TECHNOLOGY TRANSFER FOR AGRICULTURAL GROWTH IN ADAA WOREDA

Walelign Areru Mengist

A Thesis Submitted to the department of Technology and Innovation management

School Of Humanity and Social Science

Presented in Partial Fulfillment of the Requirement for the Degree of Master's in Technology and Innovation management

Office of Graduate Studies

Adama Science and Technology University

June 2024

Adama, Ethiopia

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Advisor: Tsegaye Mulugeta (Ph.D)

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Declaration

I hereby declare that this Master Thesis entitled "**Technology Transfer for Agricultural Growth in Adaa Woreda**" is my original work. That is, it has not been submitted for the award of any academic degree, diploma or certificate at any other university. All sources of materials that are used for this thesis have been duly acknowledged through citation

Name of the student	Signature	Date

Recommendation

I, the advisor(s) of this thesis, hereby certify that I have read the revised version of the thesis entitled "**Technology Transfer for Agricultural Growth in Adaa Woreda**" prepared under my guidance by **Walelign Areru** submitted in partial fulfillment of the requirements for the degree of Masters of Science in Technology and Innovation Management. Therefore, I recommend the submission of a revised version of the thesis to the department, following the applicable procedures.

Dr. Tsegaye Mulugeta	______________________	______________
Major Advisor	Signature	Date
______________________	_________________________	_______________
Co-advisor	Signature	Date

Approval Page of M.Sc. Thesis

I the advisor of the thesis entitled "**Technology Transfer for Agricultural Growth in Adaa Woreda**" and developed by **Walelign Areru**, hereby certify that the recommendations and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

Dr. Tsegaye Mulugeta ________________ ________________

Major Advisor Signature Date

______________ ______________ ____________

Co-advisor Signature Date

We, the undersigned, members of the Board of Examiners of the thesis by **Walelign Areru**, have read and evaluated the thesis entitled "**Technology Transfer for Agricultural Growth in Adaa Woreda**" and examined the candidate during open defense. This is, therefore, to certify that the thesis is accepted for partial fulfillment of the requirement for the degree of Master of Science in Technology and Innovation Management.

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Final approval and acceptance of the thesis are contingent upon submission of its final copy to the Office of Postgraduate Studies (OPGS) through the Department Graduate Council (DGC) and School Graduate Committee (SGC).

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School Dean Signature Date

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Office of Postgraduate Studies, Dean Signature Date

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ABSTRACT

The purpose of this study was to assess the state of technology transfer for Adaa Woreda's agricultural growth. The significant of research were to increase crop productivity, increase the income, improve agricultural production techniques, and save time. This study's scope was limited to Adaa Woreda's agricultural productivity. The study used a mixed research approach, cross-sectional data, and primary and secondary sources to accomplish this goal. Questions about the primary data were gathered using questionnaires. The agricultural office in Adaa Woreda, as well as additional papers, provided the secondary data. A sample size of 193 respondents were used in the multiple stage method of sampling. The primary finding of this study was to analysis of crop productivity and which technology was more relevant than others factors by using Stata version 15 software application. The findings of the study to show that estimated results of gender, family size, land size, irrigation, fertilizer, improved seed and tractor were found significant and important determinants. The results of the multiple linear regression analysis on the determinants of agricultural productivity show that gender, family size, land size, irrigation, fertilizer, improved seed, and tractor are more significant than other factor.

Key terms**: **agricultural growth, crop productivity, and technological transfer.

CHAPTER ONE: INTRODUCTION

1.1 Back ground of the study

Agriculture is the world's most important sector. It provides all our food, raw material for most of agro based industries and creates important opportunity to large population of developing countries (Moussa, S. Z. 2002). In Africa, agriculture is central to economic growth and the reduction of poverty. The agriculture sector accounts for 35 percent of the continents GDP and corresponds to 40 percent of its exports. About 72 percent of the people live in rural areas, and the sector supplies 70 percent of the employment opportunities. Furthermore, 70 percent of the poor people live in rural areas in the African countries. Further, about 59 percent of the rural populations are living below the poverty line (Moussa, S. Z. 2002).

Agriculture is the mainstay of the Ethiopian economy. The sector contributes 50% of the country's gross domestic product (GDP). It directly supports about 85% of the population and generates 88% of foreign exchange earnings (Tewodros & Tesfaye, 2018). The differences in production environments among regions enable the country to produce a variety of crops and rear different species of livestock.

However, the production system is dominated by smallholder farming under rain fed condition. The farming systems are also traditional, with a subsistence crop and livestock mixed farming system, with an average per capital land area of 0.2 ha in 2008 (Organisational & Matter, 2010). Although, the country is characterized by a diverse agro ecological zone and endowed with ample natural resources which support successful crop and animal production, the agricultural sector has low productivity (Sewnet et al., 2016). By most measures, the growth and innovation of the sector is weak. For instance, between 1996 and 2005, agricultural GDP per capital grew only by 0.48 per year.

Various factors contributed to the low productivity of the agricultural sector and food insecurity in the country. Of all the barriers, the low level of agricultural technology development, dissemination, utilization of modern production inputs and the low adoption rate of proven research technological production packages by smallholder farmers are among the important factors (Sewnet et al., 2016). For instance, only 37% of the farmers use inorganic fertilizers, with a very low application rate of 16 kg per hectare. Moreover, the uses of improved varieties is very limited in the country (Spielman et al. ,2010).

In the last decades, agricultural information has increased rapidly; however, the effective transfer of agricultural knowledge and technological package systems is a bigger challenge(Sewnet et al., 2016). The main factors affecting the effective transfer of agricultural systems to the end-users are the knowledge level of the information users, there access to information of end users, and the readiness of farmers for adoption (Carrascal et al., 1995). Therefore, comprehensive transfer of research knowledge and production technology is demanded to impact the livelihood of the end users; farmers (Sewnet et al., 2016); Carrascal et al., 1995). The agricultural innovation system approach is already recognized as a best means to use as a comprehensive framework for analyzing the status of the agricultural system in developing countries (Klerx et al., 2009). Up-to-date and structured data coupled with open information transfer system in parallel with interactions among the stakeholders are necessary for an improved agricultural information transfer system (Bouma, 2010) and agricultural production uplift (Sewnet et al., 2016).

The scarcity of financial resources with increasing net food imports and world food prices raises concerns of poverty about the outlook for Ethiopia. Financing the expected increase in cereal imports by the developing countries will depend mainly on their export earnings and on food aid. On one hand, export earnings depend on international market prices and the rate of economic growth of the developed countries; on the other hand, food aid depends on the surplus of food production and the competing demands for development assistance among developing countries in the world. However, food aid as well as financing food imports neither lead to development nor reduce poverty. Since the early recognition of the role that the agriculture sector can play in simulating overall economic development, the focus has been on accelerating its rate of growth. Steady agricultural development generates economic growth in non-agricultural sectors, which reduces poverty as well as urban unemployment rates. Most of the developed economies were supported by continuous agricultural growth. For developing countries, the agricultural sector is still and will continue to be the engine of development and overall economic growth.

According to the Ethiopia Socioeconomic Survey (ESS) 2013/14, agriculture (farming or livestock) is practiced by 98 percent of rural households, 61 percent of small town households, and only 13 percent of large town households. On average, households own 1.4 hectares of land. Fertilizer is applied in about two-thirds of maize, wheat, barley, and teff fields. It is only applied in 35 percent of sorghum fields. Herbicides and pesticides are also used. With the exception of maize and wheat, improved seed coverage is very low. Estimations based on self-reported yield by field show that in 2013/14 Maher season productivity for five major crops was as follows: maize 22 quintals per hectare; wheat 18 quintals per hectare; sorghum 11 quintals per hectare; barley 11 quintals per hectare; and teff 8 quintals per hectare. The crop disposition pattern of major cereal crops shows that production is mainly for consumption (from 55 to 77 percent). Sales account for 7-22 percent of crop disposition. The composition varies by crop type. Farm households tend to sell more high value crops, such as teff and consume more of low value cereal crops such as sorghum and maize.

According to Adak (2015), technology has become a major endogenous variable in aggregate production functions. Fast, positive economic growth and high productivity rates were brought about by the new technological investments. The relationship between the research and innovation sectors was first studied at the start of the 1990s (Aghion & Howitt, 1992). Using simulations, they constructed an endogenous growth model. (Romer, 1990) defined the benefits of investing in technology in literature. Johns suggested that long term growth may be possible through R&D efforts (Jones, 1995). National research centers studied the influence of R&D on aggregate production functions in the early 2000s (Sveikauskas, 2007). The best-defined analysis of R&D activities and productivity development was found in the works of (Loo & Soete, 1999). Research and development efforts by small businesses have been demonstrated to yield significant economic benefits by introducing novel technology (Comin, 2004). Studies on patenting and economic growth have been conducted recently (Westmore, 2013). Some recent methods use the Schumpeterian model to explain the endogenous growth functions of today (Aghion, Akcigit, & Howitt, 2013). More recently, the relationship between entrepreneurship, innovation, and economic growth has been studied in the literature on economics (Galindo & Teresa, 2014).

Agricultural technology transfer plays a chief role in transforming agricultural productivity in rural areas, especially in the current setting where food demand surpasses production capacity. Technology transfer facilitates the movement of soft and hard skills essential for improving farm production. Technology transfer is the main component of technology development; this is because for the developed technology to be applied effectively, it needs to reach the end-users of the technology with its full package, and the feedback also needs to reach the developer of the technology so as to involve the ideas of all actors in the decision-making. Considering technology dissemination as a main part of technology development and research coordination, it was started in 1960 in Ethiopia (EARO, 1998), and since then, a number of efforts have been made to improve the technology transfer system and linkage between different partners like research, extension, farmers ,and other stakeholders (ICRA, 2010). Although extension has a long history in Ethiopia, the coverage is very low and the linkage of the actors in the system is very poor (Sewnet et al., 2016); Davis et al., 2010), which is the main reason for the low adoption of improved agricultural technology/production systems, and inputs (Sewnet et al., 2016). Moreover, the extension agents are not accessible for farmers, and the interaction between different agricultural innovation actors is very limited in the country (Gildemacher et al., 2009). This poor linkage of the stakeholders, coupled with disregarding farmers indigenous knowledge in extension programs and during the policy development process, makes the linkage ill functioning (Kassa and Alemu, 2017; (Sewnet et al., 2016). This calls for improvement of the linkage between the different agricultural innovation actors and the information and knowledge transfer system, so as to alleviate poverty, improve the livelihood of smallholder farmers in particular, and improve the overall economic status of the country.

Agricultural technology transfer occurs when an individual acquires, imitates, or adapts technology developed elsewhere, to improve the level of his/her agricultural productivity. Inadequate assimilation of technology is limiting the rate of agricultural growth over time, and thus affects both quantity and quality of what is produced.

The application of agricultural technology has enabled agricultural sector to be able to meet the rising demands for food occasioned population increase. Consequently, modern agriculture engages in the usage of various sophisticated technologies (Amadi &Okagwa, 2020). Agricultural technology is the integration of advanced engineering principles, farming techniques and scientific development to manipulate the growth, maturity and well-being of crops and livestock (Nnodim & Raji W.I, 2023). Agricultural technology transfer plays a chief role in transforming agricultural productivity in rural areas especially in the current setting where food demand surpasses the production capacity. Technology transfer facilitates the movement of soft and hard skills essential for improving farm production

1.2 Statements of the problem

In sub Saharan African countries like Ethiopia, where small-scale farming dominates, the overall national economy’s agricultural growth and productivity are very poor. The agriculture of the economy is characterized by limited use of improved input and back-ward agricultural activity (Moussa, S. Z. 2002).

