JIMMA UNIVERSITY

COLLEGE OF SOCIAL SCIENCES AND HUMANITIES

DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES

THE ROLE OF ADOPTING OF IMPROVED AGRICULTURAL TECHNOLOGIES IN ENHANCING INCOME OF RURAL HOUSEHOLDS IN KONTA ZONE, SOUTHWEST ETHIOPIA

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A THESIS SUBMITTED TO THE DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES, COLLEGE OF SOCIAL SCIENCE AND HUMANITIES JIMMA UNIVERSITY IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF A MASTER OF ARTS (MA) DEGREE IN GEOGRAPHY ENVIRONMENTAL STUDIES (SPECIALIZING IN URBAN AND REGIONAL DEVELOPMENT PLANNING)

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DECLARATION

This is to certify that the thesis entitled **"the role of adopting improved agricultural technologies in enhancing income of rural household's in Konta Zone**" is my own work. I have undertaken the research work independently with the guidance and support of the research advisor. This study has not been submitted for any degree or diploma program in any other university and that all sources of materials used for the thesis have been duly acknowledged.

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APPROVAL SHEET

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As thesis research advisors, I hereby certify that I have read and evaluated this thesis prepared under my guidance, by Adamu Wondimu entitled **"the role of adopting improved agricultural technologies in enhancing income of rural household's"** The Case of **Konta Zone in selected kebeles.** We recommend that it submitted as fulfilling the thesis requirement.

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DEDICATION

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ABBREVIATION

ADLI	Agricultural Development-led Industrialization
ATA	Agricultural Transformation Agency
ATE	Average Treatment Effect
CSA	Central Statistics Agency
CIMMYT	International Maize and Wheat Improvement Centre
DA	Developmental Agent
FAO	Food and Agricultural Organization
FTC	Farmer Training Center
GDP	Gross Domestic Product
GTP	Growth Transformation Plan
HHs	Households
HYVS	High Yielding Variety Seeds
KAO	Kebele Administrative Office
KZBANRM	Konta Zone Bureau of Agriculture and Natural Resource Management
KZBFED	Konta Zone Bureau of Finance and Economy Development
MOA	Ministry of Agriculture
MoFED	Ministry of Finance and Economic Development
MoARD:	Ministry of Agriculture and Rural Development
PADETES	Participatory Demonstration and Training Extension System
SPSS	Statistical Package for Social Science
SDPRP	Sustainable Development and Poverty Reduction Program
TLU	Tropical Livestock Unit
PASDEP	Plan for Accelerated and Sustainable Development to End Poverty
UNCTAD	United Nations Conference on Trade and Development
WB	World Bank

ABSTRACT

Adoption improved agricultural technologies have long been promoted by governments and development organizations as effective ways to increase farm productivity and reduce poverty. Encouraging rural households' to use improved agricultural technologies to increase the efficiency of production and productivity is among the important policy measures to address the problem undertaken by the government. However, the adoption of many seemingly beneficial technologies remains low. The general objective of the study was to assess factors influencing the adoption of improved agricultural inputs and their impact on the income of small household farmers in the Konta zone. Both descriptive statistics, inferential statistics and econometric models were used to analyse the data. The logistic regression model was used to analyse the impact of technologies and the factors influencing the adoption of agricultural technologies respectively. The results presented that farmland size, number of oxen, number of livestock, and distance of household from farm training centre had a significantly influence the adoption level of improved agricultural technology. On the contrary, the high price of improved technology, access to credit, and membership in the cooperative associations of household heads had negatively affects the adoption level of improved farm inputs. Regarding the impact of adopting improved agricultural technology smallholder farmers who had adopted improved agricultural technology enhanced their annual crop income by about 15927.12 Birr per year for NNM, which is significant at 5% probability level, about 14177.854 birr per year for SM which is significant at 1% probability level, about 15304.172 birr per year for KM which is significant at 1% probability level and about 15159.602 birr per year for RM which is significant at 1% probability level. Based on the findings, the study suggests that strengthening the promotion of full-scale technology adoption will have a vital role in improving the livelihood of households in the study area. In doing so, managing the possible determining factors that affect the adoption of improved agricultural technology should be a precondition.

Keywords: Improved agricultural technologies, Smallholder farmers, Adoption

CHAPTER ONE

1. INTRODUCTION

1.1 Background of the Study

Three-quarters of the world's poorest people live in rural areas and the vast majority depend on agriculture for their livelihood and survival (Charlie, 2012). This has triggered much of the need to increase productivity and sustainability in agriculture around the world. According to Challa (2013), an improvement in input and output relationships, new technology tends to raise output and reduces the average cost of production which in turn results in substantial gains in farm income. Agricultural technology adoption is assumed to improve the welfare of adopters through higher crop yields, and reduced per unit cost of production which leads to higher own personal consumption and disposable income (Zeng et al., 2017).

New agricultural technologies play a key role in increasing agricultural production (and hence improving national food security) in developing countries. Where successful, adoption of improved agricultural technologies can stimulate overall economic growth through inter-sectoral linkages while conserving natural resources (Faltermeier and Abdulai 2006; Sanchez et al. 2009). Given the close link between food insecurity, poverty, farming and environmental degradation the impact of cultivation practices has received significant attention in the last few decades. New cultivation techniques have been introduced in many countries to enhance productivity in the agriculture sector.

Sub-Saharan Africa (SSA) has the highest number of people living in extreme poverty, comprising 413 million people in 2015 (Beegle et al., 2016). The number has increased significantly since the 1990s and it is expected that around 88% of the world's poorest will live in Africa by 2030 (World Bank, 2015). Therefore, by increasing the productivity of small farmers in developing countries, the agricultural sector leads to economic growth and development, poverty eradication, and improved food security (Workineh et al, 2019).

In Ethiopia, about 33% of the rural population lives below the national poverty line and an additional 14% of non-poor households are estimated to be vulnerable to falling into poverty (World Bank, 2015). A study by Kariyasa and Dewi (2013) indicated that the adoption of improved technologies increases productivity, which later results in socio-economic development. Adoption of improved agricultural technologies has been associated with higher earnings and a reduction in rural poverty among farm households, improved nutritional status, lower staple food prices, increased employment opportunities as well as earnings for landless laborers. Therefore, increasing the productivity of small farmers through improved technology has become a policy priority of the Ethiopian government (Abbebaw& Haile, 2013).

