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The Role Of Road Transport Services On Small-Holder Farmers' Agricultural Productivityin Case Of Abeshigeworeda Gurage Zone, Central Ethiopia

A Thesis Submitted to the School Of Graduate Studiesas,In Partial Fulfillment Of Requermrnt For the degree of Masters In Development Studies.

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We hereby certify that we have read and evaluate this thesis titled the role of road transport services on small-holder farmers’ agricultural productivity in case of Abeshige Woreda Gurage Zone, Central Ethiopia ” prepared under our guidance by Tamiru Berafe(Asst. prof) and Yoseph Yonas (PhD). We recommend that the thesis shall be submitted as fulfilling the requirements for the award of Ma. Degree in Governance and Development Studies

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ACRONMY AND ABBREVIATION

ADLI	Agricultural Development Led Industrialization
AIE	Agro Industrial Economy
CETR	Central Ethiopia Region
ESS	Ethiopian Statistical Service
FDRE	Federal Democratic Republic of Ethiopia.
GDP	Gross Domestic Product
HH	Household
IMF	International Monetary Fund
MoFEC	Ministry of Finance Economic Cooptation
NGO	Non-Government Organization.
OLS	Ordinary Least Square
SDG	Sustainable Development Goal
SNNP	South Nation Nationality and People
US	United State

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ABSTRACT

Agriculture plays a vital role in Ethiopia's economy, with road transport services significantly influencing the transition from subsistence to commercial agricultural production. This study examines the impact of road transport services on the agricultural productivity of smallholder farmers in Abeshige Woreda, Gurage Zone, Ethiopia. Using a mixed-method research design, data were collected from 195 households through structured questionnaires and analyzed using descriptive and econometric methods. Findings reveal that transport infrastructure, road quality, and accessibility are critical factors in improving agricultural productivity. Only 23.59% of the roads in the study area are asphalted, and 45% of transport services are accessible to farmers, leading to challenges in transporting agricultural inputs and outputs. Respondents indicated that poor transport access increases transaction costs and limits market participation, with 72.31% reporting high transport costs as a significant constraint. The study used Ordinary Least Squares (OLS) regression to evaluate the influence of explanatory variables such as income level, landholding size, cost of inputs, and road accessibility. Key findings highlight that better road quality and accessibility positively impact agricultural productivity, allowing farmers to reduce transaction costs, access timely market information, and adopt market-oriented practices. Conversely, long distances to markets and high input costs negatively affect productivity. The study concludes that improving transport infrastructure and reducing transport costs can enhance smallholder farmers' productivity, ensuring better livelihoods. Recommendations include investing in road development, ensuring timely road maintenance, and enhancing market accessibility to foster sustainable agricultural growth.

Key Words: Agricultural productivity, Gurage Zone, OLS estimation, Road, Smallholder, Transport service

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the Study

Although agriculture is the foundation of economic progress in developing nations like Ethiopia, the agricultural system is subpar. Numerous auxiliary rural infrastructure facilities are necessary for the overall growth of agriculture. The mobility of people, the gathering and exchange of goods and services, the spread of knowledge, and the development of the rural economy are all facilitated by efficient and effective rural transportation. It is also evident that the degree and caliber of rural development are often greatly influenced by the growth of rural infrastructure. Higher and higher-quality rural development has been observed in nations that have improved their rural infrastructure (Adedeji *et al.*, 2014).

The entire development effort may be hampered by inaccessibility or bad road conditions, which are obstacles to trade, industry, and agriculture. Rural communities typically benefit from improved rural road quality. It is anticipated that these improvements will improve their access to markets, jobs, and social services, raising their level of living. Better service availability is the primary source of the economic benefits of better road accessibility. The cost of transportation and agricultural inputs is reduced when there are plenty of roads. Increasing the timely availability of inputs can lead to increased agricultural productivity (Welling, 2022).

Rural road infrastructure has received policy attention from the Ethiopian government. Therefore, estimating the impact of rural road accessibility on the nation's smallholder farmers' commercialization is the study's goal. According to the study's findings, 19% of homes in villages have access to all-weather roads, compared to their peers' 16 percent. More intriguingly, the results indicate that commercialization is positively and significantly impacted by the mode of transportation utilized for agricultural reasons. According to (Mekonnen *et al.*, 2017), findings showed that the degree of commercialization was 17 percentage points higher for farmers who used modern modes of transportation than for those who did not. Therefore, rural transport infrastructure

development that meets the access and mobility needs of rural people is necessary to integrate remote areas with urban centers.

Furthermore, through boosting agricultural productivity and guaranteeing food security, raising agricultural production is crucial to reaching the Sustainable Development Goals (SDGs) and ending poverty. This contributes to the accomplishment of the Sustainable Development Goals, which were agreed upon by world leaders in 2030 and which state that eradicating extreme poverty and hunger should be the top priorities (Necas & Moldan, 2019).

In agriculture-based economies, expanding access to rural transportation infrastructure can therefore be a key component of a plan to increase long-term agricultural yield and productivity. It is commonly acknowledged that transportation plays a significant role in the global expansion of agriculture. However, in most parts of the world, there aren't many possibilities for rural transportation (Soseco, 2016).

In addition to connecting rural areas, roads also had an impact on cropping patterns by facilitating market access, increasing productivity by making inputs like seeds, fertilizer, and pesticides more readily available, enabling farmers to realize better prices for agricultural and related products like milk, boosting school enrollment, and, most importantly, creating new job alternatives in non-farm and service sectors (Sangwan S S, 2010).

Low agricultural production among Ethiopia's smallholder farmers is sometimes attributed to a lack of access to rural transportation infrastructure. To boost agricultural productivity, smallholder farmers should have access to information about input and output market participation, farmer cooperative associations, and rural transportation services. Given the transportation expenses that smallholder farmers, and rural women in particular, incur, more attention has to be paid to interventions in intermediate modes of transportation and other load-reducing methods. Therefore, as a form of indigenous knowledge system, more rural road development, better rural transportation services, and farm labor exchange agreements are needed to address this critical issue (Tamene, 2020).

Delivery of agricultural supplies and extension services, as well as the evacuation and selling of agricultural goods, depend on rural transportation. Additionally, it increases

output, boosts earnings, and facilitates the diffusion of innovation. Better transportation promotes access to essential amenities and cuts down on travel time, freeing up more time for social and economic activities. While the value of farm productivity is observed to grow with road quality, transportation service frequency, and proximity to commercial hubs, households in rural locations have been linked to lower levels of consumption expenditure (Olukotun, 2007).

Poverty and poor road accessibility in rural locations are closely related; isolated people are unable to take advantage of the social and economic possibilities available in a larger geographic area. Additionally, it makes it more difficult for households to move about and get inputs and market their produce. The consequences of poverty and disadvantage are frequently exacerbated by such inadequate physical accessibility. In 105 nations, 85 percent of the poor (as determined by the Multidimensional Poverty Index) live in rural areas, and this trend of higher incidence and severity of poverty in rural compared to urban areas is constant throughout all developing world regions. Therefore, the majority of people living in extreme poverty reside in rural areas. Therefore, it is imperative that transportation infrastructure, especially rural roads, be improved (Alkire *et al.*, 2014).

Improvement of rural roads and transportation access will improve the smallholder farmer's agricultural productivity. Improve transport access for farmers who use large distances or far from major markets and improve the Price and availability of crops, road status, and improvement of transport access will improve the level of agricultural output. It implies that recent investments in road infrastructure encourage smallholder farmers in rural areas to participate in markets and increase agricultural productivity. Additionally, because the road construction took place in more remote places, it suggests that the investment had a pro-poor effect (Philemon *et al.*, 2018).

1.2. Statement of the Problem

The role of road transport services in enhancing agricultural productivity has been widely recognized, particularly in rural areas of developing nations like Ethiopia. However, the existing body of knowledge exhibits significant gaps and limitations. Poor road access remains a critical barrier to smallholder farmers' productivity, as it limits their ability to access markets, healthcare, and educational facilities, while also increasing transportation costs. Studies, such as Lindsay (2015), emphasize that poor and

inadequate rural roads force smallholder farmers to rely heavily on manual transportation, resulting in high transaction costs and low economic competitiveness.

Furthermore, persistent infrastructure challenges hinder the spread of new technologies, restrict access to essential services, and exacerbate socio-economic inequalities, particularly for women (Muleta & Deressa, 2014). Existing research, such as Guidi (2011), highlights that excessive transportation and marketing costs prevent smallholder farmers from participating effectively in markets, while Porter (2007) notes the negative correlation between poor road accessibility and farmers' standard of living. Despite these insights, most studies have not adequately explored the interplay between road quality, transport services, and their direct impact on smallholder farmers' agricultural productivity.

Previous studies have predominantly focused on practical societal issues rather than addressing scientific knowledge gaps. For instance, research by Chowdhury et al. (2005) and the World Bank (2009) identifies rural transport as essential for achieving development goals but fails to incorporate comprehensive econometric analyses to understand its relationship with agricultural output. Similarly, Edris Hussein (2016) and Mahesha (2017) examined specific crops but neglected key variables such as food security and theoretical modeling.

This study addresses these gaps by employing a theoretical framework and using econometric methods to analyze the relationship between road transport services and agricultural productivity. It focuses on smallholder farmers in Abeshige Woreda, Gurage Zone, aiming to uncover how road infrastructure impacts crop production, household income, and market access. The findings will contribute to bridging the existing knowledge gap, providing empirical evidence for targeted policy interventions.

1.3. Objectives of the Study

1.3.1. General Objective

- To examine the role of road transport services on smallholder farmers' agricultural productivity in Abeshige Woreda, Gurage Zone, and Central Ethiopia.

1.3.2. Specific Objectives

1. To analyze the impact of road transport accessibility and quality on smallholder farmers' agricultural productivity.
2. To assess the contribution of transport services in enhancing smallholder farmers' access to input and output markets.
3. To identify the key constraints faced by smallholder farmers in utilizing road transport services for agricultural activities.
4. To evaluate the relationship between transportation costs and smallholder farmers' market participation.

1.4. Research Questions

- How does the accessibility and quality of road transport influence the agricultural productivity of smallholder farmers?
- To what extent do transport services contribute to smallholder farmers' access to input and output markets?
- What are the primary challenges faced by smallholder farmers in accessing and utilizing road transport services?
- How do transportation costs affect the level of market participation among smallholder farmers?

1.5. Significance of the study

The study on the role of road transport services in smallholder farmers' agricultural productivity in Abeshige Woreda, Gurage Zone, Central Ethiopia, holds significant value from various perspectives. From an academic standpoint, it fills critical knowledge gaps by exploring the relationship between road infrastructure and agricultural productivity in a specific regional context, offering localized insights that can contribute to broader comparative studies. Policymakers can also benefit from the findings, as they provide evidence-based recommendations for prioritizing investments in road transport infrastructure to enhance rural development and agricultural growth. This can lead to informed decisions and tailored interventions addressing the unique challenges faced by smallholder farmers.

From a community development perspective, the study emphasizes the empowerment of farmers through improved market access and connectivity, fostering better livelihoods and reducing poverty. Enhanced transport services not only support agricultural activities but also improve access to essential services like education and healthcare, further contributing to rural transformation. On a practical level, better road transport reduces the costs of agricultural inputs, minimizes post-harvest losses, and integrates farmers more effectively into value chains, ultimately boosting productivity and income.

Moreover, the findings have global relevance, as they can serve as a model for other regions with similar rural challenges in developing countries. The study's implications align with global goals, including Sustainable Development Goals (SDGs) such as No Poverty (SDG 1), Zero Hunger (SDG 2), and Industry, Innovation, and Infrastructure (SDG 9). In conclusion, this study is significant as it highlights the transformative potential of road transport services in addressing key challenges in agricultural productivity, rural development, and poverty alleviation, both locally and globally.

1.6. Scope of the Study

The scope of the study on the role of road transport services in smallholder farmers' agricultural productivity in Abeshige Woreda, Gurage Zone, Central Ethiopia, encompasses thematic, geographical, temporal, and methodological dimensions.

Thematically, the study focuses on understanding how road transport services impact smallholder farmers' agricultural productivity. This includes analyzing aspects such as access to markets, availability of agricultural inputs, reduction of post-harvest losses, and integration into regional value chains. It also explores the challenges faced by smallholder farmers due to inadequate transport infrastructure and identifies potential solutions to enhance productivity.

Geographically, the study is confined to Abeshige Woreda, located in the Gurage Zone of Central Ethiopia. This specific area was selected for its relevance to rural agriculture and the significant role road transport services play in connecting farmers to markets and essential resources. The study aims to generate findings that reflect the unique conditions of this region while offering insights applicable to similar rural settings in Ethiopia and beyond.

Temporally, the study spans a two-year period, conducted from 2023 to the end of 2024. This timeframe allows for a comprehensive analysis of seasonal variations in agricultural activities, transport challenges, and productivity outcomes, ensuring a thorough understanding of the dynamic relationship between road infrastructure and agricultural performance over time.

Methodologically, the study adopts a mixed-methods approach, combining both qualitative and quantitative research methods. Data collection includes surveys and interviews with smallholder farmers, local officials, and stakeholders in the agricultural and transport sectors. It also involves an analysis of secondary data, such as transport infrastructure development plans and agricultural productivity reports, to support the findings. This methodological approach ensures the study captures both numerical trends and the lived experiences of the farming community.

In summary, the scope of this study is well-defined, focusing on the thematic relevance of road transport services, the geographical context of Abeshige Woreda, the temporal coverage from 2023 to 2024, and a mixed-methods research approach, all designed to provide a comprehensive understanding of the topic.

1.7. Limitation of the Study

This study used a cross-sectional research design, however, it is better to use a longitudinal (time series) or panel study design by selecting the most productive rural zone like Abeshige woreda around the country level and examine the trend analysis of rural road transport service impact on smallholders farmers farm productivity in different period and also budget deficit, lack of internet access and lack of written documents were the few limitations from the vast.