In today's Ethiopian creativity and technology transfer for growth and poverty reduction are unavoidable. Academic research and technology transfer have long been recognized as the most successful ways of advancing the country's economy (Gobena et al., 2021). Therefore, the purpose of this study was to assess the status of technology transfer for agricultural growth in Adaa Woreda and to recommend some points on how to minimize poverty and maximize food security. Development in Ethiopia is characterized by some internal and external challenges. The six factors likely to contribute to future increase in crop productivity in Adaa Woereda are: expansion of land under cultivation, irrigation intensive projects, fertilizer distribution, supply of machinery, awareness of information technology, and biotechnological increase in yield.

The majority of the Adaa woreda population resides in rural areas and is engaged in some forms of agricultural production. Particularly, the development of agricultural productivity in Adaa Woredas is influenced by; traditional methods of farming with little change in farming practice in this Woreda, a lack of modern input, environmental and infrastructural constraints a lack or insufficiency of expertise in promoting agricultural policy and land use planning, agricultural causes , and surveys. This study identified the factors of technology transfer for agricultural growth in Adaa Woreda. Since no study was undertaken previously regarding the assess technology transfer for technology transfer for agricultural growth in Adaa Woreda. Even though there were many studies that are similar to these which were undertaken as a whole in the Oromia region as well as other parts as of the region, no study has been conducted in Adaa Woreda so far. So, the contribution of this study is more about to assess agricultural growth of farmers in the study area.

The purpose of this study is minimize poverty , increase the crop productivity and ensure food security by using different technology transfer methods and different technology product with rural area in Ethiopia. (Moussa, S. Z. 2002) study about technology transfer for agricultural growth in Africa used a quantitative approach, secondary data, graphical analysis, and time series analysis but this study used a mixed research design, both primary and secondary data, and cross-sectional data types and to include the factors that affect information technology in agricultural growth. (Tewodros & Tesfaye, 2018) study also Agricultural Knowledge and Technology Transfer Systems in Southern Ethiopia used quantitative data and questioner data collection technique around Hawassa; however this study used a mixed research approach and major factors of technology transfer for agricultural growth around Adaa Woerda. (Flood, 2013) study to increase the productivity of barley and to ensure the sustainability of barley production in the various barley agro-ecologies, but the gap in that study was a lack of improved varieties for the different production systems, and inadequate information and technology on barley-weed competition in different production systems. G (2020) studied factors affecting agricultural productivity in Doba Woreda using to mixed research approach, primary and secondary data sources and descriptive statistics, but the gap in this research was that it analyzed only descriptive analyses, not expressed in an econometric model, and which factors were more significant in increasing agricultural productivity not clearly stated.

1.3 Questions:

This research seeks to identify the status of technology transfer and factors that affect technology transfer for agricultural growth. Specifically, the study addresses the following main questions:

1. What are the effects of socioeconomic characteristics on farmers in technology transfer for productivity?
2. What are the factors that affect technology transfer for agricultural growth?
3. What are the statuses of technology transfer in the Adaa Woereda agricultural sector?

1.4 Objective of study

1.4.1General Objective

The main objective of the study is to assess the status of technology transfer for agricultural growth in Adaa Woreda.

1.4.2 Specific Objective

This research paper addresses the following specific objectives:

- Describe the effect of socioeconomic characteristics on farmers in technology transfer for productivity.
- To identify the major factors affecting technology transfer for agricultural growth.
- To describe the status of technology, transfer in the Adaa Woereda agricultural.

1.5 Significance of the study

The significates of these study are, increasing crop productivity, improving agricultural production methods, saving time, reduce poverty, and improve the quality of life of its population.

1.6 Scope of the study

The major focus of this study was to determine the status of technology transfer for agricultural growth in Adaa Woreda. The research area selected for the survey study was Adaa Woreda in the Oromia region. The agricultural growth at the global level was also critically reviewed from secondary sources. Adaa Woreda has 14 kebeles, but this research was focused on two kebeles, such as Godino and Keteba. It also focused only on crop productivity in 2022/2023 or 2014/2015 E.C.

1.7 Limitation of the study

Lack of organized and adequate historical data at the Woreda level was one of the limiting factors in this study. This emanates from the poor record handling and lack of willingness of some of the offices to provide the relevant documents. In addition, the available agricultural production-related data was highly exaggerated compared to the sources at the household level. This was a challenge for addressing research objectives that depended on secondary data from the Woreda.

CHAPTER TWO: LITERATURE REVIEWS

2.1 Theoretical Literature Reviews

In the agricultural economic literature, many econometric models have been formulated to determine sources of agricultural growth. Models of agricultural production have included internal and external factors, among other explanatory factors, to verify the effectiveness of development and agricultural investments. A historical review of such models shows that early efforts included only land and labor as major factors for agricultural growth. Modern models, however, have added fertilizer and machinery inputs. Soil fertility, climate, and life expectancy were also proposed for statistical analysis as explanatory variables. In comparison to Asia, some studies suggest that animal and human diseases, along with soil fertility, are the main factors behind the poor performance of the agriculture sector in Africa. More recently, researchers added to the list of explanatory variables several alternative factors, such as agricultural research, marketing infrastructure (roads, transport, and communication), education, and specifically agricultural technical education in addition to irrigation versus rainfall factors. Some of the literature has focused on government intervention and price control as policy constraints that reduce profit margins and thus prevent the use of technology. It is argued that technology transfer cannot have a significant impact in Africa without strong institutional foundations. More attention has been given to macroeconomic policies in African countries as a consequence of the economic crises and increasing indebtedness of African countries.

2.2 Technology Transfer

The process of moving technology from one unit to another is known as technology transfer. Technology transfer is the flow of know-how, technical information, or technology from one organizational context to another, according to Bozeman (2000). When it comes to raising per capita income or altering the economic and social structure, technological advancement is a key factor in determining economic development. First, there are two main ways that technology can be transferred: through equipment or other intermediary commodities.

Barriers to technology transfers in agriculture

Technology transfer presents a variety of challenges from one location to another, including misaligned university strategies for academic entrepreneurship, a narrow focus for the technology being transferred, a lack of attention to entrepreneurs and teams, difficulties moving from opportunity to market, a failure to recognize value, and a restricted ability to close the financing gap. Farmers encounter numerous difficulties while trying to market their produce. A few of the difficulties are listed here.

Weak market linkages

Weak market linkage areas with surplus production and areas with deficits coexist, but farmers are unable to benefit from the surplus markets due to inadequate market coordination (Alene et al., 2007). Unfavorable correlations between input and output pricing result from underdeveloped markets for agricultural inputs and outputs (Aune, & Bationo, 2008).

Asymmetry of information

When parties involved in a transaction have unequal information, information asymmetry arises. Opportunistic behaviors may result from this (Hobbs, 1996). In particular, specification opportunism results from information asymmetry, whereby the party transacting has the advantage of misleading the other party about details of the transaction, such as product quality, scales of measurement, and other relevant details (Gebremedhin et al., 2009). Accordingly, Alene et al. (2007) have shown that Kenyan farmers obtain low prices from the dealers who buy their grain due to inadequate and unequal access to information. Small farmers are the primary victims, even though they might be participating in specification opportunism (Gebremedhin et al., 2009).

Transacting parties make an effort to obtain information about activities and transactions from a variety of sources in order to mitigate the difficulties posed by information asymmetry. Farmers mostly rely on agronomists, extension agents, other farmers, family members, friends, printed materials, and websites as knowledge sources, according to Charatsari & Lioutas (2013).

High transaction costs

The main obstacle keeping smallholders from trading their agricultural products is transaction costs (Markelova & Mwangi, 2010). Fixed Transaction Costs (FTCs) are the expenses related to information gathering, negotiation, and oversight (Key, Sadoulet, & de Janvry, 2000). Since a farmer may pay the same search costs to sell one ton or ten tons of product, the FTCs are unaffected by the quantities of inputs and outputs sold (Alene et al., 2007). Smallholders who sell agricultural products must choose between paying below market rates and paying a lot of money to find better deals (Tadesse & Shively, 2012). Conversely, proportional transaction costs (PTCs) comprise the expenses incurred in moving the inputs or goods being exchanged, such as the time required to get the product to the customer and the cost of transportation (Alene et al., 2007). Because fixed transaction costs influence the decision to transact and proportional transaction costs affect the amount to transact, fixed and proportional transaction costs are two-phase decision processes for market participation (Kyeyamwa et al., 2008). One of the goals of establishing cooperatives is to prevent market failure and guarantee economies of scale by pooling resources to buy inputs and jointly marketing defensive agricultural goods (Cook, 1995; Kindness, & Gordon, 2001). Ethiopia's rural development plan encourages the use of marketing cooperatives as a means of commercializing smallholder agriculture (Bernard, Taffesse, & Gabre-Medhin, 2008). In order to gain access to various markets, enhance price negotiation, and achieve economies of scale, cooperatives assist producers in combining their goods and coordinating their efforts (Baden, 2013). According to Stringfellow, Taylor, Lucey, Mckone, and Hussain (1997), there are trade-offs between group cohesion and economies of scale. Even if having more members increases the cost of coordinating, having more members helps achieve economies of scale (Bernard & Spielman, 2008). Therefore, uniformity of identity is necessary for cooperative members to function well (Barham & Chitemi, 2009). Farmers that use cooperatives benefit from access to financing services. The absence of assets limits smallholder farmers because they have restricted access to financing services and extensions. They voluntarily create cooperatives to deal with this issue (Benson & Jafry, 2013). Credit companies prefer group loans, so farmers can overcome the challenges of big expenditures necessary in processing technology, storage facilities, or transportation by pooling resources required for the down payment (Kindness, &Gordon, 2001).

According to research by Barham & Chitemi (2009), cooperatives' performance in agricultural marketing increases when the proportion of male to female leaders is higher. They gave the explanation that women don't have enough time to look for new market opportunities because they have more home duties.

Lack of rural infrastructure

One of the facilities required to enable the commercialization of agricultural products is rural infrastructure. Farmers are compelled to carry their goods to main roads and then transport them to the market due to the poor state of roads in developing nations

(Kamruzzaman & Takeya, 2008). For rural residents, this is costly and time-consuming (Kamruzzaman, & Takeya, 2008; Kyeyamwa et al., 2008).

2.3 Factors affecting technology transfer for agricultural growth

The key components of the Asian Green Revolution of the 1970s were the extensive agricultural support programs offered by the government or donors, including public irrigation projects, credit subsidies, fertilizer subsidies, floor pricing, and set prices (Bahiigwa et al., 2005). (Bahiigwa et al., 2005) went on to say that the Structural Adjustment Program (SAP) of the 1980s and 1990s destroyed the agricultural support policies that Asian countries had enjoyed, making it difficult to repeat the Asian Green Revolution in Africa. The government-sponsored agricultural support was decreased by the Structural Adjustment Program as a result of the rise of neo-liberal conservative ideology (Markelova, Meinzen-Dick, Hellin, & Dohrn, 2008). One of the program's objectives is for governments to limit the growth of money and credit in order to lower their internal and foreign deficits (Weissman, 1990). As a result, it became difficult for many farmers to get access to services (Markelova, Meinzen-Dick, Hellin, & Dohrn, 2008, p. 1; (Benson & Jafry, 2013).

The primary changes made to the Structural Adjustment Program were to: (1) promote private sector participation in agricultural marketing initiatives; (2) decrease or do away with government subsidies for the marketing of agricultural products and inputs; (3) improve agricultural export diversification; and (4) urge the government to assist NGOs and cooperatives in fulfilling their mandates (Bingen et al., 2003). Analogously, the Washington Consensus policies and the structural adjustment program disapproved of sector-specific approaches that emphasized the importance of market forces and the macro fundamentals (Janvry, 2010). Conversely, in the case of Africa, agriculture has suffered from major market failures, and there was a need for government intervention to ensure growth and development, which was ignored by the Washington Consensus (Janvry, 2010).