In Ethiopia, the agriculture sector has received special attention in the development planning process of the government since the formulation of the agricultural development-led industrialization (ADLI) strategy in 1993. One of the main objectives of this strategy was to modernize Ethiopia's agriculture through the adoption and diffusion of new farm technologies such as fertilizers and certified seeds. Moreover, successive national plans of the government such as the Sustainable Development and Poverty Reduction Program (SDPRP), Plan for Accelerated and Sustainable Development to End Poverty (PASDEP), and Growth and Transformation Plans (GTP I and II) have given a strong emphasis on improving agricultural productivity through research-generated information and technologies, among others. Consequently, the use of agricultural technologies such as improved seeds and chemical fertilizer has increased over time though still falls short of the target set to transform smallholder agriculture (MoFED, 2016). Agricultural production in the country is constrained by numerous factors, including a small land size, often insufficient to be economically viable; unreliable and erratic rainfall caused by climate change, often resulting in periodic droughts; poor or declining soil fertility; limited input/output market integration; very little use of improved agricultural technologies (Abebe&Sewnet, 2014).

To accelerate the dissemination and adoption of agricultural technologies in the country, the Ethiopian Agricultural Research Institute, regional agricultural research institutes, and universities have tested and commercialized several improved agricultural technologies for crops, livestock, and natural resource

management. In addition, agricultural, technical, and vocational education and training schools in the country have trained frontline advisors who are stationed at the Farmers Training Centers (FTCs) established at the lowest level of administrative units across the country. These are some of the efforts that have been made to encourage the adoption of improved agricultural technologies by smallholder farmers in the country (Wordofa et al., 2021).

In this study, the researchers' have investigated the role of adopting improved agricultural technologies in enhancing rural households' income in konta zone. Konta is one of the zones in the southwestern Ethiopia region. The population of the zones is heavily dependent upon subsistence agriculture. However, the households receive a very low amount of production and productivity from their farmlands (KZBoANRM, 2022). Due to this, government and different stakeholder projects were implemented to improve the farmer production and productivity in the zone. According to the zone agricultural office and the researcher observation as well, to overcome the problem of low production modern agricultural inputs such as livestock, pesticide, hybrid crops, fertilizers, chemicals...etc. being distributed among the adopter's rural household farmers and started to use these modern agricultural inputs. However, the rate of adoption of improved agricultural technologies in rural households is low ((KZBoANRM, 2022)). Rural households receive a very low amount of production and productivity from farmland. Several factors can explain the low technology adoption rate in the face of significant efforts to promote improved agricultural farming practices such as poor extension service system, coercive technology promotion, demographic factors, high cost of inputs, lack of access to credit, lack of infrastructure, no organized marketing channels for production when in high supply, asset level, and others.

So, as far as the researcher's knowledge is concerned, in the Konta zone, there are no studies on the role of the adopting of improved agricultural technologies in enhancing rural household incomes. Therefore, this study was assessed the role of adopting improved agricultural technologies in improving the income of rural households in the study area.

1.2 Statement of the Problem

The agricultural sector contributes 43% to gross domestic product, 90% to export earnings, and 96% to rural employment (Biru et al., 2020). It becomes necessary to apply proper agricultural methods to increase agricultural production. Therefore, increasing the productivity of smallholders farmers through improved agricultural technology has become a policy priority of the Ethiopian government (Abebaw& Haile, 2013).With this in mind, important resources are being utilized by the Ethiopian government and stakeholders to increase agricultural productivity and alter the state of agriculture in the country. Material resources and human capital are allocated towards this end. Extension workers, packages or programs, and agricultural inputs are some of the resources that are made available to farmers to change their style of farming and enhance productivity (CSA**,** 2013)**.**For example, according to Diao (2010), a 1% annual increase in Ethiopia's GDP driven by agricultural growth results in a 1.78% reduction in the country's poverty rate per year.

There are recent studies that have assessed the contribution of adopting improved agricultural technologies to farm household incomes in Ethiopia. For instance, the positive impact of improved agricultural technologies on productivity and welfare (Asfaw et al., 2012; Mekonen and Karelplein, 2014) and improving the food security of smallholder farmers (Shiferaw et al., 2014). Most studies in the literature address the positive effects of improved grains (corn, teff, wheat, sorghum) and other crops (peanuts, pigeons, rice) on agricultural productivity and household income (Asfaw et al., 2012; Natnael, 2019; Awotide et al., 2016; Tesfaye et al., 2016 and Wake &Habteyesus, 2019, Manda et al., 2016, Bezu et al., 2014; Kassie et al., 2018 and Ali and Abdulai, 2010). According to Wordofa et al., (2021), the adoption of modern agricultural technologies is an important solution to address the problems of productivity, food insecurity, and poverty of smallholder farmers and improve household income compared to those who do not use these improved technologies.

Despite all these efforts of the government and stakeholders, and the contribution of improved agricultural inputs, agricultural productivity, and farm household incomes are still very low in Ethiopia. To understand the low adoption rates of improved agricultural technology, it is essential to consider the factors that determine farmers' adoption behavior. Adoption of improved agricultural technology is the most important tool for increasing the income of rural households, but adoption rates and the role of

technology are affected by various factors such as socio-cultural, demographic, economic, and institutional factors (Solomon Yokamo, 2020).

Accordingly, in konta zone, the determinant factors affect rural households from adopting improved agricultural technologies worth scientific research. For example, rural households are reluctant to use fertilizers, pesticides, and other improved agricultural technologies, misunderstandings about the issue, poor performance, improper implementation, and adherence to traditional fertilizer use. Even though they took these fertilizers, they kept them for the next year, and other people also pay and don't go out from the co-operative or FTC store, political factors. Therefore, these issues require scientific research. In addition; family-owned farms within the study area are affected by rural labor migration as they hinder the adoption of improved agricultural technologies. As a result, not only men but also women and young people, well-educated and informed young people are now migrating to urban areas. This will reduce the workforce of rural householders in the study area. Not only this but other factors which affect rural households to adopt improved agricultural technology, such as political factors. These factors affect small farmers' households in adopting improved agricultural technology, which in turn affects their income.

In this regard, in Ethiopia, relative studies have been undertaken with issues related to agricultural extension programs, and the level of awareness of smallholder farmers to the program. Some of these studies are: the effect of agricultural extension programs on smallholders' farm productivity by Elias et al., (2013), and their findings had shown that the extension program has a positive effect on farm productivity in the study area. Also, the study was undertaken by Wasihun et al., (2014) on the farmers' perception of their participation in extension in Ethiopia: Policy implications in Soddo- zuria Woreda of SNNPR had shown that farmers perceived that their participation is low, and had a significant correlation with sex, educational status, wealth status and frequency of contact with extension agents.