1.8. Organization of the Paper

This study was organized in to five chapter. The introduction is covered in the first chapter, and a literature review is given in the second. The study area description, research technique, and data used are covered in the third chapter. Results and discussion are presented in the fourth chapter. The study's summary, results, and suggestions are finally presented in chapter five.

1.9. Operational Definition of Key Terms

1. **Age:** The respondents' age influences productivity; younger farmers are generally more productive and engage more actively in output markets compared to older farmers.
2. **Sex:** A categorical variable; male-headed households are generally more productive than female-headed ones, based on studies.
3. **Education:** Higher levels of education enhance farmers' skills, use of inputs, adoption of technologies, and access to market information, positively impacting productivity.
4. **Farm Size:** A continuous variable measured in tsimad (1 tsimad = 1/4 hectare); larger farm sizes are associated with higher agricultural productivity.
5. **Rainfall:** Seasonal rainfall, whether sufficient or insufficient, negatively or positively affects agricultural productivity.
6. **Credit Accessibility:** Access to financial services enables farmers to enhance productivity, but misuse of credit may lead to negative outcomes.
7. **Crop Production:** Annual agricultural output positively correlates with productivity.
8. **Farming Experience:** Older farmers have more experience but are generally less productive due to reduced physical activity compared to younger farmers.
9. **Distance:** Proximity to roads affects farmers' ability to benefit from transport infrastructure and access markets.
10. **Transport Cost:** Higher transportation costs due to distance, poor road conditions, or inefficient transport modes negatively impact productivity.
11. **Food Security:** Availability of food from high-production areas to high-demand areas ensures consumption needs are met, improving nutrient quality.
12. **Tsimad:** A local unit of land measurement; 1 hectare equals 4 tsimad

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Theoretical Literature Review

Agricultural development is influenced by a myriad of factors, with transportation being a critical one. Transportation serves as the primary mechanism for moving agricultural products from farms to households, markets, and distribution centers. It not only facilitates the creation of markets for agricultural products but also strengthens connectivity between economic and geographic regions, fostering economic integration and concentration (Tunde et al., 2012). Rural transportation networks, particularly roads, play an essential role in socioeconomic growth by enabling access to transportation services, which directly affects agricultural production, economic activities, and social development.

Over the past two decades, surveys have consistently highlighted the importance of rural roads in providing access to medical facilities and emergency services, as perceived by rural populations (Bryceson et al., 2006). In Ethiopia, rural roads are deemed essential for improving access to emergency services, especially in remote areas where people must rely on vehicles or stretchers during critical situations (Fredu et al., 2016). Access to medical facilities via rural roads is thus crucial in addressing life-threatening emergencies.

Effective transportation systems are indispensable for connecting remote agricultural areas to consumer markets. Rural communities require significant investments in transportation infrastructure to sustain economic and social development (Kumi et al., 2013). Increasing food security has been a persistent challenge in developing nations, and transportation has played a pivotal role in addressing this issue by enabling the production and export of surplus goods, thereby generating foreign exchange (Alemayehu, 2011). To enhance food security and economic growth, Ethiopia introduced agricultural development policies in 2003, emphasizing market-oriented production systems and sustainable practices among small-scale producers.

Road infrastructure has a profound impact on the social and economic well-being of rural areas. Improved road networks elevate the socioeconomic status of rural communities, enhance living conditions, and boost agricultural productivity. For instance, India's Rural Infrastructure Development Fund prioritized rural road construction to support agriculture, stimulate rural sector development, and improve living standards for impoverished communities (Loksha et al., 2017).

Inadequate rural road infrastructure, coupled with limited transportation services, increases costs and restricts access to agricultural inputs. Poor infrastructure, geographic isolation, and high transportation costs can negate the benefits of crop intensification practices, thereby limiting the productivity and marketability of agricultural goods (Delaney et al., 2017).

2.1.1. Role of Transportation in Agricultural Development

Agricultural development is influenced by a myriad of factors, with transportation being a critical one. Transportation serves as the primary mechanism for moving agricultural products from farms to households, markets, and distribution centers. It not only facilitates the creation of markets for agricultural products but also strengthens connectivity between economic and geographic regions, fostering economic integration and concentration (Tunde et al., 2012). Rural transportation networks, particularly roads, play an essential role in socioeconomic growth by enabling access to transportation services, which directly affects agricultural production, economic activities, and social development.

2.1.2. Importance of Rural Roads in Socioeconomic Growth

Surveys over the past two decades have consistently highlighted the importance of rural roads in providing access to medical facilities and emergency services, as perceived by rural populations (Bryceson et al., 2006). In Ethiopia, rural roads are deemed essential for improving access to emergency services, especially in remote areas where people must rely on vehicles or stretchers during critical situations (Fredu et al., 2016). Access to medical facilities via rural roads is crucial in addressing life-threatening emergencies.

2.1.3. Transportation Infrastructure and Food Security

Effective transportation systems are indispensable for connecting remote agricultural areas to consumer markets. Rural communities require significant investments in transportation infrastructure to sustain economic and social development (Kumi et al., 2013). Increasing food security has been a persistent challenge in developing nations, and transportation has played a pivotal role in addressing this issue by enabling the production and export of surplus goods, thereby generating foreign exchange (Alemayehu, 2011). To enhance food security and economic growth, Ethiopia introduced agricultural development policies in 2003, emphasizing market-oriented production systems and sustainable practices among small-scale producers.

2.1.4. Impact of Rural Road Infrastructure on Livelihoods

Road infrastructure has a profound impact on the social and economic well-being of rural areas. Improved road networks elevate the socioeconomic status of rural communities, enhance living conditions, and boost agricultural productivity. For instance, India's Rural Infrastructure Development Fund prioritized rural road construction to support agriculture, stimulate rural sector development, and improve living standards for impoverished communities (Loksha et al., 2017).

2.1.5. Challenges of Rural Transportation in Ethiopia

In Ethiopia, inadequate rural road infrastructure and limited transportation services increase costs and restrict access to agricultural inputs. Poor infrastructure, geographic isolation, and high transportation costs can negate the benefits of crop intensification practices, thereby limiting the productivity and marketability of agricultural goods (Delaney et al., 2017). Rural roads in Ethiopia are often poorly constructed and deteriorate during the rainy season, leading to increased transportation costs and reduced accessibility (Kemtsop & Starkey, 2013). Despite progress in road network expansion, sustainability and maintenance in remote areas remain significant challenges (FDRE, 2020; AfDB, 2021).

2.2. Empirical Literature Review

2.2.1. Transportation Infrastructure and Agricultural Productivity

Empirical studies highlight that inadequate transportation infrastructure in Ethiopia's rural areas limits agricultural productivity by lowering farm-gate prices and increasing post-harvest losses (Usman et al., 2013). Policy interventions need to focus on both expanding rural road networks and enhancing the availability of transportation services in remote areas. Similarly, in India, rural infrastructure development—especially road systems—has been a cornerstone for integrating villages into the mainstream economy, facilitating the transportation of goods and services, and boosting agricultural and economic growth (Mahesha et al., 2017).

2.2.2. Impact of Rural Roads on Market Access and Cost Reduction

Rural roads reduce transportation costs, improve market access, and enable smallholder farmers to participate in markets more effectively. For instance, Temane (2020) emphasizes that better rural roads significantly reduce transportation costs, which directly enhances market participation and agricultural productivity. Studies in Ethiopia's Horro Guduru Wollega Zone reveal that proximity to all-weather roads significantly impacts productivity by reducing post-harvest losses and improving market integration. Ownership of intermediate transportation modes further enhances these outcomes (Temane et al., 2017).

2.2.3. Combined Effects of Road Expansion and Extension Services

Research by Gebresilasse (2023) indicates that rural road expansion, when combined with agricultural extension services, increases agricultural productivity by 6%. Improved access to roads and extension services encourages the adoption of modern farming techniques, crop diversification, and efficient labor distribution, highlighting the synergistic impact of these interventions.

2.2.4. Market Integration and Crop Diversification

Market integration, facilitated by rural roads, plays a crucial role in shaping agricultural productivity. According to Kebede (2022), households in remote areas connected to markets via rural roads are more likely to diversify crops and adopt modern farming practices. Improved road connectivity reduces transaction costs and enhances farmers' ability to access inputs and sell outputs, fostering economic growth and productivity.

2.2.5. Smallholder Farmers' Market Participation

Smallholder farmers' market participation depends on infrastructure, socioeconomic, and institutional factors. Studies show that transitioning from subsistence to commercial agriculture requires investments in rural transportation infrastructure and market systems (Osmani & Hossain, 2015). Improved road infrastructure connects farmers to input and output markets, facilitating commercialization and boosting productivity (Gebremedin et al., 2010).

2.2.6. Case Studies of Rural Transportation in Ethiopia

Case studies in Ethiopia illustrate the substantial impact of rural roads on poverty reduction and agricultural productivity. For example, households with road access were 10.4% less likely to remain in poverty between 2012 and 2016, even during drought conditions (Nakamura et al., 2019). Investments in rural road infrastructure yield high returns by reducing transportation costs, improving household consumption, and increasing market access, with internal rates of return ranging from 12% to 35% (Stifel et al., 2013).

2.2.7. Global Comparisons and Lessons for Ethiopia

Globally, transportation infrastructure has been shown to stimulate economic and agricultural growth. For example, in China, investments in transportation systems like high-speed rail have spurred industrial transformation and crop diversification (Yogita, 2021; Wang et al., 2023). Similarly, Ethiopia's rural road projects have demonstrated that improved connectivity leads to better access to agricultural inputs, the adoption of modern farming techniques, and increased agricultural productivity.

2.3. Conceptual Literature and Framework

2.3.1. Conceptual Literature

The relationship between transportation infrastructure and agricultural productivity is grounded in the theory of market accessibility and transaction cost reduction. Efficient transportation systems reduce costs associated with moving goods, improving farmers' access to input and output markets (Usman et al., 2013). Improved rural roads facilitate

access to agricultural inputs such as fertilizers, seeds, and equipment, which are critical for increasing productivity (Mahesha et al., 2017).

Rural road infrastructure also addresses spatial inequalities by connecting remote agricultural areas to urban markets, thereby integrating rural economies into larger economic systems. Studies by Bryceson et al. (2006) and Kumi et al. (2013) emphasize that transportation infrastructure fosters regional economic integration and enhances socioeconomic development by improving market participation and access to essential services like healthcare and education.

Additionally, rural roads are instrumental in reducing poverty. Nakamura et al. (2019) show that rural households with road access have a significantly lower likelihood of remaining in poverty. Investments in transportation infrastructure not only improve agricultural productivity but also generate long-term economic benefits by increasing market participation, reducing transaction costs, and enhancing rural livelihoods.

2.3.2. Conceptual Framework

The **conceptual framework** presented in this study highlights the interconnected relationship between road transport infrastructure, transaction costs, and agricultural productivity. Improved road networks play a crucial role in reducing transportation costs, thereby enhancing the profitability of agricultural products. Farmers benefit from lower transportation expenses, leading to higher farm-gate prices and reduced post-harvest losses. This, in turn, increases the overall efficiency and output of agricultural activities. Furthermore, rural roads improve market access by connecting farmers to local, regional, and even international markets. With better access to markets, farmers can sell surplus produce and access necessary agricultural inputs, such as seeds, fertilizers, and modern tools, thus encouraging commercialization, the adoption of modern farming techniques, and crop diversification.

Additionally, better road infrastructure has a broader socioeconomic impact. By improving access to social services like healthcare, education, and emergency services, rural roads elevate the living standards and incomes of rural households. These improvements foster overall community development, contributing to poverty alleviation. Finally, policy interventions aimed at enhancing rural road infrastructure are

critical for sustained growth. Expanding and maintaining rural road networks, coupled with support for agricultural extension services and the removal of institutional barriers, will further promote agricultural productivity and market integration. The conceptual framework underscores that investments in transportation infrastructure have a ripple effect, not only improving agricultural productivity but also reducing poverty and fostering comprehensive socioeconomic development in rural areas.