Some argue that because rain-fed agriculture predominates in Sub-Saharan Africa and other parts of Africa, with variable agro-ecological circumstances, the African Green Revolution should be planned differently from the Asian one (Janvry, 2010).

Furthermore, irrigation affected income, prices, food security, and growth in addition to facilitating the adoption of Green Revolution technology in Asia, such as rice and wheat varieties (Hussain & Hanjra, 2004). The expansion of the agricultural sector is essential to achieving the Millennium Development Goals of eradicating poverty and hunger (Rockstrom, Karlberg, Wani, Barron, Hatibu, Oweis, Bruggeman, Farahani, & Qiang, 2009).

2.3.1 Household characteristics of farm operators

Numerous factors, including household characteristics, influence farm operators' ability to transfer technology for agricultural growth. As will be discussed below, some of these characteristics include landholding size, age, gender, and education level.

2.3.1.1 Education and agricultural production

The importance of education in technology transfer for agricultural (2004 growth and productivity has been highlighted by research findings. (Asfaw & Admassie, 2004), for instance, found that the traditional factors of production—such as labor, capital, and stock growth—could not adequately account for the rise in national income. The 1960s saw the recognition of education's role in the rise in the national GDP. A corresponding investment in human capital should be made to support production practices and technology in order to accomplish agricultural development (Schultz in Bingen et al., 2003). This is due to the fact that knowledge and information are necessary for farmers to use technology, obtain input, alter their methods, and market their produce (Chowa, Garforth, & Cardey, 2012). According to Burton (2013) formal education increases farmers' participation in environmental initiatives and practices that support agriculture's sustainability. Additionally, it is thought that education promotes economic growth by increasing farmers' productivity and eradicating growth-resisting practices like word-of-mouth marketing (Asfaw & Admassie, 2004). The idea that the "knowledge poor will remain income poor" is supported by the likelihood that poor farmers' irrigation returns will stay low if there is inequality in educational endowments (Hussain & Hanjra, 2004). Everyone agrees that gaining information via education has a significant role in promoting economic development (Asfaw & Admassie, 2004).

2.3.1.2 Gender and agricultural production

In a particular culture or place, gender refers to the roles and interactions that are socially formed for men and women (Adeoti, Cofie, &Oladele, 2012). Women's and men's equal involvement is crucial to increasing agricultural income and productivity. When it comes to production, harvesting, and processing tasks on farms, women typically make up the majority of the labor force (Jafry & Suleiman, 2013). It is also well known that women farmers generate the majority of food and are in charge of providing for the necessities of the household (Camara, Diakite, Gerson, & Wang, 2011). Additionally, studies show that compared to male farmers, women farmers has higher environmental consciousness (Burton, 2013). However, several research findings suggest that there are gender disparities in the agriculture industry. As an illustration, certain crops are classified as "men's crops" and others as "women's crops" (Mohammed, & Abdulquadri, 2011). According to a study done in Ghana by Adeoti et al. (2012), men were more likely to produce vegetables because it required greater physical power. Conversely, de Brauw, Li, Liu, Rozelle, and Zhang (2008) found that women in China contributed 64% to the production of livestock, while men dominated 59% of the marketing job. They pointed out that their male colleagues control the profits and that this is the feminization of the labor force. Lack of capital, knowledge, and market access are further issues that hinder women farmers from producing enough to meet their basic needs (Jafry & Suleiman, 2013). Women are vulnerable to land grabbing and the loss of their cultural legacy because they lack understanding about women's rights (Camara et al., 2011). In the past, there have been other problems that have limited women's involvement and power in the agriculture industry. The custom of fathers giving farms to their sons, depriving daughters of farm ownership, was one of the obstacles (Alston, 2003). In addition, women's voice in land ownership was diminished by the belief that land rights were exclusively the property of men (Githinji, Konstantinidis, & Barenberg, 2014). Thus, given the vital contribution made by women in the agricultural sector is vital, there is a need to clarify which obstacles are unique to them (de Brauw et al., 2008).

Researchers are also curious to look at the production variations across families headed by men and women. Researchers discovered a range of outcomes in this regard. De Brauw, Huang, Zhang, & Rozelle (2013) conducted a study in China that demonstrated that families headed by women produced an equivalent amount of crops as households headed by men. Ragasa, Berhane, Tadesse, and Taffesse (2013) found that there was no production difference between plots owned by male and female farmers, provided other influencing factors were constant, in their survey done in the four major regions of Ethiopia (Tigray, Amhara, Oromia, and SNNP). They went on to say that variations in production were caused by variations in plot quality, access to inputs, and the quality of extension services. There is no valid reason why women should be less productive than men if they have equal access to inputs, information, and technology (de Brauw et al., 2008). Gender disparities in economic productivity are still a problem in Ethiopia, where most women still experience discrimination. Nonetheless, women now have more rights to manage joint marital property with their husbands because of revisions to Ethiopia's Family Law (Hallward, Driemeier, & Gajigo, 2013).

2.3.1.3 Age, landholding size, and agricultural production

Agricultural production is influenced by other household characteristics such as the farm operator's age, and landholding size. The age of the household head is a proxy variable for the farming experience of farm operators. Farmers are highly dependent on their previous knowledge of farm practices in cultivating different crops (Adomi, Ogbomo, & Inoni, 2003). Hence, experienced farmers are expected to enhance the productivity of their holdings. However, it is not without limit, as older farmers lack the required physical strength on the farm, which lowers the probability of technology adoption (Moussa, Otoo, Fulton, & Lowenberg-DeBoer, 2011 Burton, 2013).

Land is the most critical natural resource for countries like Ethiopia, where the agricultural sector is the engine of the national economy (Amsalu, Stroosnijder, & de Graaff, 2006). Farm operators with larger landholding sizes would have a better farm income if sufficient family labor was available. This leads to an increased demand for children who can work on the land (Hedican, 2006; Kim, &Park, 2009). It is not possible to expand the landholding size without matching it with an increase in the size of the household. Hence, households with larger families face the challenge of feeding each of the family members, and this will have its own negative effect on the nutritional status of the family (Olayemi, 2012).

2.3.2 Agricultural production technologies

Agricultural production technologies include biological and chemical technologies. Specifically, these technologies include chemical fertilizers, selected seeds or high yielding varieties, irrigation, and soil quality enhancing technologies. Farmers use these technologies in order to enhance the production and productivity of the land. It is also indicated that, for poor farmers, the adoption of technology places new demands on their limited resource base (Kamruzzaman & Takeya, 2008).

2.3.2.1 Chemical fertilizer

Fertilizer is natural or artificial substance containing the chemical elements that improve the growth and productivity of plants. Fertilizers enhance the natural fertility of the soil or replace chemical elements taken from the soil by previous crops.

Chemical fertilizers are artificially manipulated substances containing known quantities of three microelements, i.e., nitrogen, potassium, and phosphorous (Santos, Araujo, Leite, Nunes, & Melo, 2012).

African governments have promoted the increasing use of agricultural inputs in their own countries, inspired by the Asian Green Revolution, which was brought about by using high-yielding seed and fertilizer technologies (Crawford, Kelley, Jayne, &Howard, 2003). In a similar vein, Aune & Bationo (2008) argued that the entry point for intensification is the use of organic and inorganic fertilizer in the Sahel because, if soil fertility is not improved, the use of other technologies such as high-yielding varieties will not have a significant impact.

Crawford et al. (2003) further indicated that the objectives of input promotion strategies have many features, such as financial, economic, social, and political objectives. The financial aspect of the input promotion strategy is to increase the net income of farmers, traders, or other participants in the agricultural economy. The economic feature of the input promotion strategy is also to increase the real income of the society as a whole. The social aspect of the input program is the improvement of welfare indicators that are difficult to measure in terms of monetary values. Some of the social objectives are to improve nutrition intake and national food self-sufficiency. The political objective of the input program arises because of the government intervention for the sake of equalization of benefits. Some programs may be designed intentionally to build political support; as a consequence, they may benefit one or more groups at the expense of others.

Documents indicated that the application of inorganic fertilizers in Sub-Saharan Africa is minimal (de Janvry, 2010; Freeman, & Omiti, 2003). For instance, (Janvry, 2010) stated that the utilization of fertilizer in Sub-Saharan Africa (SSA) is only 11 kg/ha compared to 130kg/ha in South Asia and 271 kg/ha in East Asia. The application of fertilizer in SSA is considered as the lowest rate in the world (Xu, Burke, Jayne, & Govereh, 2009).This is a clear indication that the intensification of African agriculture remains a critical development challenge because the fertilizer application in a hectare of land in SSA is below standard (Crawford et al., 2003). The insufficient use of fertilizer in Africa has resulted in the area productivity being below the world average (Morris et al., 2007); Kuhn, Gaiser, & Gandonou, 2010).

The major reasons for low fertilizer use could be because of demand and supply factors (Crawford et al., 2003). On the demand side, farm households may not accept the profitability of fertilizer use; alternatively, they may accept it as profitable but too risky in financial terms. Fertilizer input may also be too risky for farmers because the level of input use is determined before the onset of the rainy season which is uncertain. For instance, positive expectations about the rainfall conditions of the coming season leads to increased chemical fertilizer application by 41.92 kg/ha in Eastern Ethiopia (Fufa, &Hassan, 2006). The uncertainty about the weather has a negative effect on the application of yield-augmenting inputs as they are unprofitable in the absence of enough rain (Morris et al., 2007). Possible reasons for the lack of profitability could be attributed to low crop responses because of agro-ecological conditions, unresponsive seed varieties, fertilizer utilization or inappropriate application rates (Crawford et al., 2003).

Other possible reasons for lack of profitability could be due to high input prices or low output prices because of high transportation costs, policy interventions or noncompetitive behaviour of marketing agents (Crawford et al., 2003). The problem may not be profitability but rather the inability of farmers to pay for goods and services due to limited access to credit to finance fertilizer purchases (Crawford et al., 2003).At the beginning of the rainy season, farmers are generally in need of cash for food, leaving little cash for purchasing chemical fertilizers (Hayashi, Abdoulaye, Gerard, & Bationo, 2007). On the supply side, the high costs at the source by importers and local manufacturers may limit the access to fertilizer (Crawford et al., 2003). In addition, inadequate arrangements for financing the purchase of fertilizer by importers and traders, poor port, rail and road infrastructure, transportation costs and non-competitive behavior of suppliers may also affect the supply of fertilizer (Crawford et al., 2003).

2.3.2.2 Improved seeds

Improved seed refers to a seed produced through a series of seed production channel that is suited for a particular domain, have a specific Package of practices, superior than local cultivars in many characters and offer farmer to harvest a bumper amount of crop through its genetics potential for bulk production.

In combination with chemical fertilizers, improved varieties of seeds are critical agricultural inputs that help farmers to obtain improved agricultural yields. The productivity and value of crops is improved through the genetic manipulation of selective breeding (Sassenrath et al., 2008). Moreover, formal sector supplied improved seeds should fulfil certain quality standards set by the national regulations (Bishaw, Struik, & Van Gastel, 2012). Seeds that fulfil the quality requirements have a positive impact on the productivity of land. For instance, Li, Liu and Deng (2010) found that 30 per cent of the growth rate of agricultural production was due to new seed varieties. A study conducted in Afghanistan by Kugbei (2011) confirmed that the yield from the improved wheat seeds was 33 per cent higher than the local seed varieties.