On other hand, Elias et al., (2015) have been conducted on farmers' satisfaction with agricultural extension service and its influencing factors: the case study in north west Ethiopia and their empirical result revealed that perceived economic return, regular extension contact, family size and off-farm income were driving factors for farmers' satisfaction. In addition, Mengistie and Belete, (2015) have

been conducted on review of the role of extension service for agricultural transformation with particular emphasis on Ethiopia and their paper concluded that total eradication of agricultural development problems can be achieved through extension service approach if the role of extension is properly conceived and effectively administered. Moreover, Wordofa et al., (2014) have been conducted focusing on improving smallholder farmers' income through farmer training centers: an impact evaluation in Haramaya district of Ethiopia and their results indicate a positive and statistically highly significant gain of farm income (excluding chat) by the participants of Farmer Training Centers (FTCs).

However, above mentioned studies did not consider the political factors which affect the adoption of modern agricultural technology among smallholder farmers. And also a majority of study was conducted on the impact of adoption of modern agricultural input technologies in a different part of Ethiopia. This may not have equal representation and implications in this study area. Therefore, it is very important to assess the role of adopting improved agricultural input, its implementation, and factors that affect farmers' decision whether to use or not to use modern agricultural inputs in konta zone. What is the reason? Is it because the difference in output wholly transformed to cost of production without generating any positive outcome?

To answer the above key questions, studies are required to be conducted in the area but to the best of the researcher knowledge's considered, no such adoption studies were conducted in study area to identify the determinants of agricultural technology adoption and the impact of the adoption on the livelihood of adopters and to address the problem of very low adoption of the modern agricultural technologies for productivity and there by welfare improvements. To this end, this study was conducted on the study area to fill the gap within the scope of investigation and identifying those constraints of adoption decision and the impacts of the adoption on the income of the adaptors.

Thus, considering the gap between the study area and determinant factors, this study have assessed the role of adopting improved agricultural technologies in enhancing the income of rural households in the Konta Zone. Furthermore, one of the most important things is that the researcher has initiated to conduct a research on adoption of modern agricultural input technology and their productivity is backward (traditional) use of modern agricultural input technology and its low production capacity of smallholder farmers in the study area.

1.3 Objectives of the Study

1.3.1 General Objective

The main objective of this study was to assess the role of adopting improved agricultural technologies in enhancing incomes of rural households in Konta Zone.

1.3.2. Specific Objectives of the Study

- ✓ To explore the role of modern agricultural inputs use in enhancing rural households' income in the study area.
- ✓ To investigate the major demographic, institutional, socio-economic and political factors affecting the adoption of improved agricultural technology in the study area.
- ✓ To identify modern agricultural inputs that is currently used by the rural households in the study area.

1.4 Research Questions

The key questions that are answered by this research are:

1) Does the adopting improved agricultural input have significant impact on enhancing rural household income?
2) What are the factors influencing level of modern agricultural technology adoption?
3) What are the existing statuses of modern agricultural inputs uses in farming households?

1.5 Significance of the Study

Because most farmers in developing countries are engaged in agriculture, it is very important to investigate the role of adopting improved agricultural technologies. This study proves the need to improve farmers' living standards by improving production capacity. Given the low adoption of modern agricultural technologies and low-income levels of smallholder farmers in the study area, this study were integral in investigating factors affecting the adoption of improved agricultural technology and subsequent reduction in income levels.

Therefore, the results of the study was provided a feedback information to farmers, zone agricultural office, government and stakeholders, scholars and researchers investigate the underlying reasons why low adoption of agricultural technology and poor agricultural production lead to low income levels, and serve as a source of reference for academicians who intend to conduct research on similar issues.

1.6 Scope of the Study

The study was limited to three rural kebeles. Concerning the research topic, the research focuses on the assessing the determinant factors which affects the adoption of modern agricultural inputs and level of agricultural productivity in enhancing smallholder farmers income in three selected kebeles (bakeferda, cheta and konta koysha kebeles) in konta zone.

1.7 Limitation of the Study

The inclusion of most rural kebeles of the zones in the study is important to derive sound able generalization but researcher considered limited number of kebeles due to shortage of finance, time, and resources. The study is limited only to three rural kebeles. As a result of shortage of time, finance, and lack of prior experience in doing a research the researcher might be force to take samples from only limited area. Even though a konta is a wide zone, the researcher selects a sample or considers individual respondents to be included in the study only from **3** kebeles. This might affect the generalization of results.

This study was affected by the inconvenience of public transportation during data collection to travel from one kebele to another in the zone. To alleviate this, motor cycle transportation system has been used to accomplish the data collection process.

The translation of language may be one of the limitations of this study. For instance, the interviews were conducted in kontegna language and reinterpreted to English for analysis; hence, they may lose their exact meanings in this process. The process of transcription was time-consuming. To tackle this problem both direct and contextual meanings are used based on the context to make the message more meaningful in English.

In spite of these few constraints, maximum efforts have been done to make the study meaningful and complete as much as possible and, eventually, managed the completion of the research.

1.8 Operational Definition

Rural: is any locality that exists primarily to serve agricultural hinterland.

Household: is defined in this research as people living under the same roof and eating food from the same pot.

Rural Household: is a household that lives in the countryside with limited land size; predominantly rely on family labor; subsistence producers, practice mixed farming.

Technology Adoption: the decision to acquire and use a new or improved invention or innovation.

Kebele: is the lowest administrative unit of settled rural area.

1.9 Organization of the Study

The research prepare was organized into five chapters.

Chapter one deals with the introduction consisting of the background of the study, statement of the problem, objectives of the study, research questions significance of the study, the scope of the study, and limitation of the study.

Chapter two is concerned with the review of related literature including theoretical, empirical literature, and conceptual.

Chapter three deals with research methodology which comprising description of the study area, sampling technique, data type, source, and method of data collection, and analysis of the study.

Chapter four presents results and discussions.

Chapter five deals with summary, conclusion and recommendation on the major findings of the study.