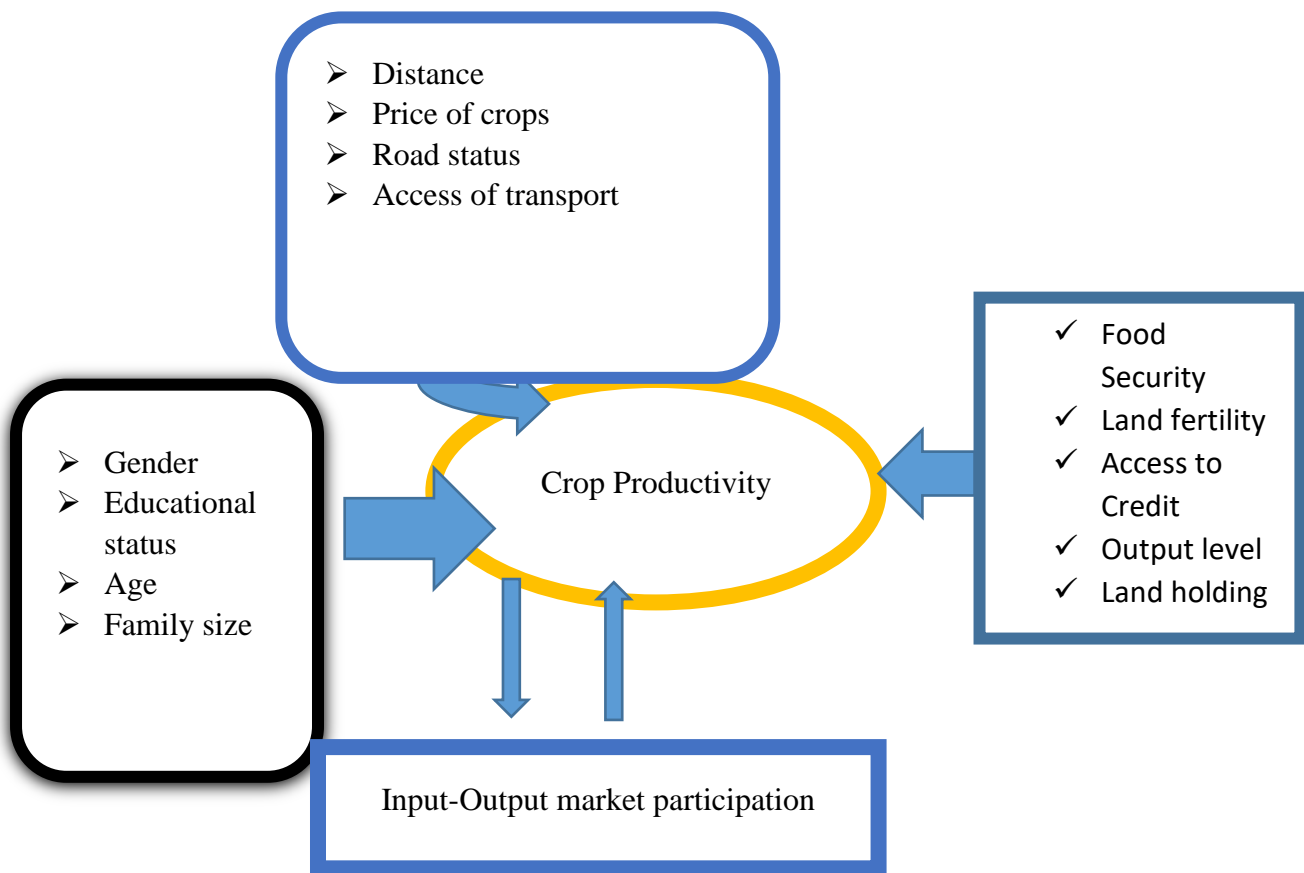


FIGURE 1: CONCEPTUAL FRAMEWORK ILLUSTRATES DETERMINANT FACTORS ON SMALLHOLDER FARMERS’; SOURCE: ADOPTED FROM SILESHI TEMENE 2020

CHAPTER THREE

3. RESEARCH METHEDOLOGY

3.1. Description of Research Area

The study was conducted in Abeshige Woreda, located in Gurage Zone, within the Central Ethiopian Regional State. Situated in the central and southeastern mountainous region of Ethiopia, Abeshige Woreda is bordered by the Hadiya Zone and Yeme Special Woreda to the southeast, the Oromia Region to the west, north, and east, and the East Gurage and Silte Zones to the southeast. As part of Gurage Zone, Abeshige benefits from a region known for its rich agricultural potential, but faces considerable challenges related to infrastructure.

Topographically, Abeshige Woreda, like much of Gurage Zone, spans elevations ranging from 1,000 to 3,600 meters above sea level. The area is characterized by diverse agro-ecological zones—Kolla, Wenadega, and Dega—which significantly impact the local climate and agricultural productivity. The average annual temperature in Abeshige ranges between 13°C and 30°C, with annual rainfall varying from 600 mm to 1,600 mm. These climatic conditions support the cultivation of a variety of crops and livestock, forming the backbone of the local economy.

Land use in Abeshige Woreda is largely dedicated to agriculture, with smallholder farmers relying on cultivated land for their livelihoods. However, the woreda faces significant challenges related to road infrastructure, which hinders both agricultural productivity and market access. The lack of reliable and well-maintained road networks impedes the transportation of agricultural inputs and outputs, limiting farmers' ability to reach markets and exchange goods effectively. This lack of infrastructure negatively

impacts the economic potential of the farming community, leading to difficulties in production, trade, and market transactions.

The total population of Abeshige Woreda is part of the larger Gurage Zone population, which is estimated at 3,163,177 people (Gurage Zone Finance and Economy Office, 2021/2022). Although there are urban and semi-urban areas within the zone, Abeshige Woreda is predominantly rural, housing approximately 75,005 households (Gurage Zone Rural Development Office, 2020). Farming remains the primary livelihood activity for the majority of the population, with smallholder farmers making up the bulk of the community.

Abeshige Woreda, like other parts of Gurage Zone, is home to a dynamic rural population that relies heavily on agriculture for subsistence. However, inadequate road infrastructure poses a major barrier to enhancing agricultural productivity and market access. Addressing these infrastructure deficits is crucial for improving the socio-economic well-being of the local population, promoting agricultural growth, and facilitating greater market participation.

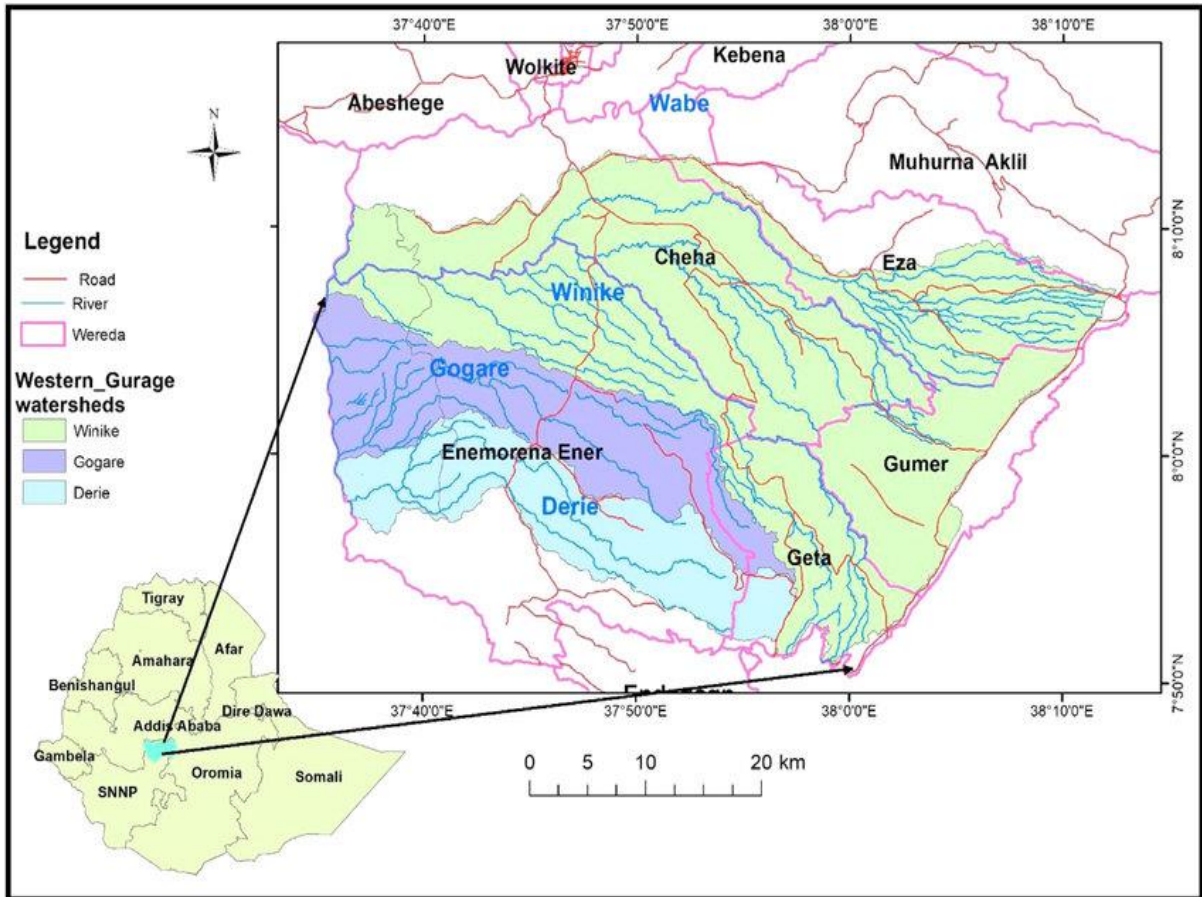


Figure 2: Gurage Zone Administrative map(Source: Gurage Zone finance and economy office, 2024).

3.2. Research Design

The researcher used Explanatory Research Design. This design is more appropriate to analyze cause-and-effect relationships, such as how specific aspects of road transport (e.g., accessibility, quality, or costs) influence agricultural productivity and market access. If the study is focused on identifying and explaining the mechanisms or factors that enhance or hinder the role of transport in productivity, an explanatory research design were better suited. This design is particularly relevant if the goal is to use statistical tools (e.g., regression analysis) to measure the strength and direction of these relationships.

3.3. Research Approach

Accordingly, the study included qualitative and quantitative research methods. Data from structured household surveys was analyzed using the quantitative technique. The information gathered from unstructured interviews with key informants—agricultural and rural specialists from the Guraghe zone finance and economy department—was analyzed using qualitative research.

3.4 Target Population of the Study

The target population of this study consisted primarily of smallholder farmers residing in Abeshige Woreda, located in the Gurage Zone of Central Ethiopia. Smallholder farmers were selected as the key participants because they are directly affected by agricultural productivity and are significantly influenced by road transport services. These farmers typically manage small-scale agricultural operations, cultivating crops and raising livestock for both subsistence and market sale. They often face challenges in accessing essential resources such as inputs, markets, and services, making their productivity closely linked to the quality of road transport infrastructure in their region.

The study focused on farmers who rely on road transport services to move their agricultural products to markets and to acquire inputs like seeds, fertilizers, and equipment. Given the importance of transportation for connecting rural communities to

wider markets and other services, the research aimed to explore how road access, transport costs, and infrastructure quality affect these farmers' agricultural productivity. The study population also included farmers from different age groups, gender, and farming practices to ensure a diverse range of experiences and perspectives.

In addition to smallholder farmers, the study also engaged with key informants such as local government officials, agricultural experts, cooperative leaders, and transport service providers. These stakeholders were included to provide insights into the broader context of transportation services, infrastructure development, and the policies in place that affect road access for farmers. Through this multi-faceted approach, the study aimed to provide a comprehensive understanding of how road transport services impact agricultural productivity for smallholder farmers in the selected area.

3.4.1. Sampling Frame

Gurage zone was one of the densely populated zone in Central Ethiopia region according to the Gurage zone finance and economic development office (2023) total population of the selected woredas has householder in totally of 26 kebeles, and two semi town which was Darge and Walga towns.

3.4.2. Sampling Technique

Multistage random sampling method is appropriate for the study. This approach is well-structured, combining purposive and random sampling to ensure representativeness and minimize bias. The first stage involves selecting the study area, the Gurage Zone, which is a significant cereal crop-producing region and aligns with the study's objectives. In the second stage, Abeshige Woreda is purposefully selected from the zone's thirteen woredas and two administrative towns due to its relevance as a cereal-producing area. The third stage involves the random selection of seven kebeles within the woreda to ensure geographic representation. Since the kebeles in the research area have similar topographical, agroecological, institutional, demographic, and socioeconomic characteristics, this method minimizes the risk of overrepresentation of specific subgroups. Finally, households are randomly selected within the chosen kebeles to prevent sampling bias and ensure diversity among respondents.

This multi-stage sampling method is effective because it progressively narrows the target population, focusing on relevant areas while maintaining randomness in selection at the kebele and household levels. If there are noticeable variations within kebeles, such as differences in distance to roads or market access, stratified random sampling could be incorporated at the household level to ensure even greater representation. Additionally, the inclusion of purposive sampling for qualitative components, such as interviews with key informants like transport providers or government officials, could enhance the depth of the study. Overall, this method provides a practical and systematic approach to achieving a representative and unbiased sample for the study

3.4.3. Sample Size Determination

The study utilized a simple random sampling technique to ensure that each respondent had an equal chance of being selected. This approach was chosen to facilitate the assembly of a representative sample from the broader population, enabling the researcher to make generalizations about the entire population. To maintain respondent confidentiality, the study ensured that their responses remained anonymous, fostering trust and encouraging honest participation. A sample is a subset of individuals chosen from the overall population, allowing researchers to gather insights and make inferences. To determine the appropriate sample size, the researcher applied a sample size formula with a 95% confidence level and a $\pm 5\%$ margin of error. The sample size was calculated using the formula provided by Kothari (2004), ensuring that the sample would be representative of the entire population.

The formula used is:

$$n = (z^2 * p * q * N) / (e^2 * (N - 1) + z^2 * p * q)$$

☞ Where:

☞ n is the desired sample size,

☞ z is the standard normal deviate at the required 95% confidence level (1.96),

☞ p is 0.05 (the proportion of the target population to be included in the sample),

☞ q is 1 - p (which is 0.95)

☞ e is the level of statistical accuracy set at 0.03, and

☞ N is the total population.

Using this formula, the sample size for the study was determined to be 203. This ensured that the sample was statistically representative of the population in the study area.

Respondents were randomly selected from the total population in the selected kebeles using the simple random sampling method. The kebeles included in the study were Wolga, Kulit One, Kulit Two, Darge, Wuded Four, Wudade Five, and Jaju. The sample size from each kebele was allocated proportionally based on its population size. The distribution of the sample was as follows: Wolga had 40 respondents (19.7%), Kulit One had 25 respondents (12.32%), Kulit Two had 20 respondents (9.85%), Darge had 40 respondents (19.7%), Wuded Four had 25 respondents (12.32%), Wudade Five had 25 respondents (12.32%), and Jaju had 28 respondents (13.79%). In total, 203 respondents were selected, ensuring that each kebele was adequately represented in the sample. This method of proportional allocation ensured a balanced and representative sample that accurately reflected the population of Abeshige Woreda.

TABLE 1: SELECTED KEBELES

No	Name of Kebeles	Total Pop	SSD (ni)	Sample ni (in %)
1	Walge	10,000	40	19.7
2	Kulit One	8000	25	12.32
3	Kulit Two	7,000	20	9.85
4	Darge	10,000	40	19.7
5	Wudad Four	8,000	25	12.32
6	Wudad Five	8,000	25	12.32
7	Jaju	9,000	28	13.79
	Total	60,000	203	100

Source: Own Survey 2023

3.5. Data Sources and Types

3.5.1. Data Sources

3.5.1.1. Primary Data Sources

Primary data was collected directly from stakeholders in Abeshige Woreda through various methods such as surveys, interviews, focus group discussions (FGDs), and direct observations. Surveys served as a critical tool to gather quantitative data on factors like road accessibility, transportation costs, market participation rates, and agricultural productivity among smallholder farmers. Key informant interviews (KIIs) with stakeholders, including local government officials, cooperative leaders, and transport service providers, provided qualitative insights into the challenges and opportunities associated with road transport services. FGDs with smallholder farmers, categorized by gender, age, or farming practices, further explored collective perspectives, shared challenges, and community-driven solutions. Additionally, observations of road conditions, transport services, and farming activities provided real-time data, such as the quality of roads, types of transport used, and accessibility to markets and input suppliers.