Furthermore, Alemu, Mwangi, Nigussie & Spielman (2008) stated that improved seeds can cause a remarkable improvement in agricultural productivity and production for small-scale farmers in Ethiopia if they are combined with modern science and modest changes in farmers' cultivation practices. As the improved seeds are small, farmers are more concerned about the characteristics of the seeds rather than the price (Li et al., 2010).The farmers may reduce costs by saving and using the seed varieties for the following production year (Bingen et al., 2003). In a study conducted in Nigeria, Awotide, Awoyemi, & Diagne (2012), showed that poverty reduction should be combined with the provision of improved rice seeds to farm operators at the appropriate time.

2.3.2.3 Irrigation facilities

Irrigation is the process of supplying water in fields through manmade sources like wells, under-ground water, small and big dams etc. Irrigation helps to maintain the condensation of the loam. It provides mineral as well as other nutrition by the assimilation from the mold. Irrigation is one of the most feasible ways to grow cash crops like sugarcane, tobacco, etc.

The poorest people who mainly depended on rain-fed agriculture for their livelihoods reside in Sub-Saharan Africa (Burney, &Naylor, 2011). Burney and Naylor stated that crop yields in Sub-Saharan Africa were low and influenced by the variability of weather conditions in the area. The cropland which is irrigated accounted for only 3 per cent compared to 39 per cent in South Asia and China (Janvry, 2010). One of the lessons of the Asian Green Revolution was that repeated cultivation during a year and improved yield could be possible with the application of irrigation combined with fertilizer and improved crop varieties (Burney, &Naylor, 2011). Water, as one of the major instruments of poverty alleviation, plays a significant role in food production, food security, hygiene, sanitation and environment (Hussain & Hanjra, 2004). The proper utilization and the reduction of wastage of water resources is critical. This is because the level of water consumption in agriculture is influenced by the efficiency of irrigation systems and cultivation methods used by farmers (Castro, & Heerink, 2010). For instance, introducing a system of trading water can be a powerful incentive to reduce the amount of water used in agriculture once it has a value and can be sold by the rightful owners Irrigation is one of the critical inputs in agriculture which benefits the socio-economic status as it leads to poverty reduction. However, irrigation can also trigger socioeconomic upheavals when it causes problems such as disease, land degradation, water pollution and destruction of living beings and natural ecosystems (Hussain & Hanjra, 2004). (Hussain & Hanjra, 2004) further stated that poor populations are most affected by the potential negative effects of irrigation.

Access to good irrigation allows the poor to increase production, gives them opportunities to diversify their income base and reduce their vulnerability to the seasonality of agricultural production and external shocks (Hussain & Hanjra, 2004).

As the first beneficiaries from irrigation infrastructure are often land owners, poor landless farmers are not direct beneficiaries in the short run (Hussain & Hanjra, 2004) but may, in the long run, receive an indirect benefit in the form of increased employment opportunities, higher stable wages and lower food prices (Hussain & Hanjra, 2004; Berg, &Ruben, 2006). While irrigation is believed to provide advantages for net food buyers, it may have disadvantages for those who are net food sellers (Berg, &Ruben, 2006).

Farmers incur costs to utilize productivity enhancing technologies. On the one hand, there are complementary technologies that could be utilized with little or no financial costs to the farmers. Aune & Bationo (2008) explain that mulching and seed priming are among the technologies that boost crop production without cost implications for farmers. Seed priming is carried out by soaking seeds in water to stimulate germination and reduce germination time. They also found that a crop residue application rate of 500kg per hectare increased crop yield. On the other hand, the competing uses of crop residues such as for fodder, building materials and fuel, have limited the benefits obtained from mulching (Moges, & Holden, 2007). (Janvry, 2010).

2.3.2.4 Information Technology

The information and communication technology (ICT) is vital for the farming communities to intensify agricultural development in Ethiopia. Information and Communication Technology (ICT) can be one of the promising tools for the development of agriculture. “ICT includes all digital technologies that facilitate the electronic capture, processing, storage and exchange of information". The ICT tools help to solve all the issues of poor connectivity and disintegration of the agricultural market and delayed information to the farmers, small land holdings, and non-adoption or less adoption of improved technology as they lack the reliable information due to less accessibility. There are various ICT devices such as radio, television, mobile phones, computers, tablets and networking, satellite systems which help in facilitating different farming activities and intercultural operations. Research studies reveal that ICT has reformed the traditional agricultural system and made significant contributions in increasing agricultural productivity and sustainability by empowering farmers with the correct information at the right time and place. ICT has various roles in the field of agriculture to improve crop production and reduce loss. ICT can provide agricultural extension services easily, rapidly and in higher accuracy. ICT also supports easy information access and communication in agricultural development.

2.4 Empirical literature reviews

The Green Revolution Technology requires using high yielding varieties with fertilizer application agreeable with these varieties and with reliable water supply. Although, the above-obtained results are partially pertinent to the requirements of the green revolution technologies, it is important to estimate an Aggregate Production Function in order to test the significance of the contribution of the high yielding varieties (biological increase yield) and fertilizer application among other variables. It is worth mentioning that several econometric models were used to two simple ordinary least squares (OLS) regressions were ran, linear and logarithmic models,

Several research studies examined the effect of the poor macroeconomic and price policies on the level of agricultural production of export crops and food crops. Since early 1980s, macroeconomic and agricultural policies have been highlighted as the key component to enhance agricultural growth. Macro policy reform and structural adjustment programs were used as lending instruments for agricultural development to remove production constraints. However, effectiveness of these instruments would mainly depend on the structure of such programs. In spite of these constraints on agricultural growth, some African countries were able to achieve 12.2 cereal production growth rates during 1990s, which is much higher than that of the population. Some other African countries were able to double their cereal production during 1980-1990s from the same existing soil fertility and labor. Thus, agricultural development, under certain conditions, could be accomplished in terms of cereals and food production in Africa. A recent World Bank agricultural sector strategy paper, Rural Development: From Vision to Action highlights many of these issues along with the targeting of a real agricultural growth rate of at least 4 percent annually through improving technology and increased productivity. Findings of agricultural growth studies suggest that civil strife, political unrest and poor economic policies played an essential role in causing the poor performance of agricultural growth in Adaa Woreda.

2.5 Conceptual frame work

These are inputs of technology transfer for agricultural growth. The input parameters of technology transfer are: land expansion, machinery, information technology, improving seed and fertilizer. In put parameter directly related with crop productivity. The outputs of this diagram show that crop productivity. Inputs are a subset of the explanatory variables for agricultural output growth. The performance of the major inputs or production factors is an important indicator to determine the most efficient technology transfer. Fertilizer and improving seed would be more significant than other agricultural growth.

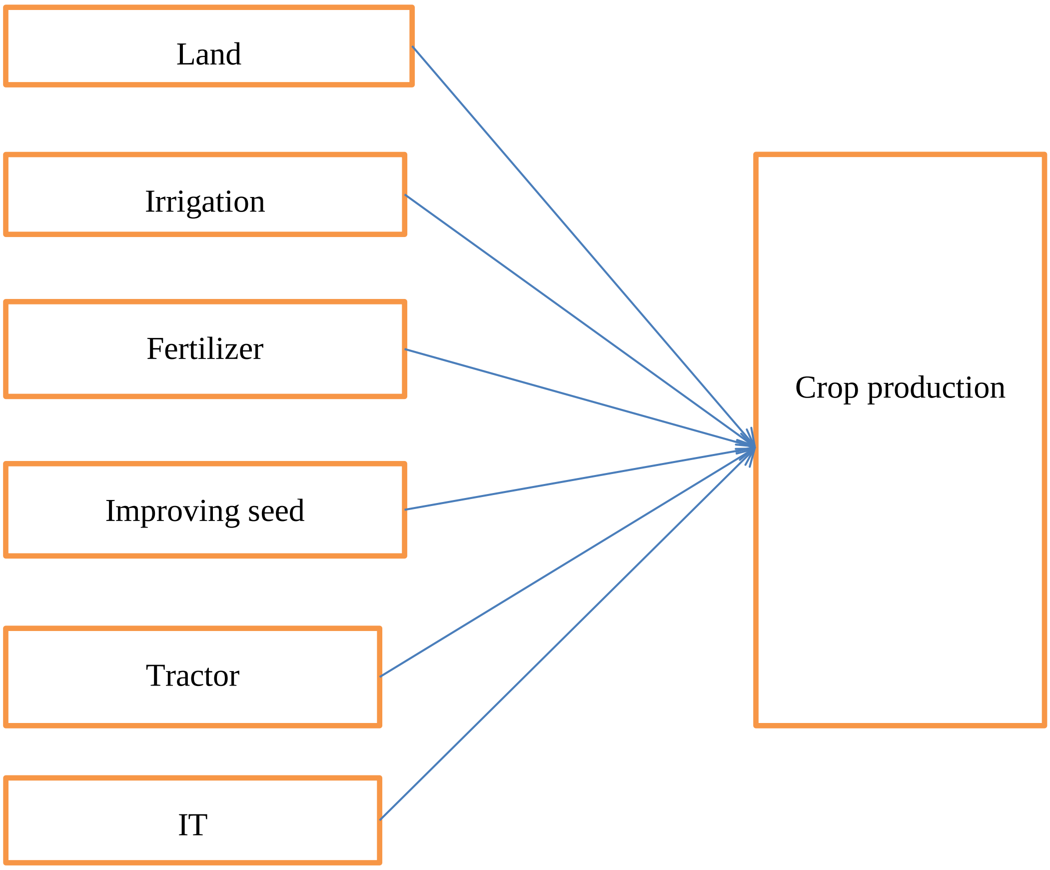


Figure 2.1 conceptual frame works

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Description of the study area

Adaa Woreda was the study's location. One of the woreda in East Shewa, in the Ethiopian Oromia region, is Adaa. It is situated in the Great Rift Valley's East Shawa zone. This Woreda ranges in elevation from 1500 to more than 2000 meters above sea level. The subtropical climate of the Woreda is typified by 860 mm of annual rainfall. The main rainy season typically lasts from mid-June to September. It is followed by a dry season, which may be interrupted in February or March by the brief rainy season. The range of the mean annual temperature is between 8–28ºC. Dark-colored clay the predominant soil type is vertisoil, which has outstanding fertility but issues with water logging in places where the land.

3.2 Research design

Research design provides a logical structure for research data gathering and analysis (Bryman, 2008). This research type is explanatory because explanatory research design explains "why" it occurred by looking for quantifiable data that show the phenomenon's causes or reasons. It investigates the factors affecting technology transfer for agricultural growth in Adaa woerda. A mixed research method was used such as qualitative and quantitative research methods. The application of these mixed research methods is essential for answering different types of research questions. A quantitative study is to focus on the representation of numbers and the relationships between the different variables under the dependent variable and the independent variable. On the other hand qualitative research is not the issue of numbers and quantification but the focus of words. Mixed research methods design creates a wider picture by enhancing the depth and insight given by numbers through inclusion of dialogue and narratives.

Household characteristics, technologies, and rural infrastructure facilities are the main elements influencing technology transfer for agricultural expansion. Additionally, a careful analysis of the secondary sources is conducted to determine the determinants influencing agricultural growth at the Woreda level. Using qualitative techniques, such as addressing the issues farm households have in agricultural marketing, these factors are addressed. It is thought that utilizing language to convey agricultural marketing difficulties and growth restrictions will be more effective. Variables like the farm factor of households and factors influencing technology transfer for agricultural growth are also subjected to quantitative methodologies. As previously explained, a single study employs a mixed methodologies research technique.

3.3 Data sources and type

3.3.1 Data sources

Primary and secondary sources were used as data sources in this study. A primary source used to households and farmers. Primary sources are the initial data sources, such respondent farms. A secondary source used to book and Adaa woreda agricultural development report.