CHAPTER TWO

2 LITERATURE REVIEW

2.1 Theoretical Perspective

2.1.1 Definition of Agricultural Technology Adoption

Different authors define technology adoption in different ways. According to Doss (2007), defining technology adoption can be complicated by the complexity of defining the technology adopted. For the introduction of improved seed, the CIMMYT studies used different definitions, ranging from farmers who used a variety that was originally an improved hybrid but was repeated, to farmers who followed the advisory service's recommendations of using only new certified seed to use.He pointed out in his analysis that when defining farmer adoption of agricultural technologies, the first thing to consider is whether adoption is a discrete state with binary responses or not. That is, it depends on whether the farmer is a user of the technologies or a non-user and takes the values 0 and 1, or the answer is a continuous variable. The appropriateness of each approach may depend on the specific context. So many CIMMYT studies used a simple dichotomous variable approach (yes or no), which are binary measures of response variables in farmers' decisions about adopting new technologies. A farmer was defined as an adopter if it was found that he or she was cultivating improved materials, i.e. improved seeds using chemical fertilizers. Therefore, a farmer can be classified as an adopter and still grow some local materials. This approach is best suited when farmers typically grow either local varieties or improved varieties. If the interesting aspects of adoption are situations where farmers plant progressively more land to improve varieties while continuing to grow some local varieties, then a continuous measure of adoption is more appropriate (Doss, 2007). That is, when the target of the adoption analysis focuses on the extent of adoption of the new agricultural technologies, a continuous response measure is applied.

Agricultural technologies include all kinds of improved techniques and practices that affect the growth of agricultural production. Some of these are high-yielding seed varieties, chemical fertilizers, pesticides, herbicides, and the use of machinery. Under improved input/output ratios, new technology tends to increase output and lower average production costs, which in turn leads to significant increases

in farm income. Users of improved technologies increase their production, which leads to an increase in productivity (Jain et al., 2009). Levinsohn et al., 2013 define technology as means and methods for the production of goods and services, including methods of organization as well as physical engineering. According to these authors, new technology is new to a particular locality or group of farmers or represents a new use of technology already in use at a particular locality or group of farmers. Technology is the knowledge/information that makes it possible to do some task more easily, provide some service, or produce a product (Lavison 2013).

2.1.2 Empirical view of Adoption

As is the case in many developing countries with an agrarian economy, agricultural technology adoption has got a number of processes. It has both spatial and temporal dimension. It is argued that technology adoption is not a one of static decision rather it involves a dynamic process in which information gathering, learning and experience play pivotal roles particularly in the early stage of adoption and diffusion (Assefa and Gezaghegn, 2010).

Technology can be adopted when it is found to be beneficial while dropped over time if loss is entertained due to increasing cost of inputs, falling of yields or shift to other more profitable technology (Dinar and Yaron, 1992). There are various reasons that brought agricultural technologies to be adopted or brought for failed to do adoption. Quite much of the studies have been generated on determinants of technology adoption both domestically and internationally. Farmers move from learning to adoption to continuous or discontinuous use over time. The characteristics of both the user and the technology are important in explaining adoption behavior and the pathway for adoption. The lag between learning and adoption, and the possibility of discontinuation imply that a longer period will be required for the majority of farmers to use the technology than if adoption was a one off decision leading to continuous use. This picture has been clearly demonstrated by the adoption process of the technology in the four regions of Ethiopia considered in this study.

The study conducted in Ethiopia and western Kenya using probit analytical model shows that gender, agro-climate zone, manure use, hired labor and extension service has a significant effect towards adoption of improved seed and fertilizer (Salasya *et al*., 1998, Cropenstedt *et al*., 2003). On the other hand a study conducted in the coastal low lands of Kenya shows that non availability and high cost of seed, unfavorable

climate conditions, perception, and insufficient soil fertility has a negative and significant effect on adoption of technology.

Birhun *et al*., (2014), in their study conducted on hybrid adoption and chemical fertilizer, factors that affect the adoption decision has been indentified using probit model and the marginal effect using OLS estimates. The result shows gender, land ownership, irrigation use, access to credit, contact with extension agent, participation in off farm business activity have positive and significant relation with the adoption decision of chemical fertilizer;, while plot distance from the home stead, distance to the nearest market and TLU (Tropical Livestock Unit) has an inhibiting role in adoption decision. According to Yanggen *et al*., (1998), in Africa fertilizer application is determined by human capital (basic education, extension and health); financial capital (income, credit and assets); yield response (bio-physical technology and extension), basic services (infrastructure and quality control) and input output price (structure conduct and performance of subsector, competition and equity).

Yu *et al*., (2011), in a study conducted on cereal technology adoption in Ethiopia, to examine the extent of adoption of fertilizer seed technology package and factors affecting the adoption of same using nationally representative secondary data, found that variables affecting the adoption of the new technology, like access to extension service, the level of adoption at the district level, and the experience of farmers using fertilizer in other crops, have a significant effect on the probability of accessing fertilizer and improved seed by farmers. Specialization, together with wealth and risk aversion, also plays a major role in explaining crop area under fertilizer, which should be related to better access to technology-related knowledge.

2.1.3 Adoption of Improved Agricultural Technologies and Their Impact.

According to Norton (2004), agriculture has become an area that requires the application of cutting-edge agricultural technology, with rapid advances in crop genetics, such as a variety of seeds and chemical fertilizers, pest and livestock management, and machinery. The issue of access to these technologies, as well as their application and dissemination, is particularly important because agricultural engineering, like other high-tech areas, is now becoming very important internationally leading countries continually borrow and build on research from other countries.

Many developing countries are lagging, in part because of self-imposed barriers to the adoption of privately produced agricultural technologies. Increasing agricultural productivity is an even more

pressing LDC problem given that the majority of the poor in developing countries live in rural areas and average sectoral productivity is falling in many low-income countries (Norton, 2004). However, agricultural productivity varies due to large differences in the degree of adoption of selected agricultural technologies and the underlying determinants of those technologies' adoption. A study by Akudugu et al. (2012) in Ghana stated that the low productivity of farmers in the country was due to the low uptake of modern agricultural technologies.

According to Tsegaye and Bekele's (2012) analysis, low production and productivity are mainly associated with poor uptake of improved technologies. Introducing improved technology agricultural technologies and found various influencing factors conducted many studies. Based on the literature review above, the introduction of improved agricultural input technology plays an important role in increasing the output and productivity of rural households. This, in turn, helps households overcome poverty, ensure food security and improve household income.

2.1.4 Impact Assessment of Technology and Household Income

Impact assessment is a process of systematic and objective identification of the short and long term effects of intervention on economic, social, institutional and environments. Such effects may be anticipated or unanticipated and positive or negative, at the level of individuals, households, or the organization caused by ongoing or completed development activities such as a project or program (Rover and Dixon, 2007, Omoto, 2003). Impact assessment evaluation is the extent to which a project has caused desired or undesired changes in the intended users. It is concerned with the net impact of intervention on individuals, households, or institutions attributable only and exclusively to that intervention (Baker, 2000). Impact on income is a reward that the owners of fixed factors of production receive as a result of allowing their land, capital, and labor to take part in production.