3.5.1.2. Secondary Data Sources

Secondary data was obtained from existing reports, publications, and records to complement and validate the findings from primary data. Government reports and statistics from the Ethiopian Central Statistical Agency (CSA), the Ministry of Transport and Logistics, and local administrative offices provided critical information on road infrastructure, coverage, and agricultural productivity trends in Abeshige Woreda. Research articles, academic studies, and reports from international organizations like the World Bank, FAO, and USAID offered additional insights into the relationship between transport services and agricultural productivity. These documents also provided theoretical frameworks, methodologies, and comparative findings from similar studies. Geographic data, such as maps and satellite imagery, helped analyze the spatial distribution of roads, farms, and markets, as well as the distances between them.

3.5.2. Types of Data

The study utilized both quantitative and qualitative data to achieve its objectives. Quantitative data, such as transportation costs, distances to markets, and crop yields, enabled statistical analysis of the relationship between transport services and agricultural productivity. In contrast, qualitative data, including farmers' perceptions of transport service reliability and the socio-economic challenges they faced, provided in-depth contextual insights. By integrating primary and secondary data sources with quantitative and qualitative data types, the study aimed to comprehensively analyze the role of road transport services in enhancing smallholder farmers' agricultural productivity in Abeshige Woreda.

3.6. Data collection Tools

To gather both quantitative and qualitative data, the researcher utilized a variety of data collection tools to ensure a comprehensive understanding of the relationship between road transport services and agricultural productivity. The primary tools used in this study included structured questionnaires, key informant interviews (KIIs), focus group discussions (FGDs), and direct observations.

The structured questionnaires were designed to collect data on various aspects such as road accessibility, transport costs, market participation, and agricultural productivity. The questionnaires included both closed-ended and open-ended questions that covered demographic characteristics, farm characteristics, road types, farm input technology, financial services, asset endowment, transport access, market-related issues, social capital, physical capital, and human capital. The respondents for the survey were smallholder farmers in the selected kebeles, and the survey was administered through face-to-face interviews to ensure clarity, particularly for illiterate or semi-literate farmers, with the assistance of enumerators fluent in the local language.

Key informant interviews (KIIs) were conducted to gather qualitative insights from knowledgeable stakeholders regarding road transport services and agricultural productivity in the area. Semi-structured interviews were carried out with local government officials, transport service providers, cooperative leaders, and agricultural experts. These interviews aimed to explore challenges related to transport infrastructure,

the role of transport services in enhancing market access, and any policies or initiatives aimed at improving road transport in the area. In-depth interviews allowed the respondents to express their views in detail, with interviews conducted with managers, directors, agricultural experts, transport officers, and URAP officers working in the sampled woreda.

Focus group discussions (FGDs) were organized to gather collective perspectives from smallholder farmers on the role of road transport services in agricultural productivity. The discussions focused on farmers' perceptions of transport challenges, their experiences with road accessibility, and the impact of transport on their productivity, as well as suggestions for improvements. The FGDs involved smallholder farmers, ideally in groups of 6-8, organized by common characteristics such as age, gender, or farming practices. Moderators facilitated the discussions, ensuring that all participants had an opportunity to share their experiences and contribute to the conversation.

Finally, direct observations were conducted to examine the real-time conditions of road infrastructure, transport services, and farming activities. The researcher observed road conditions (e.g., paved vs. unpaved roads, accessibility), transport services (e.g., availability, types of vehicles used), and the farming environment (e.g., how farmers transport inputs and outputs). These observations, made during visits to the kebeles, allowed the researcher to capture key details that might not have been gathered through interviews or surveys, such as traffic congestion, road damage, or the types of transport used by farmers. Through these diverse data collection methods, the study aimed to gather a rich set of data that provided a comprehensive understanding of the role of road transport services in enhancing agricultural productivity in the study area.

3.7. Methods of Data Analysis

The study employed both quantitative and qualitative data analysis methods to examine the role of road transport services on smallholder farmers' agricultural productivity in Abeshige Woreda, Gurage Zone, Central Ethiopia. The combination of these approaches ensured a comprehensive understanding of the relationship between road transport services and agricultural productivity.

3.7.1. Quantitative Data Analysis

Quantitative data were analyzed using descriptive and inferential statistical methods. Descriptive statistics, such as frequencies, percentages, means, and standard deviations, were used to summarize and present the data on variables like road accessibility, transport costs, market participation, and agricultural productivity. This provided a clear understanding of the general patterns and characteristics of the data.

For inferential analysis, statistical techniques like correlation and regression analysis were employed. These methods were used to identify the relationships between road transport services and agricultural productivity, as well as to determine the strength and significance of these relationships. The analysis was performed using statistical software such as SPSS version 20 or STATA to ensure accuracy and reliability.

3.7.2. Qualitative Data Analysis

Qualitative data collected from key informant interviews (KIIs) and focus group discussions (FGDs) were analyzed thematically. The researcher transcribed the data, coded it into relevant themes, and identified patterns and insights related to transport infrastructure challenges, market access, and community experiences. This approach helped in understanding the perceptions and lived experiences of farmers and stakeholders concerning the role of road transport services.

3.7.3. Integration of Data Analysis

The findings from quantitative and qualitative analyses were integrated to provide a holistic understanding of the issue. The combination of statistical insights and contextual narratives allowed the researcher to draw meaningful conclusions and provide evidence-based recommendations for improving road transport services and enhancing agricultural productivity in the study area.

3.8. Model Specification of Road Transportation on Agricultural Productivity

The study investigates the impact of rural road transportation on agricultural productivity, with agricultural productivity serving as the dependent variable. To achieve the study's objectives, an Ordinary Least Squares (OLS) regression model was utilized.

The OLS approach is selected for its consistency and efficiency, provided the Classical Linear Regression Model (CLRM) assumptions, also known as the Gauss-Markov assumptions, are met. These assumptions ensure that the OLS estimator provides the Best Linear Unbiased Estimates (BLUE) of the model parameters. Key assumptions include the absence of perfect multicollinearity among explanatory variables, homoscedasticity (constant variance of error terms), no serial correlation between error terms, and linearity of the relationship between the dependent and independent variables. Additionally, it is assumed that the error terms follow a normal distribution and have finite variances, which is critical for valid hypothesis testing and efficient estimation, particularly in small samples.

The robustness of the OLS model is ensured through diagnostic tests for multicollinearity, using measures such as Variance Inflation Factors (VIFs), heteroscedasticity using tests like Breusch-Pagan or White’s test, and serial correlation using the Durbin-Watson statistic or similar tests. Tests for the normality of residuals and the overall model fit are also conducted to validate the reliability of the results. By adhering to these methodological rigor and diagnostic validations, the study identifies the key factors influencing agricultural productivity in the context of rural road transportation. This approach provides a comprehensive framework to analyze the role of transport infrastructure on the livelihoods of smallholder farmers in Abeshige Woreda, Gurage Zone, Central Ethiopia, and offers evidence-based recommendations for addressing the challenges in this area.

$$Y_t = f(X) \dots \dots \dots (1)$$

$$Y_t = \beta_0 + \beta_1 X_t + u_t \dots \dots \dots (2)$$

$$Y_i = f(X_1, X_2, X_3, X_4 \dots X_i) \dots \dots \dots (3)$$

$$Y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 \dots \dots \dots + \beta_k x_k + u_i \dots \dots \dots (4)$$

Where Y_t Agricultural crop production

X1 Sex X2 Age

X3 Marital Status

X4 Education

X5-Livestock

X6 Family size

X7 income level

X8 Road Quality

X9 land holding size X10 cost of input X11 credit service X12 transport cost
 X13 market information X14 training X15 land fertility X16 Transport
 access
 X17 Distance from your home to road X18 years of farming experience

The econometric model for the functional form stated in equation (1)

X_i represents the the independent variables that affect the of smallholders

β_0 and $\beta_1 - k$ are estimable parameters U is the error term

3.9. Description of Variables

3.9.1. Dependent Variable

The study utilized an Ordinary Least Squares (OLS) regression model to examine factors influencing the contribution of road transport services to smallholder farmers. The dependent variable for this econometric model is **crop productivity**, representing the role of road infrastructure in enhancing agricultural output.

3.9.2. Explanatory Variables

The key explanatory variables considered in the study are demographic, socio-economic, and agricultural factors, which are described as follows:

1. **Age of Smallholder Farmers:** This continuous variable is measured in years. Age reflects a farmer's experience and productivity potential. Younger farmers are typically more adaptive to innovation and more active in output markets, while older farmers often leverage experience and traditional knowledge. Both younger and older farmers can influence agricultural productivity in different ways.
2. **Sex of the Respondent:** This categorical variable identifies the gender of the household head. Male-headed households are often associated with higher market participation due to better access to resources, while female-headed households may demonstrate notable knowledge of input markets. A positive relationship is anticipated between gender and market participation, although this can vary based on cultural and regional contexts.

3. **Education (Educ):** Education is a continuous variable representing the formal educational attainment of smallholder farmers. Education is a critical driver in transitioning smallholder farming from subsistence to commercial agriculture. It enhances farmers' capacity to adopt new technologies, use inputs effectively, and make informed decisions, thus improving productivity. Prior studies, such as Gebremedhin et al. (2009), highlight the positive role of education in fostering agricultural commercialization and sustainability.
4. **Size of Land:** Measured in hectares (or local units like tsimad), this variable represents the land available for cultivation. Larger landholdings are positively associated with agricultural productivity, as they enable farmers to expand operations and maximize efficiency. This finding is consistent with Bakary et al. (2014), who observed increased efficiency with larger land sizes.
5. **Rainfall (rf1):** Rainfall is a categorical variable that assesses the adequacy of precipitation during the farming season. Adequate and well-distributed rainfall is essential for agricultural productivity, as it supports crop growth and enhances yields.
6. **Access to Credit (as_crd):** This variable captures farmers' ability to secure financial resources to support agricultural activities. Access to credit facilitates the purchase of inputs, such as seeds and fertilizers, which enhance productivity. However, credit misallocated for non-agricultural purposes may have adverse effects. Depending on utilization, the relationship between access to credit and productivity can be either positive or negative.
7. **Crop Production (crp1):** Crop production represents the quantity of agricultural output generated in a given year. This variable is directly linked to productivity, as higher output levels reflect improved agricultural performance.
8. **Household Income:** This continuous variable measures income generated from both agricultural and non-agricultural sources. Higher household income enables farmers to invest in productivity-enhancing inputs, positively influencing agricultural output.
9. **Transportation** **Access:**
This variable evaluates the availability and quality of road infrastructure. Better transportation access reduces travel time and costs, facilitates market access, and positively impacts productivity.
10. **Farm Product Characteristics:** This variable encompasses the quality and type of crops produced. Diverse and high-quality farm products are more marketable and contribute positively to productivity and income generation.

11. **Asset Endowment:** This variable represents the physical and financial resources owned by the household, such as livestock, farming tools, and savings. Higher asset ownership enhances farmers' ability to invest in productive activities, positively influencing crop productivity.
12. **Extension Services:** This variable reflects farmers' access to agricultural advisory services. Regular interaction with extension agents provides farmers with up-to-date knowledge and practices, leading to improved productivity.
13. **Fertilizer Usage:** This continuous variable measures the amount of fertilizer applied to farmland. Proper use of fertilizers enhances soil fertility and crop yields, contributing positively to agricultural productivity.
14. **Oxen and Livestock Ownership:** Oxen and livestock ownership serve as proxies for farmers' financial and operational capacity. These assets facilitate effective land preparation and other farming activities, positively impacting productivity.
15. **Type of Landholding and Consumption:** This variable captures the land tenure system and consumption patterns. Secure landholding arrangements encourage long-term investments in land and resource management, while consumption patterns provide insights into household food security and income allocation

TABLE 2: EXPLANATORY VARIABLE AND EXPECTATIONS

Variables	Specification	Exp sign
sexof Hh	1 if male and 0 if female	+
Age of Hh	Age at time of interview in years	- /+
Education Hh	Number of years of schooling	+
Martial status	Martial status of household head	+/-
Total land size	Total land size cultivated in the year including rented-in land	+
Nature of land holding	The land fertility	+
Household family size	Number of labor force who participated in farming	+
Price of crops	Is small / high price	+
Information	If good road and asses to transport of input and outputs	+

Crop production	Total product in quintal	+
Transport Access	1 if has access 0 if does not have access	+
Asses to Credit	1 if asses to Credit 0 otherwise	+
Distance	The distance from home to market	-
Rainfall season	1 Adequate rain 0 other wise	+/-
Food security	availability of food grains	+
Road quality	Asphaltic road or timely maintenance	+
Training	Access to get training	+

Source: Adapted from (Samuel and Key 2023)

3.10. Diagnostic Tests

To ensure the reliability and validity of the Ordinary Least Squares (OLS) regression model, the study conducted diagnostic tests for, **heteroscedasticity, autocorrelation, and normality of residuals.**

Heteroscedasticity is refers to the presence of unequal variance in the error terms, which violates one of the key assumptions of the OLS regression model. The **Breusch-Pagan test** was employed to check for heteroscedasticity. If heteroscedasticity is detected, it could affect the efficiency of the OLS estimates. To address this issue, robust standard errors or generalized least squares (GLS) methods may be applied to improve the reliability of the results.