3.3.2 Data type

The framework used by the study to direct the data collection method was cross-sectional data. Cross-sectional data collection involves gathering information at a certain point in time, primarily through the use of questionnaires to collect quantitative or qualitative data. Cross section data type 2022/2023 G.C. or 2014/15E.C. was collected for this study.

3.4 Methods of data collection

Primary and secondary data were used by the researcher in order to meet the study's goal. By giving out questionnaires, primary data was gathered from respondents who were chosen at random. Both closed-ended and open-ended questions were included in the questionnaire to address respondents' ideas. The secondary data was gathered from a variety of sources, including books, the internet, and other published materials about the subject, such as the Adaa Woreda's office of rural development and agriculture. The topics covered in the questions included the difficulties in agricultural marketing and production as well as the elements that influence the transfer of technology in agriculture. Research assistants with experience helped administer the structured survey surveys. Before the field survey was conducted, each questionnaire question was reviewed with the research assistants.

3.5 Target Population and Sample Size

The researcher was selected two kebeles out of 14 kebeles. Only two Kebeles Godino and Keteba were chosen as samples by the researcher because all Kebeles in the woreda engage in similar agricultural activities. A sample size of 193 farmers was taken from the total number of farmers in the two kebeles who participated in agricultural activities, which amounted to 3475 farmers overall. Godino, 943 males and 436 females, and Keteba, 1614 male and 482 female, have the two kebeles. 116 from Keteba and 77 from Godino are chosen by the researcher. This distribution based on proportional of target population. The level of precision Sven percent of margin error used to determine the sample size first reason limited of resource then collecting data from (almost) the entire population.

Using Yamane (1967:886), the researcher selected 193 responses as a sample size from the 3475 overall population:

$$n = \frac{N}{1 + (N \times e^2)} \qquad (eq\ 3.1)$$

Where N= total population= 3475

Precision level = 7%

n= sample size

$$n = \frac{3475}{1 + (3475 \times 0.07^2)} = 193$$

3.6 Sampling techniques

Adaa woreda, one of the 180 woredas of the Oromia regional state, is the subject of this study. The selection of Adaa woreda for the study is based on numerous factors. The fact that this area is among the oldest human settlements in Ethiopian history is the primary justification. When compared to the other Woreda in the region, its land is therefore extremely fragmented and degraded. Thus, study findings on concerns of agricultural growth and associated marketing issues that could help these farm operators make more money are needed in this Woreda. A multistage sample strategy was used in the selection of respondents who were rural households. The sampling approach is multistage since one of the fourteen was chosen in the first place. Next, two kebeles were chosen at purposive sampling from among all the kebeles in the woreda. Two kebela selected with some criteria such that based on productivity, use of technology input and peace and security. Lastly, respondents were chosen at random from among the farmers in each hamlet located inside the kebele. Godino and Keteba are these two kebeles. Thus, the heads of rural households in these chosen kebeles of the two kebeles served as the study's unit of analysis. In August 2015, a pilot research was carried out on a simple random sample of 193 farmers from the two kebeles in order to verify the validity of the questionnaire.

3.7 Methods of data Analysis

The researchers used descriptive statics and econometric model of data analysis in order to analyze the data by using the Stata version 15 software applications. Descriptive statistics, such as averages and percentages presented in tables and graphs, were shown in the data analysis. The results from key informants were added to the questionnaire results. In order to analyze the survey results, the questionnaire replies were entered into STATA software. Econometric models and descriptive statistics were used in the data analysis process. Multiple regression models were employed to ascertain the impact of independent variables on dependent variables.

Econometric models

The econometric models used in this study are based on models utilized by other researchers studying related subjects as well as the scientific needs of the variables (explanatory and dependent) that are taken into consideration. When comparing the findings of several studies, it is important to take into account the approaches and models employed by other researchers.

Econometric model of farm product

It is anticipated that the variables influencing agricultural growth will have an impact on farm operators' overall agricultural output.

The crop product (croppro) is analyzed using multiple leaner regression. The multiple leaner regression model is justified by the fact that all farm families are predicted to have a non-zero value for the continuous dependent variables, which are total farm (Endale, 2011). This model are used to three or more variables of interest should have e linear relationship, which you can check by using a scatterplot. Consequently, the specification of the regression model is as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots + \beta_k X_k + \varepsilon \qquad (eq\ 3.2)$$

$$y = X'\beta + \varepsilon$$

Where:

y= is the dependent variable; X= vector of explanatory variables; β= the parameter to be estimated; ε= the error term.

Then, the functional notation of the dependent and independent variables is:

β_0=constant term

Y = croppro

X_1 = gender

X_2 = age (years)

X_3 = marital status

X_4 = educlevel (years)

X_5 = family size (number of parents)

X_6 = workexp (years)

X_7 = landown

X_8 = irriown (hectare)

X_9 = ferti (quntal/perhectar)

X_{10} = impseed

X_{11} =trac

X_{12} = it

X_{13} = extagent

The descriptions of dependent and independent variables that are used in the above functional notation are stated below.

Dependent variables

Household crop product (prod quintals)

The entire value of the crops produced in the production year 2022/2023 (2015 E.C.) is known as the crop product

Independent variables

Land holding size (landsize)

The unit of measurement for this variable is hectares. Additionally, it is hypothesized that a farm household's land holding size directly correlates with the volume of production and farm product.

Age of the household head (age)

This variable serves as a stand-in for agricultural household experience. The learning process that households go through when managing their overall farming practices is linked to the variable age. As long as farmers are within the active age range, it is anticipated to have a favorable impact technology adoption.

Gender (gender)

Men and women both play a critical role in Ethiopia's agricultural output. Nonetheless, compared to female household leaders, the opportunities are somewhat biased towards men. Poor performance of women in agriculture is attributed to gender bias towards men's access to land and education (Endale, 2011). Therefore, it is assumed that, in comparison to female household heads, male household heads will produce more and receive greater agricultural revenue. If the head of the family is a man, the gender variable is set to 1, and if not, it is set to 0.

Educational status of the head (educlevel):

Households with higher levels of education should be more likely to have access to information that improves agricultural output. It is also required of them to be creative in their acceptance of novel approaches. This variable is expressed as the total number of years of education predicted to increase agricultural output and, consequently, revenue.

Technologies

The most advocated technology in Ethiopian agriculture, according to Negatu (2006,), are chemical and biological technologies. In Ethiopia, farmers mostly utilize three types of technologies: improved seeds (imprseed), fertilizer (fertitotal), and irrigation (irriown). Continuous variables quantified in hectares and q/hec, respectively, are irrigation (irriown and fertilizer (fertitotal). The last variable, impurseed, will accept a dummy value of 1 in the case of families employing improved seed and 0 in the other case. Furthermore, the adoption of each of these technologies is thought to positively improve agricultural production. Tractors and information technology(it) are two examples of other technology that solves many problems, including poor connectivity, the breakdown of the agricultural market, small land holdings, delayed information to farmers, and non-adoption or less adoption of improved technology because farmers cannot access reliable information. Tractor and information technology will accept a dummy value of 1 in the case of families employing tractor and information technology and 0 in the other case.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

In Adaa woreda, Easter Oromia, Ethiopia, technology transfer for agricultural expansion is discussed and the results are presented in this chapter. Furthermore, an analysis is conducted on the socio-economic attributes of the participants, as well as the primary determinants influencing agricultural output and farmer income. The size of the land, irrigation, fertilizer, improved seed, tractors, and information and communication technology (ICT) are some of the factors that influence agricultural growth and revenue.

Lastly, a critical analysis is conducted of the secondary sources that discuss the agricultural production circumstances in the eastern shewa of Adaa Woereda. Both a qualitative and quantitative presentation and analysis are provided, depending on the type of data.

4.2 Socio-economic characteristics of respondents

The age, gender, married status, and educational attainment of survey participants were included in the biographical information and the socioeconomic characteristics sub-section.

4.2. 1 status of kebele

According to the below data, 77 (39.1%) of the sample respondents were Godino, and 116 (60.1%) of the sample respondents were Keteba. This suggested a low level of Godino participation in agricultural output. Because of that this Kebele have 1379 farmers overall.

Table 4. 1 Number of sampled households from each kebele

Names of kebele	Freq.	Percent
Godino	77	39.90
Keteba	116	60.10
Total	193	100.00

Source: survey result, 2022/23 OR 2015

4.2.2 **Gender of respondents**

According to the survey, men and women should contribute differently to agriculture productivity. Below the table 4.2 show that 166 (86%) of the sample respondents were men, and the remaining 27 (14%) were women. This suggested that there is virtually low female involvement in agricultural output. Despite their essential role in agriculture, women face numerous challenges that limit their productivity and ability to participate fully in agricultural development. These challenges include gender-based violence, limited access to education, training, land ownership, finance, technology, and markets. Addressing these challenges and empowering women in agriculture is critical for achieving sustainable development goals and driving economic growth.

Table 4. 2 gender of respondents

Gender of respondent	Freq.	Percent
Female	27	13.99
Male	166	86.01
Total	193	100.00

Source: survey result, 2022/23 OR 2015

4.2.3 Marital status of respondent

According to Table 4.3 shows that 78.24% were married. Out of the overall sample size, 5.7% of the respondents were divorced and 14.51% were single. This indicates that the married responders were actively engaged in farming. On the whole more respondents 151or 78.24% rural married compared to the number of those who are single and divorced. It therefore goes to show by implication that the incidence of divorce is alien to the rural people.

Table 4. 3 marital of respondent's

Marital status of respondent	Freq.	Percent
Divorced	11	5.70
Married	151	78.24
Single	31	16.06
Total	193	100.00

Source: survey result, 2022/23 OR 2015

4.2.4 Educational level of respondents

Table 4.4 indicates that the majority of respondents are illiterate: 42% of respondents are illiterate, 52% of respondents fall into the writing and reading and the remaining 6% of respondents are sum of grades 1-10 and 11–13, respectively. The majority of responders were lack literacy. The majority of respondents in the locality, who range in age from above 40 years, were illiterate because there are no educational facilities in the area.

Because there was no such developed infrastructure for schooling in rural areas in the past. Thus, it follows that illiteracy has a detrimental effect on agricultural development and poor productivity since it prevents farmers from using modern inputs like fertilizer to increase agricultural yield. The 0 means nonacademic that means person not involved in or good formal studying. So this implies that the more illiterate, has an impact on agricultural production (or agricultural development) negatively and low agricultural productivity because these farmers have no ability to use modern inputs, such as fertilizer, improve seeds, pesticides, improved tools (tractor) and have no to listen current of market and taking of other necessary things.

Table 4. 4 Educational levels of respondents

Education of respondent (no of years of education)	Freq.	Percent
0	81	41.97
1	4	2.07
2	5	2.59
3	10	5.18
4	17	8.81
5	8	4.15
6	12	6.22
8	16	8.29
10	24	12.44
11	2	1.04
12	7	3.63
13	2	1.04

Source: survey result, 2022/23 OR 2015

4.2.5 Average age, family size, work experience and education level of respondents

The average age of household respondents was 39.48, as shown in Table 4.5. As a result, the average age of respondents (39.48) suggests that most landholders acquired their property prior to 2015. The majority of farmers were members of the workforce with regular jobs. The age of the farmer was another proximate indicator of their level of industry experience.

Table 4.5 indicates that there were 4.03 average family sizes. This suggests that families with 4 members make up the bulk of sample respondents. This suggests that larger families result in a growing population in the research area, which puts a lot of strain on the environment and has an impact on agricultural productivity. Since the amount of the land is small and stable but the number of families is growing and the agricultural output is declining.