Various methodologies have been developed and used in the literature to assess the impact of programs, strategies, and the introduction of improved agricultural technologies on poverty reduction or rural household well-being. However, the results are mixed. For example, Mendola (2007) introduced Propensity Score Matching (PSM) methods to assess the impact of agricultural technology introduction on poverty in Bangladesh and observed that the introduction of high-yielding improved varieties had a positive effect on household well-being has in Bangladesh. Similarly, Wordofa et al. (2018) Adopted Propensity Score Matching (PSM) methods to assess the impact of improved agricultural technology use on farm household income in eastern Ethiopia (Wordofa et al.., 2018, Solomon Asfaw, et al.., 2012 and B. Cunguara, I. Darnhofer, 2011).

One method to analyze the role of adopting modern agricultural technologies is to consider the income differences between users and non-users. Estimating the impact of technology adoption on household welfare outcome variables (i.e. total income and per capita consumption, based on non-experimental observations) is non-trivial. What we do not observe are the outcome variables for adopters if they did not adopt (their income if they had not adopted modern technology). That is, we do not observe the outcome variables of households that adopt when they would not have adopted (or vice versa). In experimental studies, this issue is addressed by randomly allocating adoption to treatment and control status, thereby ensuring that the outcome variables observed in the control households without adoption are statistically representative of what would have occurred without adoption.

2.1.5 Adoption of Improved Agricultural Technologies in Ethiopia

2.1.5.1 The Need for Improved Agricultural Technologies Adoption in Ethiopia.

One main fact that both agricultural researchers and policy makers agree on is that, to realize a Green Revolution in Africa, an increase in the use of fertilizers and improved seed technologies is inevitable (Morris *et al*., 2007).

Ethiopia being one of the African countries was developed strategic objectives to accomplish the objective of the Green Revolution and to increase agricultural productivity and production as a prerequisite for food security and agricultural-led industrialization. The Government's first priority for the agricultural sector is to increase agricultural productivity and production as a prerequisite for food

security and agricultural-led industrialization. This productivity gains are expected to come from closing the large gap between leading farmers and the majority, whose productivity performance (as measured by yields per hectare, livestock unit etc.) is far below potential. Proven and appropriate agricultural technologies will be up-scaled through a revitalized agricultural research and extension system, combined with improved supply channels for farm inputs, with a focus on high potential areas where the investment is likely to generate the best returns. The focus will be on simple and affordable agronomic packages including the use of improved seeds, fertilizers and fertility management, weed and pest control, and improved harvest and post-harvest management" (MoARD, 2012). The means of achieving such objective is clearly by focusing on simple and affordable agronomic packages including the use of improved seeds, fertilizers and fertility management, weed and pest control, and improved harvest and post-harvest management. That means developing modern agricultural technologies and distributing among the farmers of the country, which is the focus of the country to attain sustainable growth in agricultural production.

Therefore, the need for technology adoption in the country is to increase agricultural productivity for the attainment of the issue of food securities and sustainable economic growth. The low yields prevalent in Ethiopian agriculture are generally attributed to low usage and efficiency of modern inputs. The CSA national survey data show that, while about 40% of cereal production benefits from the use of fertilizer, only about 10% also gains from other inputs, such as improved seed or irrigation (CSA, 2011).

2.2 Empirical Studies on Impacts and Determinants of Agricultural Technologies Adoption

2.2.1 Impact of Improved Agricultural Technologies Adoption in Rural Households Income

Various methodologies have been developed and used in the literature to assess the impact of programs, strategies, and the adoption of improved agricultural technologies on poverty reduction or rural household well-being. However, the results are mixed. For example, Mendola (2007) introduced Propensity Score Matching (PSM) methods to assess the impact of agricultural technology introduction on poverty in Bangladesh and observed that the introduction of high-yielding improved varieties had a

positive effect on household well-being has in Bangladesh. Below are some of the results of previous studies.

In a study by Wordofa et al. (2021), they assessed the causal effect of the use of improved crop and animal husbandry technologies on farm household income based on 248 randomly selected households in six districts of eastern Ethiopia using the PSM estimation procedure. The main results of the study showed that smallholder households using improved agricultural technologies had statistically significant household income compared to those not using these technologies. More specifically, they found that improved use of agricultural technology resulted in an average 23,031.28 Birr higher annual farm income per household compared to not using such technology.

A study was conducted using cross-sectional data collected from randomly selected 163 sample households from north-eastern Ethiopia and the analysis was performed using a multivariate regression model, confirming that the resulting increase in adopting farmers was a 24% have higher agricultural income from agricultural production due to adoption. It shows that the adoption of improved agricultural technology plays an important role in increasing the productivity and income of rural households (Natnael, 2019).

According to Tsegaye mulugeta (2020), the study assessed the impact of the adoption of improved agricultural technologies high-yield varieties (HYVs) on rural household well-being as measured by consumer spending and poverty indices in two regions of rural Ethiopia (Amhara and Tigray) and 51 rural villages based on World Bank data (2010). The analysis shows that the adoption of improved agricultural technologies has a robust, significant, and positive impact on per capita consumption expenditure and a negative impact on household poverty status. The average total increase in consumer spending per capita ranges from 582.67 Birr to 606.69 Birr per year.

A Shita et al. (2020) analyzed the impact of agricultural technology on income distribution using a propensity score matching model. For this purpose, data were collected from 400 agricultural households from three districts in Awi Zone, Ethiopia, and it was found that agricultural technology has a significant and positive impact on household income.

Study, based on evidence from southern and northern Tigray Ethiopia, shows that the adoption of improved agricultural technologies has a positive and significant effect on farm income, making adopters better off than non-adopters, and also the importance of agricultural technology in increasing production and productivity can be realized if yield-enhancing technologies are widely adopted and spread (Berihun K. et al. 2014).

Solomon Asfaw, et al.., (2012), conducted the study on the potential impact of adoption of improved legume technologies on rural household welfare: evidence from rural Ethiopia and Tanzania. Both secondary and primary data source were used. The study utilizes cross-sectional farm household level data collected in 2008 from a randomly selected sample of 1313 households (700 in Ethiopia and 613 in Tanzania). The causal impact of technology adoption is estimated by utilizing endogenous switching regression. The result reveals that adoption of improved agricultural technologies has a significant positive impact consumption expenditure (in per adult equivalent terms) in rural Ethiopia and Tanzania. This confirms the potential role of technology adoption in improving rural household welfare as higher consumption expenditure from improved technologies translate into lower poverty, higher food security and greater ability to withstand risk.