Autocorrelation is occurs when the residuals are not independent of each other, particularly in time-series or spatial data, violating another OLS assumption. The researcher used the **Durbin-Watson (DW) test** to detect autocorrelation. A DW statistic close to 2 suggests no autocorrelation, while values significantly below 2 indicate positive autocorrelation and values above 2 suggest negative autocorrelation. If autocorrelation is present, it may necessitate using feasible generalized least squares (FGLS) or adding lagged variables to the model.

Normality of Residuals is a crucial assumption in OLS regression, as it ensures that hypothesis tests and confidence intervals are valid. The **Jarque-Bera test** was conducted to assess whether the residuals follow a normal distribution. If the residuals are not normally distributed, transformations or alternative estimation techniques may be required to improve the model's robustness. By performing these diagnostic tests, the study ensured the accuracy, consistency, and interpretability of the OLS regression results.

CHAPTER FOUR

4. RESULTS AND DISCUSSION

4.1. Demographic characteristics

The demographic and socio-economic characteristics of smallholder farmers in Abeshige Woreda, Gurage Zone, Central Ethiopia, provide vital insights into how road transport services impact agricultural productivity. These characteristics influence both the access to and the utilization of road transport, which, in turn, affects farmers' productivity and economic outcomes.

The study revealed that **54.87% of respondents were male**, while **45.13% were female**, showing a nearly balanced gender distribution. Although men dominate smallholder farming, women also play a significant role, particularly in managing household tasks and farming activities. Access to road transport is essential for improving women's participation in both the input and output markets. This finding is consistent with **Alemayehu and Bewket (2017)**, who highlighted that women in rural Ethiopia often face barriers such as limited access to resources like land, credit, and transportation. Ensuring that road transport services are equally accessible to both men and women could help address gender disparities and boost agricultural productivity.

Regarding marital status, **64.1% of respondents were married**, while **35.9% were single**. Married farmers typically face larger family sizes and increased responsibilities, which often require more road transport to meet both production and household needs. Larger family sizes can also mean more labor available for farming, which, when complemented by efficient road transport, can enhance agricultural output. Similar findings are reflected in **Bakary et al. (2014)**, who noted that larger family sizes are associated with more labor for farming activities, making road transport a crucial factor in increasing agricultural efficiency. Additionally, **Dercon and Hoddinott (2005)** observed that married farmers tend to have better access to resources like labor and can participate more effectively in markets when transportation is readily available.

The study also found that **32.31% of respondents were illiterate**, **50.26% had secondary education**, and **17.44% had a diploma or higher**. This high level of education, particularly secondary education, suggests that farmers are likely aware of the benefits of modern agricultural practices, including the role of road transport in improving market access. Educated farmers are more likely to adopt new technologies and utilize road transport services to optimize input procurement and crop sales. This finding aligns with **Rosegrant and Cline (2003)**, who emphasized the role of education in enabling farmers to improve their productivity by adopting better agricultural practices and technologies. However, the substantial percentage of illiterate farmers (32.31%) underlines the need for targeted interventions, such as training programs to help farmers better utilize road transport for improving agricultural outcomes.

In terms of family size, **26.15% of households had 1–3 members**, **35.9% had 3–6 members**, **24.62% had 6–9 members**, and **13.33% had more than 9 members**. Larger

family sizes tend to be associated with greater labor availability, which positively impacts agricultural productivity. However, these households also face higher transportation demands for moving both labor and agricultural products, especially to distant markets. This is in line with **Minten and Stifel (2008)**, who noted that households with larger families typically have more access to labor, which, combined with road transport infrastructure, can boost productivity. Therefore, improving road infrastructure is essential for addressing transportation constraints, particularly for larger households.

Income levels among respondents were categorized into three groups: **10.26% reported low income, 56.41% reported medium income, and 33.33% reported good income.** Farmers in the medium- and high-income categories likely benefit from better road access, which enables them to participate more effectively in markets and sell their produce at competitive prices. On the other hand, the low-income group faces challenges such as poor road infrastructure, which limits their market access and impedes their productivity. This finding resonates with **World Bank (2007)**, which argued that poor road infrastructure is a significant constraint to income growth in rural areas. Improving road transport could help low-income farmers gain better access to markets and increase their agricultural output, thus raising their income levels.

Overall, the study underscores the crucial role that road transport services play in improving agricultural productivity in Abeshige Woreda. While farmers in higher income categories are likely benefiting from existing road infrastructure, those with lower incomes, larger family sizes, and limited education face more significant challenges. This is consistent with research by **Gollin and Rogerson (2010)**, who emphasized that improving rural roads directly boosts agricultural productivity by reducing transportation costs and providing better market access. **Minten and Stifel (2008)** also highlighted the importance of rural roads in enabling market integration and enhancing agricultural practices. Therefore, improving road transport services is essential for boosting productivity and fostering inclusive agricultural growth in the region.

TABLE 3 DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS

		Freq.	Percent	Cum.
Sex	Female	88	45.13	45.13

	Male	107	54.87	100
Marital Status	Single	70	35.9	35.9
	Married	125	64.1	100
Education	Illiterate	63	32.31	32.31
	Secondary Education	98	50.26	82.56
	Diploma and above	34	17.44	100
Family size	1 – 3	51	26.15	26.15
	3 – 6	70	35.9	62.05
	6 - 9	48	24.62	86.67
	≥9	26	13.33	100
Income level	Low	20	10.26	10.26
	Medium	110	56.41	66.67
	Good	65	33.33	100.00

4.2. Descriptive statistics of continuous Variables

Table below presents the descriptive statistics of continuous variables that are important for understanding the agricultural productivity of smallholder farmers in Abeshige Woreda, Gurage Zone, Central Ethiopia. These variables include crop production, land size, years of farming experience, and the distance from home to the main road.

The average crop production for the farmers in the study area is **186.54 quintals**, with a standard deviation of **107.08**, and the range of production varying from **40 to 650 quintals** per year. This variability indicates that the region has a high potential for crop production, with some farmers achieving significantly higher outputs than others. This aligns with findings from **Tadesse et al. (2014)**, who observed a wide variation in crop yields among smallholder farmers in Ethiopia, which can be attributed to differences in access to resources such as land, inputs, and road infrastructure.

Regarding land size, the average holding size is **2.73 hectares**, with a minimum of **0.5 hectares** and a maximum of **10 hectares**. This suggests that most farmers in the study area own relatively small plots of land. Smaller landholdings are often associated with reduced agricultural productivity, as they limit the scale of production. These findings are consistent with **Gebremedhin et al. (2009)**, who pointed out that land size

significantly affects productivity in smallholder farming. The majority of farmers in the area owning land smaller than 3 hectares reflects the common trend in Ethiopia, where smallholder farmers typically operate on limited land resources, which constrains their ability to increase production without improvements in efficiency and access to inputs.

The average number of years of farming experience in the study area is **14.28 years**, with a standard deviation of **11.73**. Experience is a vital determinant of agricultural productivity, as more experienced farmers tend to have better knowledge of efficient farming practices, crop selection, and pest management. This finding supports **Hassan et al. (2007)**, who highlighted the positive relationship between years of farming experience and productivity, noting that experienced farmers are more likely to adopt improved technologies and practices.

In terms of road access, the average distance from farmers' homes to the main road is **3.76 kilometers**, with a range between **1 and 10 kilometers**. This distance is a significant factor influencing farmers' ability to transport their products to markets, as longer distances typically result in higher transportation costs, greater physical effort, and more time spent on logistics. As **Minten and Stifel (2008)** suggested, distance from roads has a negative correlation with market access and agricultural productivity. Farmers who live farther from main roads face additional challenges such as higher transaction costs, limited access to information, and more effort spent on transporting goods, which ultimately reduces their efficiency and market participation. This finding aligns with **Alemayehu and Bewket (2017)**, who emphasized that poor infrastructure and long distances to markets are major barriers to agricultural productivity in rural Ethiopia.

TABLE 4: DESCRIPTIVE STATISTICS OF CONTINUES VARIABLES.

Variable	Obs	Mean	Std. Dev.	Min	Max
Cr. product in quintal	195	186.5385	107.0822	40	650
land size	195	2.730769	1.965705	0.5	10
year of farm experience	195	14.27692	11.72561	1	36
Distance from home	195	3.75641	1.684801	1	10

Source: Using Own survey (2024)

4.3. Educational level of respondents

The educational level of farmers plays a significant role in shaping agricultural productivity and economic success, particularly in regions where access to education is limited. The data you provided suggests that the majority of smallholder farmers in the study had secondary education (50%), followed by illiterate farmers (32%), and those with a diploma (18%). These findings reflect that a substantial portion of farmers have reached a level of education that enables them to comprehend and utilize agricultural innovations, including the benefits of road transport systems in improving their productivity.

Smallholder farmers, with better education, tend to be more aware of how transportation infrastructure can impact their agricultural output and market access. According to a study by Jha et al. (2015), improving transportation systems allows farmers to sell their products directly in larger markets, avoiding middlemen, and thus ensuring better prices. Education helps farmers understand the potential of this improved access to markets, which can lead to higher earnings and incentives to invest in better farming techniques.

The relationship between education and agricultural productivity is also highlighted in various studies. For example, a study by Kebede and Hassen (2017) demonstrates that education is positively correlated with the adoption of new farming technologies, which leads to increased crop yields. Educated farmers are more likely to make informed decisions about resource use, pest management, and soil fertility. These decisions directly contribute to enhanced productivity.

In the context of road infrastructure, education equips farmers with the knowledge to advocate for better roads and other public services. Educated farmers are often more capable of organizing and presenting their concerns to government authorities, thereby improving the overall welfare of their communities. In line with this, studies show that communities with better education levels tend to have stronger collective voices, which can result in better governance and investment in infrastructure (Narayan & Petesch, 2002). The correlation between education and improved agricultural productivity is also discussed by Fafchamps (2003), who emphasizes that knowledge of market dynamics, including transport and communication, is key to reducing transaction costs and increasing profits for smallholder farmers.

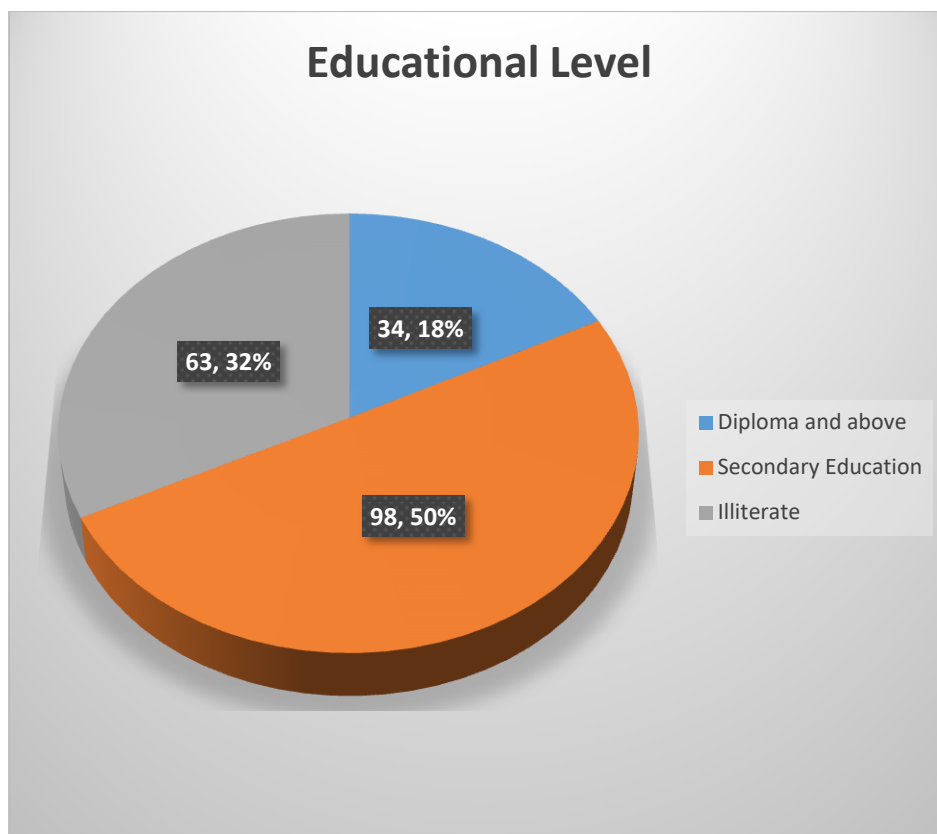


FIGURE 3: EDUCATIONAL LEVEL OF RESPONDENTS

4.4. Descriptive Statistics of Categorical Variables

The findings in Table below underscore the significant role that fertility, road infrastructure, and access to agricultural inputs play in improving agricultural productivity and the broader economic activities of smallholder farmers. The study reveals that 77.44% of the land in the area is fertile, and 72% of farmers take advantage of this by cultivating crops twice a year. This practice enhances food security and overall productivity, as it allows for more frequent harvests and contributes to a steady supply of food in the region. However, the study also highlights the challenges farmers face in acquiring essential agricultural inputs such as fertilizer, improved seeds, and crop protection chemicals, as well as the high cost of these inputs. Respondents report that 59% find the cost of inputs to be very expensive, further exacerbating the economic challenges they face.

The role of transportation infrastructure in mitigating these challenges is critical. Efficient transport services can help smallholder farmers minimize transaction costs, making it easier for them to access markets and purchase necessary inputs. However, the

study finds that only 23.59% of respondents reported having access to quality road infrastructure (asphalt roads), while 76.41% noted that road quality was inadequate. As a result, only 45% of respondents had access to transport services, with many farmers bearing high transportation costs, especially during the summer season. This lack of access to affordable transportation significantly hinders their ability to obtain inputs and sell their produce at fair prices.

From the respondents' perspective, transport services play a crucial role in increasing agricultural productivity. Sixty-three percent of the respondents confirmed that transportation had a high impact on their productivity, while 22.56% and 13.85% reported medium and low impacts, respectively. However, the high transportation costs remain a major constraint, with 72.3% of respondents indicating that transport services are very expensive. This finding aligns with research by Foster and Rosenzweig (2010), which suggests that inadequate transport infrastructure and high transport costs are significant barriers to agricultural productivity, particularly in rural areas.