Furthermore, 112 household heads out of the 193 respondents could read and write. This covered formal education, adult education, and religion. With an average of 6.81 years of education, the majority of respondents who could read and write were at below grade eight. The average job experience was 18.4 years, as Table 4.5 illustrates. This indicates that the respondents' mean work experience. So that the bulk of sample respondents have eighteen years or more of job experience. This suggests that increased work experience causes the population in the study area to grow, placing significant pressure on the environment and influencing agricultural productivity.

Table 4. 5 Average age, family size, work experience and education level of respondents

Variable	Obs	Mean	Std. Dev.	Min	Max
Age	193	39.47668	13.15931	20	71
Enduclevels	112	6.813	3.206	1	13
Familysizes	193	4.031088	2.661271	1	15
Workexps	193	18.40415	12.17718	1	52

Source: survey result, 2022/23 OR 2015

4.3 Factors that affect technology transfer for agricultural growth

4. 3. 1 landholding of household respondent’s

According to the table 4.6 below the majority of sample respondents 79.3% possess their own land, which is used for farming. Although the remaining 20.7% do not own land, they do not have enough land to produce more.

Table 4. 6 landholding of household respondent’s

Do you have your own land	Freq.	Percent
NO	40	20.73
YES	153	79.27
Total	193	100.00

Source: survey result, 2022/23 OR 2015

4.3.2 Irrigated land

The vast majority of respondents (87.56%) utilize irrigation, whereas only a small percentage (12.44%) do not use of irrigation. The most crucial factor in boosting agricultural output when there is a lack of rainfall is irrigation. However, the majority of respondents said they use irrigation as a result to increase agricultural productivity. Irrigation boosts agricultural productivity in severely fragmented land, potentially allowing for more than one harvest annually. Table 4.7 shows that 87.56 % of all respondents irrigated their land.

Table 4. 7 irrigation use of household

Do you use of irrigation	Freq.	Percent
NO	24	12.44
YES	169	87.56
Total	193	100.00

Source: survey result, 2022/23 OR 2015

4.3.2 The average land and irrigating land

According to table 4.8 shows below that average of land of 1.391 hectare and the minimum land owner 0.25 hectare maximum land owner have 12 hectare. The standard division of land size is 1.539. The average irrigated land area was 0.89 hectares, the minimum land owner 0.25 hectare maximum land owner have 12 hectare. While the average farm land area was 1.39 hectares. The ratio of irrigated land to total land was 0.64. Sixty four percent of farmers' entire landholding size was made up of irrigated land, a significant amount. The study Woreda's percentage of irrigated land was somewhat less than the normal for the Adaa Woreda.

Table 4. 8 average land size and Irrigated land in hectares

Variable	Obs	Mean	Std. Dev.	Min	Max
landown	153	1.391	1.539	0.25	12
irrgland	169	0.889	1.323	0.25	12

Source: survey result, 2022/23 OR 2015

4.3.2.1 Source of water due to irrigation process

The primary sources of water for irrigation in the research areas were found to be private wells, check dams, and river diversion (Table 4.9). 79.88 percent of respondents said they had utilized check dams for irrigation, and 13.02 percent said they had used both river diversion and check dams as water sources. According to the same source, smallholder farmers' primary supply of water was from river diversion. The major problem of river diversion as a source of water for irrigation is that most of the rivers are non-perennial rivers. They do not flow throughout the year which hinders farmers from obtaining a continuous benefit from irrigation.

Table 4. 9 Mean irrigated land (ha.) and water source of respondents

Source of water	Freq.	Percent
Check dams	35	79.88
Check dams &river diversion	22	13.02
River diversion	10	5.92
Rivers	2	1.18
Total	169	100.00

Source: survey result, 2022/23 OR 2015

4.3.3 Fertilizer

According to the survey results, 188 respondents, or 97.4%, used chemical fertilizer, whereas 5 respondents, or 2.6%, did not utilize chemical inputs (Table 4.10). This result shows that majority respondents were used to fertilizer so that fertilizer one of part of technology.

Table 4. 10 show fertilizer activity of the sample of respondents

Do you use fertilizer?	Freq.	Percent	Cum.
NO	5	2.59	2.59
YES	188	97.41	100.00
Total	193	100.00	

Source: survey result, 2022/23 OR 2015

For all types of crops, soil types, and agro-ecologies in the area, the standard application rate of chemical fertilizers (DAP and urea) is 4 quintals per hectare. The majority of responses (97 percent) did meet the regional standard. They applied 6.13 quintal per hectare of chemical fertilizers per hectare on average. Furthermore, the average fertilizer application of all responders (6.13 quintal/hectare) was more than the standards requirement. Because the soil fertility time to time reduce so that the fertilizer to be more use of the standard then to get more productivity.

Table 4. 11 The average fertilizer users and intensity of fertilizer application

Variable	Obs	Mean	Std. Dev.	Min	Max
quntalperhecs	188	6.12766	2.377407	1	11

Source: survey result, 2022/23 OR 2015

4.3.4 Improved seed

42.5% of respondents utilized enhanced seeds, according to the below table, while 57.5% of survey respondents did not use improved seeds. The farmers were interested and motivated to use improved varieties such as wheat, teff and onion but there was not enough improved seed supply for farmers to benefit from it. Most of the respondents stated that the improved seeds sent to the kebele could not satisfy even the demands of a single village. Due to inadequate farmer training, lack of experience sharing, and use of local seeds, the majority of respondents did not use upgraded seed. Even the administration and extension agents could not communicate with them in advance to keep seeds for them from the improved variety.

Table 4. 12 show improved seed activity of the sample of respondents

Do you use improved seed?	Freq.	Percent
NO	111	57.51
YES	82	42.49
Total	193	100.00

Source: survey result, 2022/23 OR 2015

4.3.5 Tractor

The vast majority of respondents (79.23%) did not use a tractor, whereas only a small percentage (20.73%) did. The tractor is the most crucial tool for increasing agricultural productivity in times of shortage. The majority of respondents, however, did not utilize tractors due to ignorance or a lack of sufficient land.

Table 4. 13 show tractor of the sample of respondents

Do you use tractor	Freq.	Percent
NO	153	79.27
YES	40	20.73
Total	193	100.00

Source: survey result, 2022/23 OR 2015

4.3.6 Information technology

Information technology is utilized by 88.6% of respondents to communicate with others and obtain information pertaining to agricultural data. 11.4% of respondents said they were unable to use ICT.

Table 4. 14 show it of the sample of respondents

Do you use information technology?	Freq.	Percent
NO	22	11.40
YES	171	88.60
Total	193	100.00

Survey result 2022or 2023 or 2015

With respect to the type of ICT product used by household, mobile phone appears to be the most widely accepted and highly used by the respondents as presented in the table 4.15 below. This is followed by mobile phone representing 27.46% of the total respondents; both radio and Mobil phone used to around 26.94%, not used to information technology product 11.4% and radio, Mobil phone and internet used around 1.04%. radio, Mobil phone and internet which is a new electronic agricultural innovation introduced to the agricultural household recently seems to be the least used ICT delivery channel by agricultural household. But mobile phone is the widely accepted and highly delivery channel.

Table 4. 15 Types of information technology product

Types of information technology	Freq.	Percent
Mobile phone	53	27.46
Radio	10	5.18
Radio and mobile phone	52	26.94
Radio, mobile phone and internet	2	1.04
Television and mobile phone	45	23.32
Television, radio and mobile phone	9	4.66
Total	171	100.00

Survey result 2022or 2023 or 2015

Reasons for applying with different types of agricultural technology

The majority of the respondents used to some technology that increase the productivity and improve the quality of life the main reason for farmers to utilize the inputs (Table 4.16). 34.72 percent use to both increase productivity and improving quality of life and 26.42 percent is used to only increase crop productivity.

Table 4. 16 Purpose of agricultural technology used to farm

Purpose of agricultural technology	Freq.	Percent
To increase productivity	51	26.42
To increase productivity , improve quality of life and saving time	37	19.17
To increase productivity and improve the quality of life	67	34.72
To increase productivity and reduce cost production	6	3.11
To increase productivity and saving time	21	10.88
To increase productivity , improve quality of life and reduce cost production	11	5.70
Total	193	100.00

Survey result 2022or 2023 or 2015

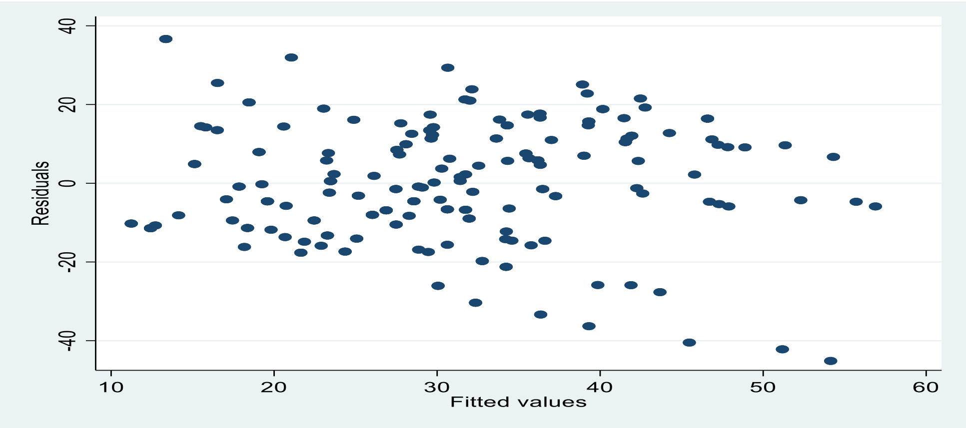
Regression models

A regression model was used to determine the effect of factors on crop product. The model calculated the crop product values for the farm product. Some basic assumption tests were carried out and are attached in the appendices section.

To analyses the regression model, some basic assumptions needed to be tested. One of the assumptions that needed to be tested was the normality test (Appendix 2).

The distribution's normality is not refuted by the Shapiro-Wilk W test result, which is likewise not statistically significant. The Variance Inflation Factor (VIF) test was performed to evaluate multicollinearity among explanatory variables (Jenber, 2011). The results of the Variance Inflation Factor showed that there was no issue with multicollinearity among the explanatory variables. The fact that each independent variable's VIF value is less than 10 indicates that multicollinearity was not a problem (Appendix 3). The model specification test (Appendix 4) is checked using the Ramsey RESET test and linktest (Gebru, Nega, & Hagos, 2011; Jenber, 2011)

The Cook-Weisberg test for heteroskedasticity is used to test for the issue of heteroscedasticity, or non-equality of the error variance (Gebru et al., 2011). The constant variance null hypothesis is not rejected by the test. Therefore, heteroskedasticity is not an issue. The results of the Ramsey and link tests have also confirmed that there are no missing variables from the model (Appendix 4). A two-way scatter plot of each independent variable and the dependent variable is used to test the linearity assumption. Figure 4. 1 The scatter plots fitted value e isn't a linearity issue.



Survey result 2022/ 2023 or 2015

According to table 4.17 average crop product per household is 44.4 and average crop product per hectare is 40.2 .so that crop product is increased with compare to Adaa woerda record data 2015 E.C. therefore crop product increased also the income increase and reduce poverty.