2.2.2 Empirical Studies on Determinants of Adoption of Improved Agricultural Technologies

There are literatures on adoption of high yielding varieties and management of technologies both abroad and inside the country. Studies indicated that, the adoption decision of farmers are affected by a number of variables such as economic, demographic, sociocultural, and institutional factors.

2.2.2.1 Economic Factors

These are very important for agricultural technology adoption. Many authors have analyzed farm size as one of the most important determinants of technology adoption. Farm size can influence, and in turn be influenced by, the other factors affecting adoption. Various studies conducted on the impact of farm size on the adoption of improved agricultural technologies have shown conflicting results. However, many studies have found a positive association between farm size and agricultural technology adoption (Ahmed S.2004 and Gabre-M.etal. 2001 cited as Solomon Yokamo 2020).

According to Solomon Y., Endrias O. (2018), farmers with a large farm size are likely to adopt new technology because they can afford to devote part of their land to testing new technologies. While farmers with small land sizes use technologies that do not consume large land. The reviewer agrees that a farmer with a large farm is more likely to adopt improved farming technology than a farmer with a small land. Family size is used simply as a measure of labor availability. According to Alemayehu Keba (2019), the household size must be positive and significant at a 1% level of significance, with each additional family size increasing the probability of adopting improved corn varieties by 5.85 percent.

Farm income is one important variable for adoption decision. The amounts of household income obtain from the sale of crop and animal, after household consumption met helps to purchase agricultural inputs. According to Almaz Giziew (2008) and Solomon *et al*. (2011) reported that household income had a positive and significant effect for technology adoption decision. However, in the study of Simtowe *et al*. (2011) reported that income no significance effect on technology adoption. Study conducted by Berihun K. *et al*…, (2014) reveal participating in different off-farm activities was found to have a positive and significant relationship with chemical fertilizer adoption decision which is statistically significant at 1% level of significance. Off-farm income could best be taken as an important ingredient of adopting chemical fertilizer in such a way that farmers could easily afford fertilizer cost; and these farmers are mostly exposed to new and updated information since they move from one town to another and contacted with different people with different background. Due to this reason, off-farm participants, citrus paribus, have 41.8% higher probability of adopting chemical fertilizer unlike off-farm non-participants.

Livestock size is an important indicator of households' wealth position. Livestock are also important source of generating income that helps to purchase agricultural inputs. Usually it has a positive association with technology adoption decisions. Solomon *et al* (2011), Huang *et al.* (2015) and Simtowe*et al*. (2011) reported that livestock ownership had a positive and significant results for technology adoption decisions than those who had no livestock. However, Adam Bekele and Yitayal Abebe (2014) indicated that Livestock ownership had a significant effect on delaying technology adoption.

2.2.2.2 Demographic Factors

Farmers' age, gender, and educational level are likely to affect the likelihood of farmers adopting new technologies DegefuKebede, et al. (2017). Gender is a very important explanatory variable when studying adoption factors. The prevailing social structure of rural households imposed different responsibilities on male and female members. Many studies have shown that having a female board negatively influences technology adoption decisions. Due to social and cultural values and norms, men have freedom of mobility, and participation in various training, meetings, and workshops. Asfaw S. et al. (2012) found that the gender of the head of household negatively affects technology adoption. It was found that when the head of the household is male, the chances of adopting the wheat technology package decrease. In contrast to this result, Degefu Kebede et al. (2017) found that male-headed households were more likely to adopt improved wheat varieties than female-headed households. As Gishu Nigatu (2018) reported that a male-headed household has a positive and significant association (at the 5% level) with the likelihood of adopting an improved corn variety. Household size is simply used as a measure of labor availability for farmers with large families (Mwangi and Kariuki, 2015).

Study conducted by Sennuga *et al.,* (2020) reveal a positive and significant relationship between household size and technology adoption. It determines the adoption process in that; larger households have the capacity to relax labor constraints during the introduction of new technologies (Mignouna, *et al*., 2011). This implies that farmers with large families will certainly generate more income through large-scale production of improved technologies using family labor. Hence, the bigger the family size, the more economically stable the family (Mwangi and Kariuki, 2015).

2.2.2.3 Institutional Factors

Access to advisory services helps disseminate information and farmers receive updated information on farming technologies, helping them to easily adopt the new technologies. Many authors have reported a positive relationship between advisory services and technology adoption. Farmers' close contact with advisors increases farmer awareness of improved farming technologies, which in turn drives adoption. Farmers are usually informed of the existence and effective use and benefits of new technologies through extension agents. The extension Agent acts as a link between the innovators (researchers) of the technology and the users of that technology. This helps to reduce the transaction costs involved in

disseminating the information about the new technology to a large heterogeneous group of farmers (Genius, M., et al., 2010).

The study by B. Kassa, et al. (2014) reported that contact with extension workers positively influences chemical fertilizer introduction and is statistically significant. Farmers who are visited by advisors and keep other things constant are 11.1% more likely to accept chemical fertilizer compared to unvisited or uncontracted farmers in northern parts of Ethiopia. Access to credit is a very critical factor in the adoption of agricultural technologies by small farmers. It can make it easier for farm households to purchase the farm inputs they need and improve their ability to make long-term investments.

Access to credit services provides rural households with the greatest improvements in their well-being and is one of the best opportunities that could prompt rural households to diversify their economic base and is important when considering the decision to implement chemical fertilizers and high-yielding varieties (HYV) in northern Ethiopia. Farming households that have access to credit and keep other things constant are 9.9% and 24.5% more likely to use chemical fertilizer and HYV, respectively compared to the credit-rationed farmers.

Access to information reduces uncertainty about a technology's performance and can therefore change a person's assessment from purely subjective to objective over time. Sometimes access to information can also lead to rejection of the technology (B. Kassa, et al., 2014).

Access to Information: Agricultural technology information plays an important role in improving technology and it is important to ensure that the information is reliable, consistent, and accurate. The evaluator agrees that access to information encourages the introduction of improved agricultural technologies. Access to Infrastructure: Access to roads distance to the nearest marketplace, and farmer training center are important factors that regulate technology adoption. When market connectivity is increased, this, in turn, increases farmers' confidence to produce a needs-based commodity for sale through the use of improved agricultural technology. The study by DegefuKebede et al. (2017) ensures that market distance has negatively impacted the adoption of the wheat technology package. The result shows that an increase in the distance to the market by one kilometer leads to a decrease in the probability of the introduction of wheat technology packages by a factor of 0.023, with other factors

remaining constant. This could be due to limited access to new information about technology and a lower likelihood of these farmers being involved in agricultural research trials and visits.