In addition to transportation, access to market information plays an important role in improving productivity. The study indicates that all smallholder farmers have access to market information through various sources, including television, radio, agricultural experts, and middlemen. This access enables farmers to make informed decisions regarding crop prices and market trends, and allows them to adjust their production strategies accordingly. Research by Gabre-Madhin (2012) emphasizes that the availability of market information reduces marketing inefficiencies, allows farmers to negotiate better prices, and encourages the introduction of higher-quality products. As a result, farmers are better positioned to plan investments in improved farming methods, increasing their overall productivity.

Moreover, the role of financial services in facilitating access to credit for farmers is critical. While the study finds that 32.82% of respondents have accessed credit services, many farmers remain unable to benefit from these services due to limitations in the availability of credit or restrictions imposed by financial institutions. This echoes findings from other studies, such as those by Alemu et al. (2015), which show that limited access to credit is a major barrier for smallholder farmers looking to invest in agricultural inputs and technology.

TABLE 5: DESCRIPTIVE STATISTICS OF CATEGORICAL VARIABLES.

		Freq.	Percent	Cum.
Do you have an Oxen	Yes	113	57.95	57.95
	No	82	42.05	100
Fertility of the land	Fertile	151	77.44	77.44
	not fertile	44	22.56	100
How often do you cultivate	once in a year	55	28.21	28.21
	twice in a year	140	71.79	100
Cost of input	Expensive	115	58.97	58.97
	Medium	75	38.46	97.44
	Cheap	5	2.56	100
Credit service	Yes	61	32.82	32.82
	No	134	67.18	100
asphalt road in your woreda	Yes	46	23.59	23.59
	No	149	76.41	100
The role of transposrt service	High	124	63.59	63.59
	Mediun	44	22.56	86.15
	Low	27	13.85	100
Transport service access	Yes	88	45.13	45.13
	No	107	54.87	100
transport cost	Expensive	141	72.31	72.31
	Medium	3	1.54	73.85
	Cheap	51	26.15	100
market information	TV and Radio	24	12.31	12.31
	Experts	89	45.64	57.95
	middlemen/phone	82	42.05	100
Training	Yes	153	78.46	78.46
	No	42	21.54	100

Source: Using Own survey 2024

4.5. Farmers credit access

The provision of credit services plays a significant role in enhancing agricultural productivity by enabling smallholder farmers to invest in essential agricultural inputs, such as seeds, fertilizers, and equipment, as well as expand their operations by purchasing more land. Access to credit allows households to borrow against future income, which is crucial for smoothing consumption and financing investments that can increase farm productivity and, ultimately, income.

The study indicates that 31.3% of respondents have access to credit services, with 58% of those obtaining credit from microfinance institutions. However, 42% of respondents, despite needing credit for agricultural production, do not have access. The findings suggest a gender disparity, with female farmers reporting greater access to credit than male farmers. This result is intriguing, as it contrasts with many studies that highlight the barriers women face in accessing credit due to cultural norms, lack of collateral, and limited financial literacy (Quisumbing et al., 2014). In this case, the study suggests that government initiatives aimed at encouraging female participation in agricultural production and credit access may be playing a positive role. Women may also have cultural networks that support their access to resources, including credit.

The gendered access to credit is consistent with findings from other research. For example, a study by Doss (2003) found that in some rural contexts, women are more likely to have access to microcredit schemes that are specifically designed to empower female farmers and entrepreneurs. These microcredit programs, which often focus on small loans for agricultural investments, have been successful in helping women in rural areas overcome financial barriers and invest in their farms. The research further highlights the importance of gender-sensitive credit policies that cater to the needs of female farmers, as women often face distinct challenges in accessing financial services compared to their male counterparts.

Despite the positive outcomes for female farmers in this study, the research also highlights some potential negative consequences of credit usage. For instance, borrowing to finance agricultural production comes with risks, especially if loans are not repaid on time. High-interest rates, limited loan amounts, and the inability to meet repayment deadlines can lead to financial stress and, in some cases, the loss of collateral, which could further worsen the financial condition of smallholder farmers (Karlan et al., 2017). These negative consequences

suggest that while access to credit is crucial for improving agricultural productivity, it must be accompanied by appropriate financial literacy programs and more flexible repayment structures to ensure that farmers are able to successfully use credit without falling into deeper debt.

The positive relationship between access to credit and agricultural productivity is well-documented in the literature. For instance, a study by Alemu et al. (2015) concluded that access to credit is directly linked to increased agricultural investment and productivity, as it enables farmers to purchase necessary inputs that they otherwise could not afford. Moreover, the ability to invest in technology and infrastructure can significantly improve productivity, leading to higher income and enhanced food security.

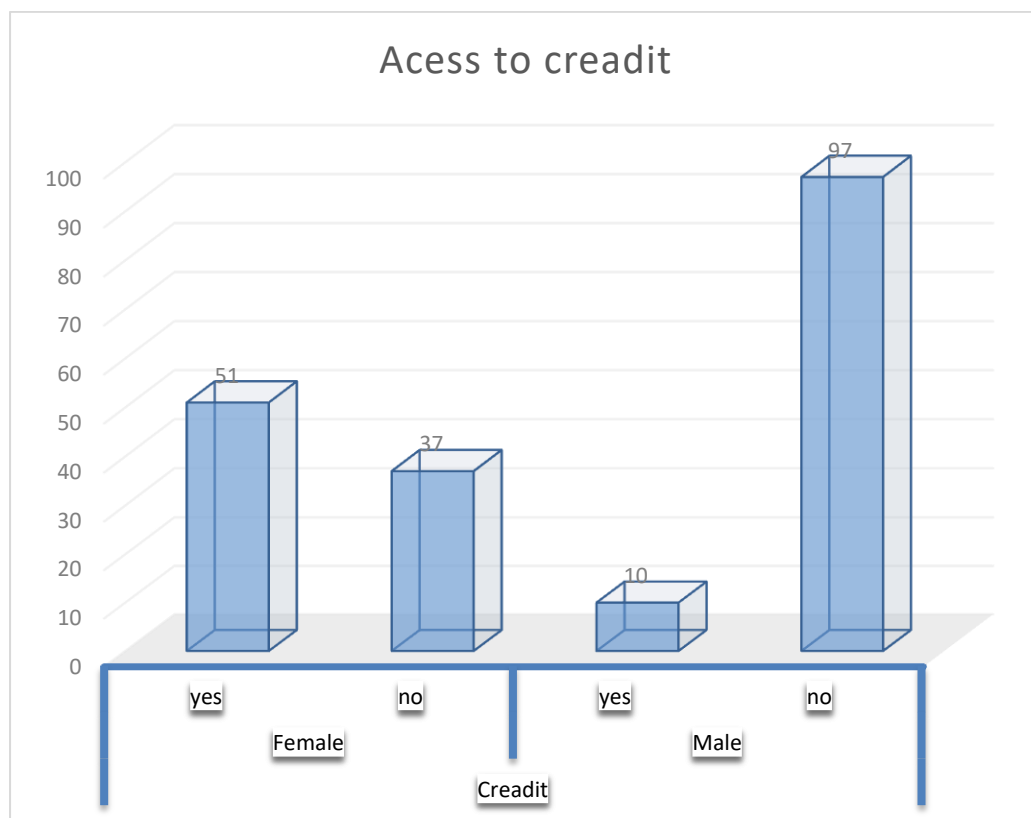


FIGURE 4: FARMERS ACCESSTOCREDIT

Source Own survey 2024

4.6. Assumption test

An **assumption test** is a statistical procedure used to verify whether the assumptions underlying a particular statistical model or analysis are met. These assumptions are crucial because many statistical methods rely on them to produce valid and reliable results. When these assumptions are violated, the outcomes of the analysis could be biased, inefficient, or misleading. Common assumption tests are typically performed in regression analysis, but they can also be used in other statistical models.

4.6.1. Normality Assumption (The disturbances are normally distributed):

The assumption of normality is fundamental in many statistical procedures, particularly in classical linear regression models, where the disturbance vector, ϵ , is assumed to be normally distributed. Departures from normality can lead to incorrect conclusions and distort the analysis of economic models. Therefore, testing the normality of regression residuals is a crucial step in any regression analysis. One of the most widely used tests for assessing the normality of regression residuals is the **Jarque-Bera test** (1980, 1987), which is based on two key measures: **skewness (S)** and **kurtosis (K)**, computed from the sample of residuals.

In this study, the **p-value** of the **Jarque-Bera test** was found to be **0.67**, which is statistically insignificant at the standard significance level of **0.05**. Since the p-value is greater than 0.05, the researcher **fails to reject the null hypothesis**, which posits that the residuals are normally distributed. This indicates that there is no significant evidence to suggest that the residuals deviate from a normal distribution. As a result, the researcher **accepts the null hypothesis** and concludes that the residuals in this study do not present a normality issue.

The acceptance of the null hypothesis implies that the normality assumption holds for the data used in this study. This finding is important because it supports the use of statistical methods that rely on the assumption of normally distributed errors, such as hypothesis testing and confidence intervals. With this result, the researcher can proceed with the

analysis, confident that the normality assumption is not violated, and the conclusions drawn from the regression model are reliable.

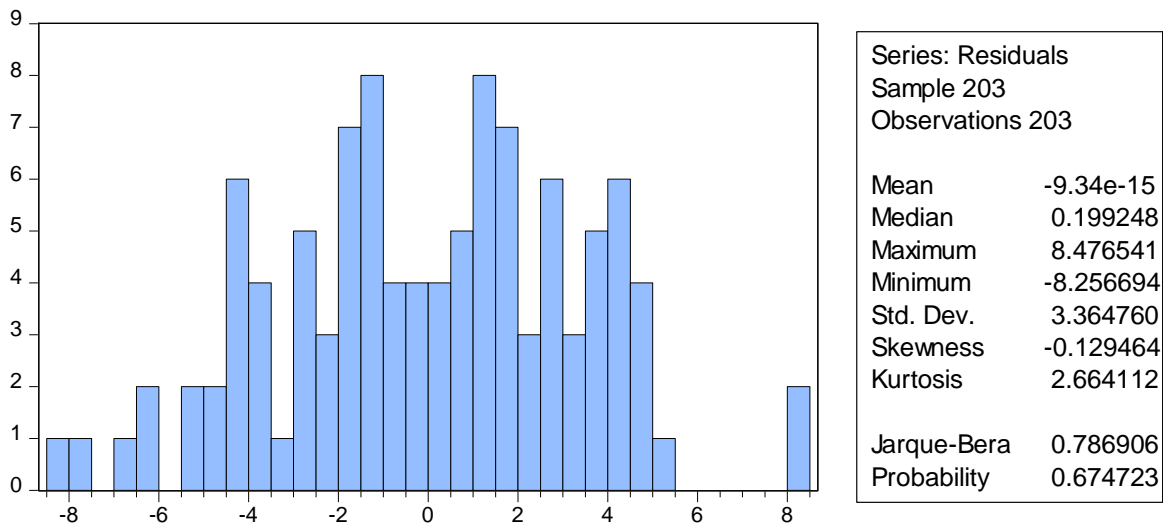


FIGURE 5; NORMALITY DISTRIBUTION FOR THE STUDY

4.6.2. Assumption of Heteroskedasticity

Heteroskedasticity refers to a condition in regression analysis where the variance of the error terms is not constant across all observations. This contrasts with **homoscedasticity**, which assumes that the variance of the residuals is constant throughout the range of the independent variables. When heteroskedasticity is present, it violates the assumption that the disturbance term's variance is constant (σ^2), potentially leading to inefficient estimates and biased statistical tests. According to Cohen, West, and Aiken (2007), Field (2009), Fox (1997), and Kutner, Nachtsheim, & Neter (2004), heteroskedasticity implies that the residuals exhibit non-constant variability, which is related to factors not included in the regression model.

To detect heteroskedasticity, one of the most widely used tests is the **Breusch-Pagan test**, introduced by Trevor Breusch and Adrian Pagan in 1979. This test evaluates whether the error variance depends on the values of the independent variables. The test produces a chi-squared statistic, and if the p-value is less than 0.05, it indicates that heteroskedasticity is present (i.e., the error variance is not constant). Conversely, a p-value greater than 0.05 means that there is insufficient evidence to reject the null hypothesis of constant error variance (homoscedasticity).

In the case of this study, the **Breusch-Pagan test** was performed on the residuals of the regression model, and the p-value obtained was **0.62**. Since this value is much higher than the standard significance level of 0.05, we fail to reject the null hypothesis. This indicates that there is no evidence of heteroskedasticity in the model, meaning the error variance is constant across all levels of the independent variables.

TABLE 6 HETEROSKEDASTICITY TEST: BREUSCH-PAGAN-GODFREY

F-statistic	3.464836	Prob. F(7,97)	0.0014
Obs*R-squared	21.00267	Prob. Chi-Square(7)	0.062
Scaled explained SS	14.91392	Prob. Chi-Square(7)	0.0301

4.6.3. Autocorrelation Assumption Test

In this study, the assumption of autocorrelation in the classical linear regression model was tested to determine whether the residuals are linearly independent and uncorrelated. Autocorrelation arises when the errors are correlated with one another, a situation known as serial correlation, which can distort the results of regression analysis (Brooks, 2008). Since the population disturbances cannot be directly observed, the autocorrelation test was conducted on the model's residuals.

To assess autocorrelation, the **Durbin-Watson (DW) test** was applied. This test checks for first-order autocorrelation, which examines the relationship between an error term at time t and its preceding error term at time $t-1$. The interpretation of the DW statistic is as follows: a value close to 2 suggests no autocorrelation, a value approaching 0 indicates perfect positive autocorrelation, and a value close to 4 signals perfect negative autocorrelation (Brooks, 2008).