Table 4. 17Average Crop products

Average product per household	44.4
Average product per hectare	40.2

Source: survey result, 2022/23 OR 2015

Determinants of Agricultural Productivity in the Study Area

Table 4.18 shows the result of the multiple regression analysis on the determinants of agricultural productivity of crop product in Adaa Woreda. Based on the magnitude of the coefficient of multiple determination (R^2), and the size and signs of the parameter estimates, as well as their statistical significance. The coefficient of multiple determinations (R^2), of 0.63 implies that 63% of the variations in productivity (Y) are explained by the joint action of the independent variables. The analysis shows that gender, family size, land size, irrigation, fertilizer, improve seeds and tractor had positive and significant relationships with productivity. This suggests that total factor productivity will increase significantly if these factors are increased above their present levels of use. It is expected that productivity will increase if more use of fertilizer and improved seed farmers cultivate greater hectares of farm land. Also, coefficients of age, and work experience were found to be negative and statistically insignificant. This suggests that the negative relationship between productivity age and work experience could be attributed. Because age and work experience were negative showing that, in mountainous and hilly areas, if the average age increased by one year, the amount of crop product (qunal) decreased by 90%.

The results of the crop product regression (Table 4.18) showed that the gender, family size, land size, irriown tractor, improve seeds, and the amount of fertilizer applied were shown to be decisive factors.

The gender of the household head was significant at 5% significance level. Thus result showed that, there is a difference in crop productivity among male-headed and female-headed households. The result indicates that crop productivity was higher for male-headed households than female-headed households by 12.9 quintal.

Family size of the household head was significant at 10% significance level. The result indicated that, holding other variables constant, as the family size increases by , the crop production increases by 2.5 because the majority of the sampled households were categorized at many (productive) family sizes. This implies that the families size the head of the household, the more use he/she has in managing the land.

The land size was significant at 1% significance level. The land size is one of the variables which positively affect crop product of farmers. The land size result show that, as the land size increases by a hectare, crop product increases by 19.8 quintal.

Irrigation was significant at 5% significance level. The result indicated that as the irrigation increased by one hectare, the household crop product would increase by 6.3 quintal. Increasing the size of a land is practically impossible because the studied areas are among the most highly fragmented and densely populated parts of the country. Farmers had little choice but to rent other people's land in order to expand their irrigation land and agricultural output.

The application of fertilizer was significant 1% level. The result shows that one quintal /hectare to increase by crop product also increase by 6.3 quintal.

Improved seed was significant 1% level. Farmers who applied improved seeds get, on average, 18.7 quintal higher crop product compared to non-users.

Tractor was significant 5% level. The result indicated that farmers who use tractor get a crop product on average 12 quintal more compared to farmers with non-user.

Estimation model

$$Y = -47.28177 + 12.89584\,X_1 - 0.9097174X_2 + 2.079529X_3 + 0.6639765\,X_4 + 2.518576\,X_5 - 0.228733\,X_6 + 19.78354X_7 + 6.347316X_8 + 6.274804X_9 + 18.72434X_{10} + 12.24461X_{11} + 1.939379\,X_{12} + 0.5884592\,X_{13}$$

-47.28 is the expected value Y (crop product) when all independent variables are zero

Table 4. 18 Multiple regression results of factors that affect crop product

Source	SS	df	MS		
Model	182324.353	13	14024.9502	Number of obs	= 193
Residual	108184.425	179	604.38226	F(13, 179)	= 23.21
Total	290508.777	192	1513.06655	Prob > F	= 0.0000
				R-squared	= 0.6276
				Adj R-squared	= 0.6006
				Root MSE	= 24.584

croppro (Y)	Coef.	Std. Err	t-value	P>|t|
Genders (X_1)	12.89584	5.622706	2.29	0.023**
Age (X_2)	-0.9097174	2.362364	-0.39	0.701
Maritalstatus(X_3)	2.079529	4.517054	0.46	0.646
Educlevel (X_4)	0.6639765	0 .5372812	1.24	0.218
Familysize (X_5)	2.518576	1.467444	1.72	0.088*
Workexp (X_6)	-0.228733	0 .2930885	-0.78	0.436
Landsize (X_7)	19.78354	2.631594	7.52	0.000***
Irriown (X_8)	6.347316	3.154713	2.01	0.046**
Fertitotal (X_9)	6.274804	1.026737	6.11	0.000***
Imprseeds (X_{10})	18.72434	3.948506	4.74	0.000***
Tracs X_{11})	12.24461	4.807801	2.55	0.012**
Its (X_{12})	1.939379	6.240165	0.31	0.756
Exagentcons(X_{13})	0.5884592	2.94886	0.20	0.842
_cons	-47.28177	16.3632	-2.89	0.004***

***Significance at 1%**significance at 5% *significance at 10%

Survey result 2022/ 2023 or 2015

4.4 The major challenges of the household in agricultural productivity growth

This section of the study presents the main obstacles to agricultural marketing, such as high selling price les asses loan ,weak markets linkage, the source of market information, and lack of rural infrastructure facility their products the most frequently. Furthermore, the assistance provided by farmers' cooperatives and extension officers is also showcased and examined. The majority of the respondents challenge different technology use in case of high selling price, weak market linkage and lack of rural infrastructure the main reason for farmers to utilize the inputs (Table 4.19). 34.2 percent challenge with use to high selling price, weak market linkage and lack of rural infrastructure facility and 1.04 percent is minor challenge of use of technology such as asymmetry of information and less asses of loan.

Table 4. 19 Challenge of the household in agricultural productivity growth

Challenge of agriculture	Freq.	Percent
Asymmetry of information and less asses of loan	2	1.04
High selling price	11	5.70
High selling price and asymmetry of information	2	1.04
High selling price and lack of rural infrastructure	42	21.76
High selling price and weak market linkage	17	8.81
High selling price, lack of rural infrastructure and Asymmetry of information	29	15.03
High selling price, weak market linkage and lack of rural infrastructure	66	34.20
High selling price, weak market linkage, lack of rural infrastructure and asymmetry of information	13	6.74
Weak market linkage	3	1.55
Weak market linkage and lack of infrastructure	8	4.15
Total	193	100.00

Survey result 2022/ 2023 or 2015

4.5 A critical assessment of agricultural production in the Adaa woreda

The aforementioned findings are associated with the survey information gathered from the Adaa Woreda kebeles Godino and keteba. The critical evaluation of agricultural production at the Woreda level is the main topic of this subject. This document analysis primarily comes from the Adaa Woreda Bureau of Agricultural and Rural Development. Aside from these records, additional pertinent materials were examined.

4.5.1 Crop production

Adaa woerda is one of the most important economic activities is agriculture. According to estimates from the Adaa Woreda Bureau of Agricultural and Rural Development 2023, there were 20345 farm household's area in 2023. The thirteen-year crop production data from the Adaa Woerda has been gathered and examined (Table 4.20 The average crop productivity in the Adaa Woreda is 39.2 quintals/ha, while the average crop product is 40. 2 quintals/ha throughout the 2015 years under analysis. Moreover, the Woreda goal for crop productivity was anticipated to be 39.2 quintals per hectare by the end of the Growth and Transformation Plan (2014/15). The Woreda productivity is predicted to reduce by 1 quintal per hectare.

Table 4. 20 Cultivated area and total agricultural production of adaa woreda

Year	land hectare	Quanta per hectare	product
2002/03	71379	23.19	1655213
2003/04	71379	26.96	1924552
2004/05	71042	29.04	2045385
2005/06	62218	33.29	2071163
2006/07	65730	38.27	2515410
2007/08	65730	32.9	2164475
2008/09	64397	39.49	2543260
2009/10	61709	40.59	2504888
2010/11	61787	34.0	2100781
2011/12	61787	37.9	2344427
2012/13	61775	38.0	2356698
2013/14	61750	38.5	2378339
2014/15	61750	39.2	2420947

Survey result 2022or 2023 or 2015

SUMMARY, CONCLUSION AND RECOMMENDATIONS

SUMMARY

The purpose of the intervention is for farmers to get the reasonable prices and to create a conducive environment for the crop product of their Adaa Woerda. However, weak market linkages, asymmetric information and high transaction costs are some of the market challenges for governments and farmers. Farmers are establishing farmers' cooperatives to reduce the impact of these challenges.

The specific objectives of the study were to identify the major factors affecting technology transfer for agricultural growth. These specific objectives were taken as a theme to present the main finding of the paper in Chapter 4. The summary of these results was also made considering the specific objectives as a theme as shown below.

Describe the effect of socio economic characteristics of farmers in the study area.

86% of the sample respondents were men, and the remaining 14% were women. The majority respondents of this farm are men but female participation is very low. The average age, family size, work experience and education level of respondents are 40, 4, 19 and 6.9 years respectively. The majority of household is illiterate because there is no full infrastructure facility. 79% were married, 5.7% of the respondents were divorced and 14.51% were single. So that the majority of household was married to participate in agriculture.

The major factors affecting technology transfer for agricultural growth

The average land size (1.391 ha) of farm households in the study area was too small to fulfill the food requirements of their families. The small land size was further aggravated by the large average family size 4 per household. The limited opportunity for irrigation schemes forced farmers to depend mainly on rain fed agriculture. The study demonstrated that, from the total land possessed by respondents, 64 percent were irrigated. The majority (97 percent) of the respondents applied chemical fertilizers. The intensity of fertilizer application was lower than the standard set at a Woreda level. Farmers were interested in using improved seeds if these varieties were based on their choices. Respondents stated that the supply of improved seeds was insufficient and the supplies were not based on their preferences. Farmers were interested in using tractor. The majority of respondents 79.23% did not use a tractor. The tractor is the most crucial tool for increasing agricultural productivity in times of shortage. The majority of respondents, however, did not utilize tractors due to ignorance or a lack of sufficient land. Information technology is also utilized by agricultural product used to gathering different information related to agriculture. 88.6% of respondents to use information technology.

Respondents applied inputs with different purposes. For most of the respondents (34.72 percent), the use to both increase productivity and improving quality of life was the main reason for applying seed use of different technology.

The regression model used to identify the factors that affect crop product of respondents indicated that, gender, family size, land size, irriown tractor, improve seeds, and the amount of fertilizer applied were shown positive and significant level.

Table 4.18 show that, as the land size increases by a hectare, crop product increases by 19.8 quintal. The irrigation land increases by one hectare, crop product increases by 6.3 quintal. The application of fertilizer was increase of fertilizer by one quintal per hectare, towards the standard set in the area, increased the crop product by 6.3 quintal. The farmers who adopted improved seeds got on average, 18.7 quintal higher crop product compared to non-users. The farmers applying tractor got 12 quintal more farm product compared to farmers who do not use it. The regression model has been used to identify the impact of the identified variables on crop product of farm households. The model result indicates that, gender family size land size fertilizer intensity, improved seed, size of irrigated land, and tractor have found to be statistically significant determinant variables.

The major challenges of the household heads in marketing their produce

The majority of the respondents challenge different technology use in case of high selling price, weak market linkage and lack of rural infrastructure the main reason for farmers to utilize the inputs. For the majority of the respondents, the Woreda was the market place to sell their products. 34.2 percent challenge with use to high selling price, weak market linkage and lack of rural infrastructure facility.

CONCLUSIONS

The main conclusion drawn from the questionnaire indicated that the existence of low agricultural productivity in the study area, which directly influences growth of its productivity and land productiveness, is below what it should be so as to fulfill the minimum food requirements of the area. Female participation in agricultural activities is low and leads to low agricultural output. Most of farmers in Adaa Woreda are illiterate and have no awareness about modern farming system and their level of income is also low. In Adaa Woreda the farmers owned and cultivated a land of very small size. Most households in the Woreda have less access to micro finance institutions credit system, extension service, farmer training, and sharing experience and did not use more modern inputs like tractor, improved seeds, irrigation, information technology, and tools of agricultural. Most farmers in the Woreda used very low improved seed, irrigation, tructor, and modern fertilizer. The majority of farmers lived far from the farm and from the market, which has an impact on farmer productivity. The majority of farmers practiced plugging with oxen and using traditional fertilizers.