Access to extension: extension services played a positive role in ensuring economic success and shifting the poor livelihood of the rural people. Farmers are usually informed about the existence as well as the effective use and benefit of new technology through extension agents. The extension agent acts as a link between the innovators (Researchers) of the technology and users of that technology. This helps to reduce transaction costs incurred when passing the information on the new technology. In Nigeria, with a different degree of influence, access to extension services and cooperative membership had a substantial and statistically significant effect on the welfare of the rural people (Wossen, et al., 2017).

Access to road: distance to the nearest market and farmers training center is an important factor which determine the technology adoption. When there is access to roads which connects rural farmers with market, they can easily transport what they produce to the market. If the market linkage is increased, which in turn increases the farmers' confidence to produce demand-based commodity for sale through using improved agricultural technology. According to Degefu Kebede, et al.., (2017), distance from market negatively influenced adoption of wheat technology package. The result indicates that a kilometer increase in distance from the market leads to a decrease in the likelihood of adoption of wheat technology packages by a factor of 0.023, with other factors kept constant. As Alemitu Mulugeta. (2012) results revealed that farmers who are located far from the farmers' training center, they have less likely to adopt improved agricultural technologies. This might be due to limited access to new information concerning technologies and a lower probability of those farmers being involved in on-farm research trials and visits.

2.2.2.4 Socio-Cultural Factors

Cultural differences enter into the agricultural technological adoption process through network formation, indirect effects such as imitation, peer effects, and norm-based diffusion. Imitation describes the process in which farmers adopt simply because others are adopting, not because they are making a cost-benefit decision. According to Lee K. (2011), being whether religion and clan membership affect the likelihood of adopting pineapple farming in Ghana. Cultural differences have a great influence on

technology adoption and diffusion because of some technology may not be acceptable in some cultural zones/society and while it will be acceptable in other cultural zones.

Participation in social groups has a great influence on the adoption of improved agricultural technology. Farmers who participate in different social activities and farmer's research groups have better information about the technology which in turn enhances the adoption of the technology. Actively participating farmers in the farmers research groups and giving them the chance to involve in demonstration research, improves the overall awareness of farmers toward the technology adoption and well equips them to look forward regarding the advantage of the new technologies over the existing ones (Alemitu M. 2012).

Membership to an association will benefit for farmers to access inputs like improved seed, fertilizer and pesticide easily with an affordable price that is pertinent to increase agricultural production and thereby farm income Hence, Due to this, membership to an association will expected to have a positive coefficient(Zinzye,2016;Sisay,2016;Kassie etal,2014).

2.2.2.5 Political Factors

Extension in Ethiopia, from its inception in the 1950s, has been a top-down process of information and technology dissemination to farmers from development agents and researchers housed in national educational institutions, such as Alemaya University (Egziabher et al. 2013 and Gebremedhin et al. 2006, 2009).

Later, during the Derg period, Ethiopians saw the implementation of extension services as a mechanism for collectivist reform and later as a tool of political control (Spielman et al. 2012). These centralized top-down approaches, despite improvements in agricultural technologies coming out of the green revolution, hindered the realization of the potential agricultural innovations in Ethiopia (Egziabher et al. 2013). This failure, though not necessarily a reflection of the technology itself, but the poorly conceptualized implementation and political turmoil, has prevented Ethiopian agriculture from keeping up with population growth and ultimately contributed to increased food insecurity in rural areas. Additionally, extension agents focus on large, resource-rich farmers, and the marginalization of the most vulnerable farmers has further increased the exposure of the most vulnerable households to food insecurity (Assefa et al. 2008; Egziabher et al. 2013).

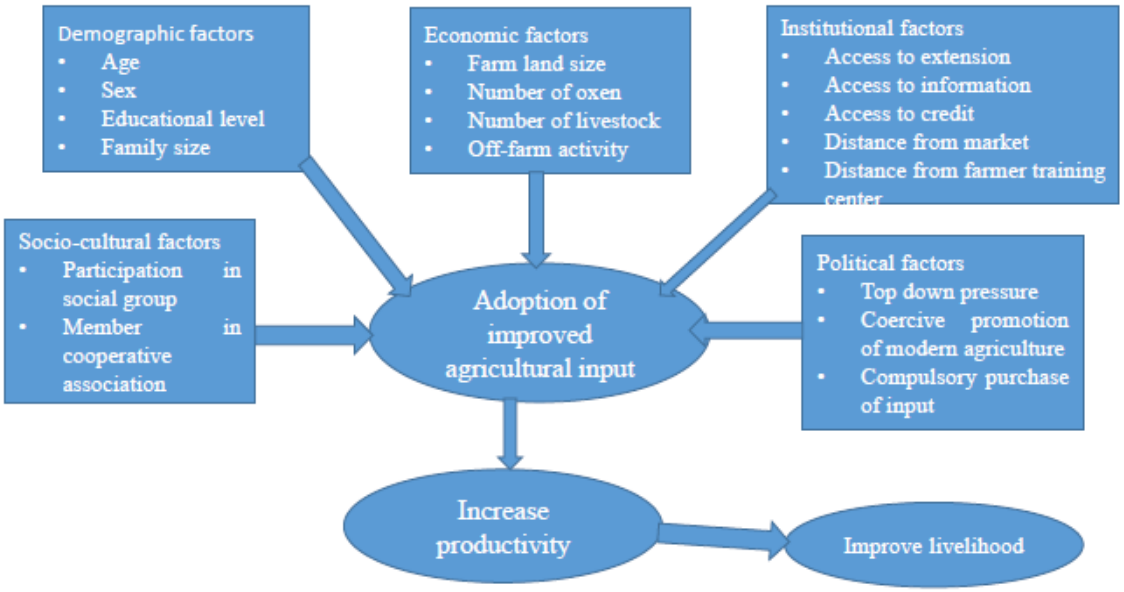
According to Anne C. and Sandy R (2017) hoping to increase agricultural production and productivity, the EPRDF launched an intensive agricultural campaign of participatory demonstration and training extension system (PADETES) which imposed annual quota targets set at the national level and divided over regions, zones, woredas, and kebeles. They also reveal in their study conducted in south Wollo, that the majority of farmers are coerced to use modern agricultural inputs. Development agents and local authorities feel pressure to meet adoption and productivity targets, not only in terms of increases in the numbers of farmers who apply fertilizer but also in terms of the amounts that farmers are supposed to apply per crop.