The Durbin-Watson test results for the model showed a value of **1.78**. This value is very close to 2, indicating that there is no significant autocorrelation problem in the model. Therefore, based on these results, the study has no evidence to reject the null hypothesis of no autocorrelation, confirming that the residuals are independent and uncorrelated

H0: There is no problem of autocorrelation

H1: There is a problem of autocorrelation

TABLE 7: TEST OF AUTOCORRELATION (DURBIN-WATSON STAT)

Test	Result
Durbin-Watson stat	178

4.7.OLS estimation result for agricultural of Production

Multiple linear regression was employed to assess the economic outcomes of road transport services on smallholder farmers' agricultural productivity. The econometric model considered twelve independent variables in total. Among these, nearly 67% had a statistically significant impact on agricultural output. The significant variables include income level at 10% significance, landholding size at 1%, cost of input at 10%, education level at 5%, credit service at 1%, fertility of the land at 5%, market information at 10%, and the presence of asphalt roads at 10%.

On the other hand, variables such as the distance from home to the main road, transport cost, the role of transport services, and years of farming experience were found to have no significant effect on agricultural productivity. Specifically, the distance from home to the main road or market and high input costs were shown to negatively impact the agricultural productivity of smallholder farmers. This indicates that greater distances to markets and higher costs for inputs hinder the ability of farmers to maximize their output.

TABLE 8: MULTIPLE REGRESSION ESTIMATE OF EXPLANATORY VARIABLES

		Robust				
Inquntal	Coef.	Std. Err.	t	P>t	[95% Conf	Interval]
Incomelevel	10.5537 3	5.937624	1.78	0.007*	-1.1617	22.2691 6
Landholdingsizeinhector	46.7961 5	3.575205	13.09	0.000***	39.74197	53.8503 2
Costofinput	-12.0147	6.835405	-1.76	0.080*	-25.5015	1.47213 5
HowmanyKMfarfromhom e	-2.31834	1.552701	-1.49	0.137	-5.38195	0.74527 3

Transportcost	1.03048 8	3.660273	0.28	0.779	-6.19154	8.25251 4
Education	22.2521 7	10.806	2.06	0.041**	0.93102	43.5733 3
Creditservice	74.4843 6	26.15651	2.85	0.005***	22.87536	126.093 3
The role of transport service	3.92645 3	4.420527	0.89	0.376	-4.79562	12.6485 2
Fertility of the land	11.6788	4.894759	2.39	0.018**	2.021028	21.3365 7
Market information	26.8503 9	14.03127	1.91	0.057*	-0.83448	54.5352 6
Asphalt road in your woreda	16.2960 5	8.888265	1.83	0.068*	-1.24124	33.8333 5
Years of farming experience	0.99314 2	0.795436	1.25	0.213	-0.57632	2.56260 4
_cons	-99.8149	53.8185	-1.85	0.065	-206.003	6.37349 7

Where ***, ** and * the level of significance at 1%, 5% and 10% respectively

The regression results provide important insights into the factors affecting smallholder farmers' agricultural productivity. These results will be compared and contrasted with findings from Ethiopia, other developing countries, and global studies to place the findings in a broader context.

Income Level (Incomelevel)

The coefficient for income level is **10.55**, with a standard error of **5.94**, and is statistically significant at the 10% level (p-value = **0.077**). This indicates that as the income of smallholder farmers increases, agricultural productivity also increases. Specifically, a one-unit increase in income leads to a 10.55-unit increase in agricultural output. This finding supports research in Ethiopia and developing countries, where higher income levels enable farmers to purchase better inputs, improve their farming methods, and invest in other productivity-enhancing activities (Bekele et al., 2013). In

contrast, studies in more industrialized countries may show less of an effect of income on agricultural output, as farmers may already be operating above subsistence levels and income may not be as binding as a constraint on production.

Landholding Size (Landholdingsizeinhector)

The coefficient for landholding size is **46.80** with a standard error of **3.58**, and it is highly statistically significant (p-value = **0.000**). This shows that an increase in landholding size leads to a significant increase in agricultural productivity. A one-hectare increase in landholding size results in an increase of 46.80 units of agricultural productivity. This is consistent with studies in Ethiopia and other developing countries, where access to more land provides farmers with more opportunities to produce diverse crops, increasing overall productivity (Tadele, 2016; Alemu et al., 2013). In other developing countries like India and Sub-Saharan Africa, land size has also been identified as a critical factor in increasing agricultural productivity, as it allows for greater economies of scale and more efficient use of resources (FAO, 2011).

Cost of Input (Costofinput)

The coefficient for the cost of inputs is **-12.01**, with a standard error of **6.84**, and it is significant at the 10% level (p-value = **0.080**). This suggests that increasing input costs negatively affect agricultural productivity. A one-unit increase in input costs decreases productivity by **12 units**. This result is consistent with findings in developing countries, where high input costs are a major barrier for smallholder farmers, reducing their ability to purchase necessary fertilizers, seeds, and other inputs (Ahmed & Hussain, 1990). Moreover, in Ethiopia, where input costs such as fertilizers and improved seeds are high relative to farmers' income, the negative impact of input costs on productivity has been observed in other studies (Mamo Tadele et al., 2016). On a global scale, input cost rises have often been associated with declines in smallholder productivity, especially in areas where farmers rely heavily on external inputs (Sims & Lafferty, 2013).

Education (Education)

The coefficient for education is **22.25**, with a standard error of **10.81**, and it is statistically significant at the 5% level (p-value = **0.041**). This result suggests that an

increase in education positively impacts agricultural productivity. Specifically, a one-unit increase in education leads to a 22.25-unit increase in agricultural output. This finding aligns with global research that highlights the critical role of education in improving farming practices, enhancing access to market information, and adopting new agricultural technologies (Bekele et al., 2013). In Ethiopia, educated farmers are more likely to adopt improved agricultural practices, access better market information, and increase their productivity (Tadele, 2016). This is supported by international studies showing that education improves farmers' decision-making abilities and provides them with the knowledge needed to enhance their productivity (FAO, 2011).

Credit Service (Creditservice)

The coefficient for credit service is **74.48**, with a standard error of **26.16**, and it is highly statistically significant at the 1% level (p-value = **0.005**). This suggests that access to credit has a strong positive effect on agricultural productivity. Specifically, smallholder farmers with access to credit increase their productivity by **74.48 units** on average. This result aligns with findings in Ethiopia and other developing countries, where access to credit is often a key constraint to purchasing inputs and expanding farm operations (Mamo Tadele et al., 2016). Research in countries like Kenya and India has similarly shown that credit access improves farmers' ability to invest in inputs, leading to higher yields and productivity (Gupta, 2018). In contrast, in developed countries, where access to credit is more widespread, the impact of credit on productivity may not be as pronounced.

Soil Fertility (Fertilityoftheland)

The coefficient for land fertility is **11.68**, with a standard error of **4.89**, and it is statistically significant at the 5% level (p-value = **0.018**). This indicates that improved soil fertility positively impacts agricultural productivity. A one-unit increase in land fertility leads to an 11.68-unit increase in agricultural output. This result is consistent with studies in Ethiopia and other developing countries, where fertile soil significantly contributes to higher crop yields (Alemu et al., 2013). Globally, soil health is recognized as one of the key factors in agricultural productivity, with fertile soils reducing the need for costly chemical inputs and boosting crop output (FAO, 2011).

Market Information (Marketinformation)

The coefficient for market information is **26.85**, with a standard error of **14.03**, and it is statistically significant at the 10% level (p-value = **0.057**). This suggests that better access to market information increases agricultural productivity. Specifically, a one-unit increase in market information leads to a 26.85-unit increase in productivity. This result is consistent with global findings that access to market information helps farmers better understand price trends, demand, and input costs, which in turn enables them to optimize their farming practices (Eleni-GabreMadhin, 2012). In Ethiopia, improved market information has been shown to help farmers obtain higher prices for their products and reduce transaction costs, leading to higher productivity (Chanyalew et al., 2011).

Asphalt Road (Asphaltroadinyourworeda)

The coefficient for access to asphalt roads is **16.30**, with a standard error of **8.89**, and it is statistically significant at the 10% level (p-value = **0.068**). This indicates that better road infrastructure positively impacts agricultural productivity, with farmers in areas with access to asphalt roads having higher productivity. This finding is consistent with studies in Ethiopia and other developing countries, where poor infrastructure, particularly roads, limits farmers' access to markets and increases transportation costs (Ahmed & Hussain, 1990). Research from other developing countries such as India and Sub-Saharan Africa has also shown that infrastructure improvements, especially in road networks, are critical for reducing costs and enhancing productivity (FAO, 2011).

Other Variables

- **Years of Farming Experience:** The coefficient for years of farming experience is **0.99**, with a standard error of **0.80**, but it is not statistically significant (p-value = **0.213**). This suggests that experience alone does not significantly impact agricultural productivity in this context, a finding consistent with some studies where other factors such as access to technology and education are more critical than mere experience (Sims & Lafferty, 2013).

4.8. Summary

The regression analysis reveals several key factors influencing smallholder farmers' agricultural productivity in Ethiopia. **Income level** has a positive impact, with an increase in income boosting productivity by 10.55 units. **Landholding size** is the most significant factor, with a one-hectare increase leading to a 46.8-unit increase in productivity. **Cost of inputs** negatively affects productivity, with a unit increase in input costs reducing output by 12 units. **Education** has a significant positive effect, where one more level of education increases productivity by 22.25 units. **Access to credit** shows a strong positive impact, increasing productivity by 74.48 units for farmers with access to credit.

Soil fertility improves productivity by 11.68 units, and **market information** also positively affects productivity, with a 26.85-unit increase for better information access. **Road infrastructure** (asphalt roads) is important, contributing 16.3 units to productivity for farmers with access to better roads. **Years of farming experience** did not show a significant impact, suggesting that other factors like access to resources are more critical than experience alone.

These findings align with studies from Ethiopia and other developing countries, highlighting the importance of income, land, education, credit, and infrastructure in enhancing agricultural productivity.

CHAPTER FIVE

5. CONCLUSION AND RECOMANDATION

5.1. Conclusion

Ethiopia's economy is currently centered on agriculture, and the improvement of agricultural production through road transport services was the primary driver of the country's shift from subsistence to more commercial agricultural production levels, both for consumption and to meet market demand. Therefore, in this study, researcher focused on the role of road transport services on small-holder farmers' agricultural productivity in the case of Abeshige Woreda Gurage Zone by including other necessary variables.

The findings from the description show the role of transport service, road quality (asphalt road), and transport service, access and transport cost variables are most important energetic variables in the increment of agricultural productivity. From the response of respondents on road quality or asphalt road was 23.59% of the woreda, but 76.41% were not qualified. For this reason, transport service and access was only 45%. From their

response to the role of transport service in agricultural productivity, 63.59% of the respondents confirm high role and the rest say 22.56% and 13.85% of the respondents say medium and low respectively, and 72.3% of respondents argue that transportation costs were very expensive and high transportation constraints was faced.

OLS was applied to analyze the role of road transport services in the growth of agricultural productivity and the findings from OLS regression model, the explanatory variables were income level, land holding size, cost of input, education, credit service, fertility of the land, market information and Asphaltroad were a significant and the remaining variables Distance from home to main road, Transport cost, The role of transposrt service and Years of farming experience were found to have no significant effect on the smallholder farmers agricultural productivity. The distance from home to the main market or main road and the cost of inputs have a negative impact on the smallhold farmers' agricultural productivity.

The OLS result emphasizes the level of significance of in dependent variables with dependent. The income from farm and non-farm is very important and significant at 10% level significance, income of smallholder farmers helps over all living standards. The farmer's income increases by one unit /one ETB, the agricultural productivity of smallholders increases by 10.55 units on average and Land holding size increases by one unit the crop production of farmers increases by 46.8 unit.

The cost of agricultural inputs have a negative and statistically significant impact at 5% on agricultural production. When the cost of input increases by one unit, the agricultural production decreases by 12 units on average and the education level of householder's one more level of education increases, the smallholder farmers' agricultural production increases by 22.25 units on average. The farmers' educational level increases, then it improves the skills of farmers at farming, by gathering better market information, improves better and connections with merchants.

Access to credit in the above table result shows it has a positive effect on small householder farmers' agricultural productivity at 1% significant level. The OLS estimation result shows that a person who has access to credit increases agricultural productivity increases by 74 units more than a who didn't have access to credit and

farmers who hold the fertile land produce 11.67 units higher production than those who do not hold fertile land. Other factors remain constant.

Market information was basic factors that affect the productivity of smallholder farmers. In this study, market information has positive and statistical significance at 10%. When the increase in market information increases by one unit, then the level of significance for smallholder farmers' agricultural productivity increased by 26.85 unit on average. In the study, the estimated probability of smallholder farmers' agricultural productivity was positively impacted by access to better road conditions or better asphalt roads, and this effect was significant at the 10% level. The results specifically show that, when all other factors are held constant, the predicted probability of producing agricultural productivity would be 16.3 percentage points higher for the farmer with access to better road conditions than for the farmer without.

Finally, the findings indicate that farmers can have good transport access. Qualified roads minimize transaction cost, and they were near to gate better information about the price of product and appropriate information to produce market-based products and produce more crops, to improve their life.

5.2. Recommendations

- ☞ The intensity to increase the householder's farmers agricultural productivity, the government should encourage the farmers through in the way of production by supporting different infrastructures.
- ☞ The respondents argue that transportation cost was very expensive and less access, therefore the government or the responsible bodies should improve this problems, through identify the role road transport service and its effect. Then gives solution through road maintenance, constructing new road projects based on concerns of community development and improve the transport access to transportation their inputs and their products from place to place.
- ☞ The benefits of efficient road transport systems to income of farm and non-farm of smallholder farmers by increasing agricultural productivity and helps over all living

standards. Therefore to increase the farmer income, government and responsible body should encourage farmers in constructing efficient road system and access.