The central focus of this thesis was to determine the status of technology transfer for agricultural growth in the case of Adaa Woreda. The land size of respondents was found to be too small to fulfill the annual crop requirements of households. This was exacerbated by the large family size of farmers and the dependence on rain fed agriculture which was erratic. The proportion of irrigated land to the total cultivated land was small and that hindered farmers from achieving multiple harvests in a year.

Based on the results of the analysis, we conclude that agricultural productivity will increase in the area if the level used of factors such as gender, family size, land size irrigation, tractor, fertilizer, and improved seed is increased. Similarly, productivity will also increase if there are increased levels of use of irrigation, fertilizer, and improved seed. The majority of the respondents used chemical fertilizers but the intensity of chemical fertilizer application was more than the recommended standard at the Woreda level.

The Regression model was used to identify the determinant factors of crop product respondents. The farm product model result showed that variables such as gender families land size fertilizer intensity, improved seed, size of irrigated land, and tractor were statistically significant variables that affected the farm product positively. This implies that a unit increase of these variables increases the farm income of the farmers.

RECOMMENDATION

Women's affairs office, educated people, and other concerned body should work in order to change the backward social attitudes that undermine women and increases the productive capacity of women in agricultural production and the government should create awareness for female and avoid bad culture influencing towards agriculture.

Government and other concerned body should go through the provision of agricultural extension, motivation and promoting the expansion of credit institution in the rural area advisory service on continuous basis in addition proving advanced technologies. Modern agricultural inputs are beyond the capacity of farmer to purchase because there is expensive.

Farmers should use various methods to control the factors affecting agricultural productivity, such as using irrigation for unpredictable rainfall distribution, by reforesting areas, and providing extension services to small-scale farmers. Agricultural office managers should also educate and counsel illiterate farmers about the importance of modern technology, improved seeds, and other mechanisms of that improving the agricultural output.

The demand of modern fertilizers is very low in the Woreda because of high price. So, the government should distribute at low price and to increase the demand of these inputs. To increase agricultural productivity the government should provide the infrastructure, and to make the market nearest to the society. To increase agricultural productivity the government should provide the extension service to the farmers and agricultural office managers should give training to small scale farmers, giving advice and awareness for the illiterate farmers about importance of modern technology, improved seeds and other mechanisms of that improving the agricultural output.

Most of the people who answered bought chemical fertilizers. However, there were a lot of conflicts around fertilizer trades in rural regions. In an uncertain future of rainfed agriculture, the farmers attempted to do their own cost and benefit analysis by strategically using the inputs, while the administrators and extension agents wanted to sell them every item that was supplied to them by the higher levels of government.

The research study's conclusions suggest that extension agents instruct farmers on how to increase agricultural output in the region by using high-yielding planting materials and using the proper amount and quality of chemical fertilizers. In addition to employing extension agents to instruct farmers on how to use high-yielding input types, it is advised that the input delivery system be enhanced to ensure that inputs are accessible when needed and at reasonable costs.

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ADAMA SCIENCE and TECHNOLOGY UNVERSITY (ASTU)

Questionnaire for Master Thesis

APPENDIX 1: HOUSEHOLD SURVEY ON TECHNOLOGY TRANSFER FOR AGRICULTURAL GROWTH

Information to be given to respondents,

Mr. Walelign Areru Mengist is currently studying at the University of Adama science and Technology (ASTU). This questionnaire is designed to study technology transfer for agricultural growth in case of Adaa Woreda" as a requirement for the partial fulfillment for the award of Masters of technology and innovation management at Adama science and Technology University. Information received form you would be used for academic purposes and treated with confidentiality. I will be very happy if you give your precious time to answer the questions. Please be assured that the responses you give are for academic purposes only.

THANK YOU FOR YOUR ASSISTANCE.

Instructions: Please provide appropriate answer(s) or tick (√) in the box provided where necessary

Respondent name (id) ___________________________________

I. **Socio-economic Characteristics**

1**.** Address: Kebela name ___________________________________

2**.** Your gender: Male [ ] Female [ ]

3. Respondent's age ______________________ years

4. Your marital status: Married [ ] Single [ ] Divorced [ ]

5. Your education level: _________________ Years of schooling

6. Family size of respondent's number _________________

7. Household head experience in agricultural activities farming in years____________**Section**

II. Technology Transfer

8. Is there technology transfer in your kebele or village? yes [ ] NO[ ]

9. If your answer to question number 8 is yes what types of technology have you used for farming? ____

10. What are the result of agricultural production technologies to you used?(Multiple answers are possible)

To increase the productivity of land [ ] To improve the quality of life [ ]

To reduce cost production [ ] To save in time [ ]

Other, specify [ ] ________

11. What do you think are the major challenges of farmers in using agricultural production technologies? (Multiple answers are possible)

1. High selling price [ ] 2. Lack of rural infrastructure [ ]
3. Weak market linkages [ ] 4. Asymmetry of information [ ]
5. Limited filling of finance [ ] 6. Other, specify [ ] ________

12. What are the most serious agricultural production technologies problems in the community?
13. How do you solve the most serious agricultural production technologies problems?

Section III. Factors Affecting Agricultural production technologies and Agricultural Income of the Farm Households

14. Do you have any agricultural land? Yes [ ] No [ ]

15. Land ownership in Hectares: _____________________

16. Do own livestock in the years 2015 E.C? Yes [ ] No. [ ]

If yes which livestock category? _______________

17. Did you use irrigation system in your land? Yes [ ] No [ ]

18. If your answer to question number 17 is yes, how many hectares are irrigated in 2015 E.C?

19. Which source of water you used on irrigation?

Check Dams [ ] River diversion [ ] Communal Wells [ ] Private Wells [ ]

Other, specify ______________________

20. Do you get advisory services from extension agents as necessary? Yes [ ] No[ ]

21. How frequently do the extension agents visit you? 0) never 1) Annually 2) Monthly 3) bi-weekly 4) Weekly

22. Did you use chemical fertilizer in your land in (2015 E.C.)? Yes [ ] No [ ]

23. If your answer to question number 22 is yes, how many kilograms of input fertilizer did you use? ._______ (kg/ hectare)

24. How much cost do you incurred for fertilizer input?

1. Unit price__________ (Birr/quintal). 2. Total cost ____________ (Birr quintal).

25. Did you use improved seeds in your land 2015 E.C? Yes [ ] No [ ]

26. What was the cost of improved seeds inputs used?

1. Unit price_______(Birr/quintal) wheat 2. Unit price____(Birr/quintal) teff

3. Unit price_____(Birr/quintal) Chickpea 4. Unit price_____(Birr/quintal) other

5. Total cost__________(Birr/quintal)

27. Did you use tractor in your land 2015? Yes [ ] No [ ]

28. If your answer to question number 27 is yes, in how many hectare of land did you use tractor? _______________ (hectar).

29. What was the cost of tractor inputs used?

1. Unit price__________ (Birr/ hectar). 2. Total cost _______________ (Birr).

30. Did you use information technology in your agricultural production 2015 E. C ?

Yes [ ] No [ ]

31 Which types of ICT device you used? Multiple answers are possible

1 .Television [ ] 2. Radio [ ] 3 mobile phone [ ] 4. Satellite system [ ]   5.internat [ ]

32. If your answer to question number 31 is yes, in which purpose did you use ICT?

Gathering information about environmental condition   [ ]

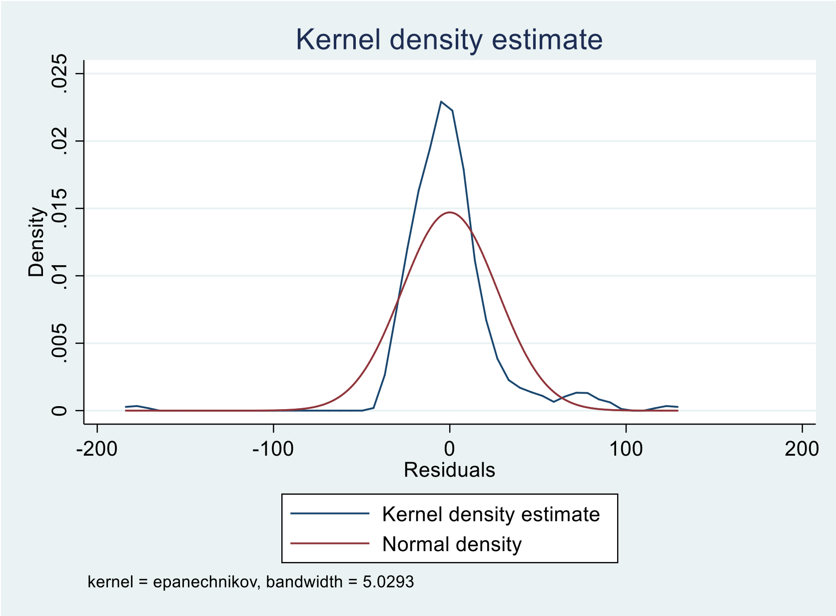
To use checking soil fertility [ ]   To measure the land size [ ]

33. Crop production by the household in 2015E.C

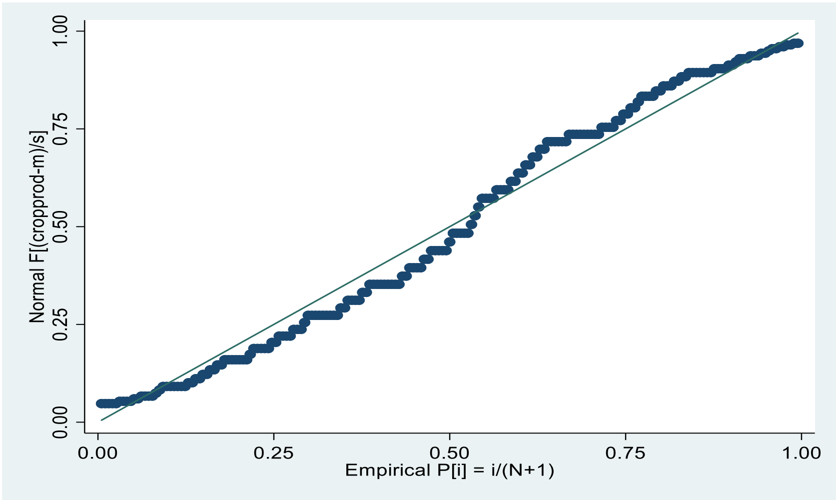
Crop grown	Area coverage(ha)	Average yield/ha	Total annual harvest(qt)
maize			
Local wheat			
Improved wheat			
barley			
tef			
pepper			
cabbage			
tomato			
potato			
onion			
Carrot			
sorghum			
Chickpea			
Others (Specify			

APPENDIX 2: THE NORMALITY TEST RESULT FOR THE CROP PRODUCT MULTIPLE REGRESSION

a) Kernel density normality test



b) Normal probability plot



APPENDIX 3: MULTICOLLINEARITY TEST RESULT FOR THE CROP PRODUCT REGRESSION MODEL

	VIF	1/VIF
irriown	4.964	.201
landsize	4.457	.224
workexp	4.047	.247
familysize	3.995	.25
age	3.683	.272
educlevel	1.587	.63
maritalstatuse	1.348	.742
fertitotal	1.306	.766
its	1.256	.796
imprseeds	1.217	.822
genders	1.215	.823
tracs	1.213	.825
exagentcons	1.113	.899
Mean VIF	2.415	.

APPENDIX 4: MODEL SPECIFICATION TEST RESULT FOR THE CROP PRODUCT REGRESSION MODEL

Ramsey RESET test using powers of the fitted values of croppro

Ho: model has no omitted variables

F(3, 176) = 10.75

Prob > F = 0.0000