- ☞ From the result Cost of agricultural inputs have negative and statistically significant impact on agricultural production, therefore government should improve this problem through communicating national and international community to minimize the cost and mobilize the distribution of inputs.
- ☞ Access to credit in the result shows it have a positive and significant effect on small householder farmers agricultural productivity. The OLS estimation result show that a person who have an access to credit increase agricultural productivity increases by 74 unit more than a farmers who didn't have an access to credit, therefore the financial sectors and responsible bodies should prepare the access to farmers, this give more chance for farmers even their land was not fertile they can buy fertilizer and use more.
- ☞ Final recommendations for farmers, future researchers and agricultural experts, Market information was basic factors that affect the productivity of farmers. In this study market information has positive and statistical significant. Therefore farmers should search the information about market conditions and agricultural experts and responsible bodies should give general information about market and market related products.
- ☞ The transport sector should arrange the constant of transport service and should control the transportation cost of the rural community.

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APPENDEX A: Questionary

Wolkite university

College of social science and humanities

Department of govornance and development studies

The Role of Road Transport Services on Small-Holder Farmers' Agricultural productivity.

Dear Sir/Madam

My name is Natinael Tesfaye, I am MA student at Wolkite University, now I'm conducting MA graduation reaserch. The research title is "The Role of Road Transport Services on Small-Holder Farmers' Agricultural productivity in Central

Ethiopia Region: A Case of Gurage Zone”. This questioner is designed for the purpose of collecting data from rural households to examines their the challenges and contribution of road on smallholder farmers agricultural productivity. For the questions you are asked to choose among the alternatives, please choose and encircle the letter of your choice and For the open ended type questions, try to put your answers on the space provided in a neat and readable hand writings. This questioner is purely an academic and any information you provide use will be used confidentially. So, feel free and respond to the question to be asked below. I would like to thank you in advance for your time and willingness to participate in this survey.

Thank you for your cooperation!!!!

Woreda _____

Kebele _____

3.1. Demographic Background of the Respondents

1. Sex: Male Female

2. Age of respondents

A. 18 -25

B. 25-35

C. 35-45

D. 45-55

E. Greater than 55

3. Marital status Single Married Divorced Widowed

4. Educational Level

- A. Illiterate (Households who can not read and write)
- B. Primary Education
- C. Secondary Education
- D. Certificate
- E. Diploma and above

5. Total number of family members (Family size) _____

1- 3 3- 6 6-9 9 and above

6. income level low, medium good

Female: Age 1- 10 Age 11- 20 Age 21- 40 Age 41– 60 Age 61 and above

7. The number of dependents in your family.

A. ildren: How many are they in number?_____

B. Adult Male: How many are they in number?_____

C. Adult Female: How many are the in number?_____

D. Elderly: How many are they in number?_____

Farm Characteristics

1. Do you have your own land?

Yes

No

2. If your answer to Q#1 is “No”, how did you get land that you have to cultivated?

A. from parents C.by crop sharing common benefit

B.by payment D.Other; specify _____

3. How much the land holding size you have acquired in Q#2 (in hector) _____

4. If your answer to Q# 1 is Yes, do you have a land owner ship certificate? Yes No

5. How large is your land holding size in TsimadI /hectar? _____.

6. What is the nature of the land you own or cultivated land?

Steeply Sloping Plain Mixed sloping

7. How do you describe the fertility of the land you cultivate?

fertile not fertile

8. How would you describe the Type of land/soil that you have cultivated?

Loam soil Red Sheshiher

9. Which is the type of agricultural activities you are Applying? Crop production Livestock rearing Non-farm activities Off-farm Other specify _____

10. If your answer in Q# 9 is Crop production, which crops are grown?

Types of crop product	For what purpose you can produce	Land devoted (in tsimad)	Crop Harvested (in qtl)	Crops sold (in qtl) in the production year	Price
					Product per qtl
Teff					
Maize					
Peppercorn					
Barley					

11. Do you get enough rainfall? yes no

12. If your answer in Q#11 is no; what type of product would you cultivate?

cash crop livestock other specify _____

13. If the answer in Q#11 is yes; How often do you cultivate your land in a given year?

once in a year twice in a year three time in a year above

14. Have you rented farm land? Yes No

15. If the answer in Q#14 is yes; from whom you would get? governmental organization

religious institution small-hold farmers other specify _____

16. The answer in the Q#14 is yes, how many hectors do you get? _____

17. If your answer in Q#14 is yes; how would you describe the cost of rented land?

expensive medium cheep

18. How many years of farming experience, do you have? _____

19. What knowledge and skill have you gained throughout your farming experience?

- On Season
- On Input Use
- On Ploughing

20. Do you have an Oxen? yes no

21. If your answer to Q#20 is yes, how many Oxen do you have? _____

22. If your answer to Q#20 is no, how would you plough your cultivation land?

- rent oxen entreaty oxen rent tractor other

23. If your answer to Q#22 is rent oxen/tractor, how much do you pay? _____

24. How would you describe the cost in Q#23? expensive medium cheap

1.3. Farm input technology and financial service.

1. Are you a member of extension package? yes no

2. If your answer in Q#1 is yes, how would you describe the service of extension package through providing new technology for the community. good medium low

3. If your answer in Q#1 is yes; which type of service you would receive?

- credit improve seeds fertilizer agricultural training other specify _____

4. Are you applying fertilizer technology? Yes no

5. If your answer to Q#4 is no; what would you apply for cultivation?

- compost muck excrement other _____

6. Which fertilizer, have you purchased in the production year?

- DAP UREA both none of them

7. If your answer to Q#4 is yes; how many quintals would you purchase? _____

8. How would you describe the cost of fertilizer? High medium low

9. Are you credit servant? yes no

10. If your answer to Q#9 is yes; which organization was Accessible to borrow?

- micro finance banks informal creditors others _____

11. If your answer to Q#9 is yes; how much would you borrow? _____

12. How would you label the interests of Lenders or borrowers? expensive fair cheap

13. For what purpose you would borrow?

to purchase agricultural inputs to purchase agricultural land for transportationother _.

14. What is your credit/ loan repayment performance? high medium low

1.4. Asset Endowment

1. Do you have livestock? yes no

2. If your answer to Q#1 is yes; how many of the following items do you own?

	Assets	Quantity	Livestock sold in year (in #)	Price per item
Livestock	Caw			
	Oxen			
	Donkey			
	Goat			
	Sheep			
	Chicken			
	Others			

1.5. Road Type

1 Is there asphalt road in your woreda? yes no

2 If yes in Q#1 how many KM far from your home?

3 If yes in Q#1 how many years has the road given service for the community?.....

4 If yes in Q#1 what type of benefit do you get? minimum transport cost easy transport our product others specify.....

5 When injury will happen on the road, who will repair the road?

a) Community b) government c) others.....

1.6.Transport Access and related issues

1. How do you rate the role of transposrt service in increasing your agricultural product?

high medium low

2. The transport service access was constant? yes no
3. If yes in Q#2 how many time transport access was assigned perday from main city to your village? once twice more than two
4. How do you rate transport constraint in your village? good medium bad
5. Distance to the nearest agricultural input and out put market in km _____
6. Farm access road a) tarred road b) un-tarred road c) footpath
7. Market access to agricultural input market a) bad b) fair c) good d) very good
8. Your capacity to transport own agricultural produce
a) Very little b) little c) high d) very high
9. The attitude of smallholder farmer to the quality and type of transport service offered
a) bad b) fair c) good d) very good e) excellent
10. The most important journey purposes of a household a) work on farm b) market c) social d) accessing medical care
11. Are there better roads to travel to market and from market? a) yes b) no
12. Are there sufficient vehicles to move to/from markets? a) yes b) no
13. Are there more frequent and reliable transport services in your area? a) yes b) no
14. Is there any change in transport cost in summer season? a) yes b) no
15. If yes in Q#11 what are the reason for changing transport cost _____
16. How do you rate the transport cost in your area? a) very cheap b) cheap c) Medium
17. Amount of Transport cost _____ Birr per kg per km

1.7. Market and related issues.

1. What is your nearest market that you would sale your product? _____
2. How would you sell your output? on farm land holding the product in home and sold after several time in market though middlemen in market by own.
3. Do you have a transport access from home to market? yes no
4. If your answer to Q#3 is no; how would you take your output to the market?
 by carrying on through donkey or horse other specify _____
5. If your answer to Q#3 is yes; how many KM far from your home? _____
6. How much do you pay to travel by car in one journey? _____
7. How many times on average do you travel in month to the nearest market? _____

8. How do you get market information based on inputs, output and price related issues?

by watching TV and Radio from Agricultural experts middlemen other specify ___

1. Social capital Related issues.

1. Are you a member of social association in your community? yes no

2. If your answer to Q#1 is yes, in which association you are participant?

indrI equb debo female's association other specify _____

3. What is the purpose of member ship in the association? giving money during injury happen giving support during crop cultivation giving money for road construction

other specify _____

4. Do you save money in the association? yes no

5. If your answer to Q#4 is yes; how much do you save? _____

2. Physical Asset

1. Which category of storage facility do you use? a) Traditional b) Modern

2. How do you rate the price of cereal crops in your area a) expensive b) medium c) cheap

3. Do you have own house; in your living area? yes no

4. If your answer to Q#3 is no; would you get the house service? by rent by house of relatives by government house other specify _____

5. If your answer to Q#3 is no; would you get the transport service?

3. Human capital and related issues

1. Do you have an Agricultural training? yes no

2. If your answer Q#1 is yes; who would adjust and give the training? by own

by government support by NGOs support by community other specify _____

3. How many quantal of product in Kg, do you get from farm, off-farm and non-farm activities? _____

4. How many quantal of product in Kg, do you sell in market? _____

5. How much do you earn from each unit? _____

Appendix B Interviews

1. How would you describe the effect of road transport service on increasing agricultural productivity?
2. What are the problem of inadequate transport service for rural community?
3. How the transport sector support farmers in their willing ness of increasing the agricultural productivity
4. Either any regulations of transport sector that farmers in their agricultural production
5. How to solve the transportation constraints faced by farmers productivity in Gurage zone Abeshige woreda
6. What are the Mjor socio-economic and transport related challenges that affect farmer's participation in crop output market.
7. How farmerscan be member of extension package?
8. How farmers can get increasing agricultural productivity training
9. What type of training was given for smallhold farmers
10. How often the maintainance of road in years

Appendix C OLS Result

1 OLS role of transport service on crop production

Source	SS	df	MS	
Model	2067423.75	12	172285.313	Number of obs = 195
Residual	157094.707	182	863.157731	F(12, 182) = 199.60
Total	2224518.46	194	11466.59	Prob > F = 0.0000

R-squared = 0.9294
Adj R-squared = 0.9247
Root MSE = 29.38

inquntal	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
incomelevel	10.55373	6.767023	1.56	0.121	-2.798176	23.90563
landholdingsizeinhector	46.79615	1.819106	25.72	0.000	43.2069	50.38539
costofinput	-12.01469	6.769506	-1.77	0.078	-25.3715	1.342112
howmanyKMfarfromyourhome	-2.318337	1.435327	-1.62	0.108	-5.150358	.5136841
transportcost	1.030488	4.549555	0.23	0.821	-7.946167	10.00714
Education	22.25217	6.74502	3.30	0.001	8.943683	35.56066
creditservice	74.48436	18.68164	3.99	0.000	37.62391	111.3448
theroleoftransposrtservice	3.926453	4.470786	0.88	0.381	-4.894784	12.74769
fertilityoftheland	11.6788	5.172833	2.26	0.025	1.472364	21.88523
marketinformation	26.85039	13.1651	2.04	0.043	.8745352	52.82625
asphaltroadinyourworeda	16.29605	9.168285	1.78	0.077	-1.793744	34.38585
yearsoffarmingexperience	.9931422	.543846	1.83	0.069	-.0799117	2.066196
_cons	-99.81492	38.24313	-2.61	0.010	-175.2718	-24.35801

2 OLS result role of transport service on crop production after taking robust action

Linear regression

Number of obs = 195
 F(12, 182) = 193.82
 Prob > F = 0.0000
 R-squared = 0.9294
 Root MSE = 29.38

inquntal	Robust					[95% Conf. Interval]	
	Coef.	Std. Err.	t	P> t			
incomelevel	10.55373	5.937624	1.78	0.077	-1.161703	22.26916	
landholdingsizeinhector	46.79615	3.575205	13.09	0.000	39.74197	53.85032	
costofinput	-12.01469	6.835405	-1.76	0.080	-25.50152	1.472135	
howmanyKMfarfromyourhome	-2.318337	1.552701	-1.49	0.137	-5.381946	.7452725	
transportcost	1.030488	3.660273	0.28	0.779	-6.191538	8.252514	
Education	22.25217	10.806	2.06	0.041	.9310198	43.57333	
creditservice	74.48436	26.15651	2.85	0.005	22.87536	126.0933	
theroleoftransposrtservice	3.926453	4.420527	0.89	0.376	-4.795619	12.64852	
fertilityoftheland	11.6788	4.894759	2.39	0.018	2.021028	21.33657	
marketinformation	26.85039	14.03127	1.91	0.057	-.834476	54.53526	
asphaltroadinyourworeda	16.29605	8.888265	1.83	0.068	-1.24124	33.83335	
yearsoffarmingexperience	.9931422	.795436	1.25	0.213	-.5763199	2.562604	
_cons	-99.81492	53.8185	-1.85	0.065	-206.0033	6.373497	

APPENDEX D Diagnostic Test

1. VIF

. vif

Variable	VIF	1/VIF
Education	19.54	0.051173
marketinfo~n	17.82	0.056115
creditserv~e	15.23	0.065669
yearsoffar~e	9.14	0.109412
incomelevel	3.96	0.252619
transportc~t	3.61	0.277158
asphaltroa~a	3.42	0.292149
costofinput	3.08	0.325037
landholdin~r	2.87	0.347965
theroleoft~e	2.38	0.420287
howmanyKMf~e	1.31	0.760833
fertilityyo~d	1.06	0.946756
Mean VIF	6.95	

2. Normality test

swilk resid

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
Resid	195	0.99650	0.511	-1.541	0.93832

3 Collecting data from respondents



4 Observation of community problem on road access