According to Planel (2014), to meet quota targets, development agents, therefore, enrolled farmers in fertilizer schemes, regardless of their real needs or ability to pay for fertilizers. Moreover, most farmers do not have enough money to purchase fertilizers in any case and thus have to take a loan. The vast majority do not know they pay interest or how much. The amount of input credit available to farmers has been reduced as compared to earlier years. At best, farmers have to pay half the value of the package up front ('half credit'). A study conducted by Anne C. and Sandy R (2017), in south Wollo, reveals that farmers who refuse to purchase the fertilizer are threatened with confiscation of their land. Though this threat of confiscation is not a formal law, extension typically shares office space with the local land authorities and sometimes decides who has access to more productive plots, or for those who do not make the required input purchases, who is relegated to more marginal areas. The money to be paid for the fertilizer is collected immediately upon its disbursement. This often requires cash-poor farmers to liquidate assets—often smaller livestock, which is used as insurance against shocks such as poor production related to increased rain variability/drought (Little et al. 2006).

2.3 Conceptual Framework of the Study

In this study, different factors have been analyzed regarding the effect of the adoption of modern agricultural technologies and their impact on rural household income. Adoption of improved agricultural technologies can only be effective when the right conditions for their successful implementation are in place. Farmers face many complex challenges in the adoption and scaling out of agricultural and natural resource management technologies and practices (Shiferaw*et al*., 2009). A context specific empirical understanding of factors affecting household decisions is important for the

promotion and scaling up of the adoption of productivity-enhancing technologies (Bewket, 2007). Researchers have argued that numerous factors can affect the farmer's decision to adopt agricultural technologies (Yu *et al.*, 2010). Based on theoretical and empirical reviews of the literature on technology adoption various factors that influence technology adoption and intensity of use can be identified and grouped into the following four broad categories. (1) Demographic factors (2) Economic factors (3) political factors (4) Institutional factors (5) socio-cultural factors. The framework emphasized mainly the relationship of the explanatory variables with the dependent variable and each other and its impact on household livelihood.



Source: - own model, (2022)

Figure 2.1 Conceptual Framework

CHAPTER THREE

3 DESCRIPTION OF THE STUDY AREA AND RESEARCH METHODOLOGY

This chapter dealt with study areas, research design, and methods that will be used to collect data that adequately address the hypotheses and objective of the study.

3.1 **Description of the Study Area**

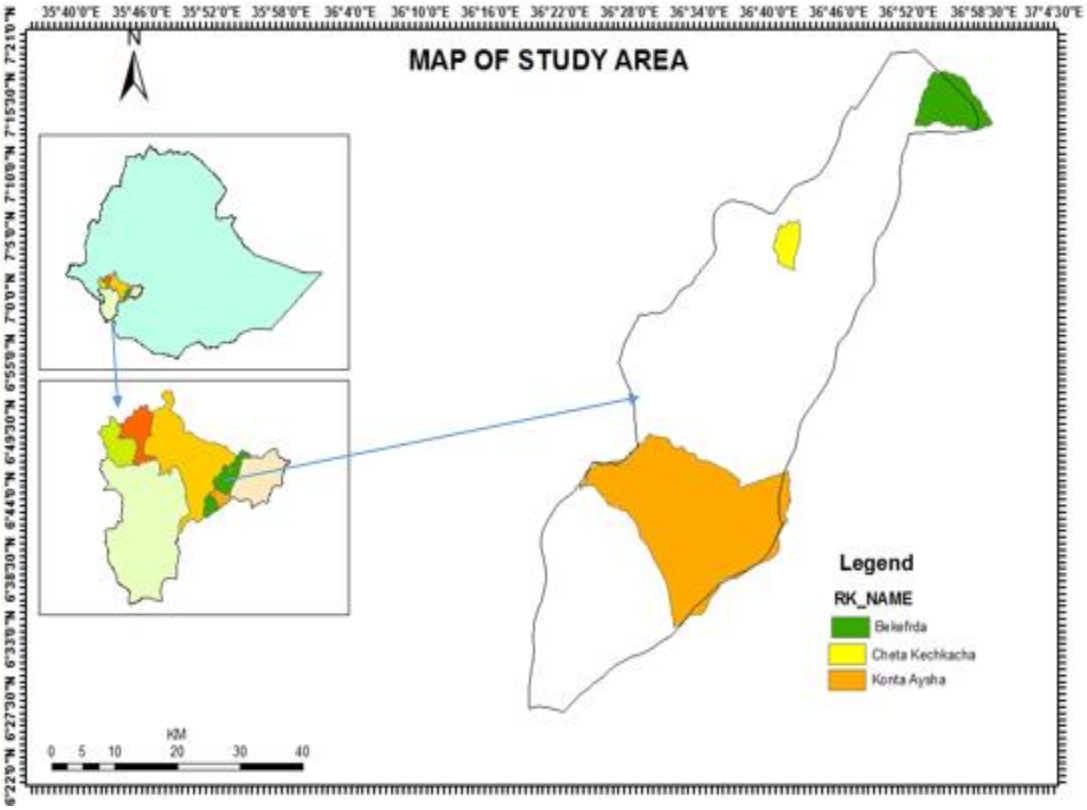
3.1.1 Geographical Location of the Study Area

Konta viously called special woreda is located southern Nation Nationality Peoples Regional state. However, following the formation of the 11th south west Ethiopian Regional State, it is recently upgraded from special woreda to a zone level.

Hence, currently, Konta is a zone found in the South West Ethiopia regional state. The zone is composed of 45 rural and 7 urban administrative units. The administrative center is Ameya town. The town is located 454 km away from the capital of Ethiopia [Addis Ababa] and 205 km away from the regional city of Bonga.

Geographically, the zone is located between 6°30' N and 7°25' N, and 36°15' E and 36°55' E. Konta zone is bordered by the Oromiya Regional State in the north, South Omo Zone in the south, Dawro Zone in the east, GamoGofa Zone in the southeast, and Kaffa Zone in the west (BoFED,2021).

Map of the Study Area



Source: GIS shape file of Ethiopian administrate map

Figure 3. 2 Map of the Study Area

3.1.2 Topography

Regarding the topographic conditions of the study area, 65% of the total area is mountainous, 15% is undulating and the rest (20%) is plain or flat. The altitude of the zone ranges from 790m to 2750 meters above sea level (BoFED, 2021).

3.1.3 Climate

Agro-climates of the study area lay into three categories such as Dega, which accounts (for 6%), Woinadega (54%), and kola accounts (40%). Generally, the average annual amount of rainfall received by the area is 1745 mm which ranges from 1200 mm to 2290 mm and the annual average temperature ranges from 10.9 ^{o}c in August to 26.05 ^{o}c in April (KZBoFED, 2021).

3.1.4 Demography

The people of Konta are Omotic-speaking people that are found in the southwest region of south west Ethiopia. The three largest ethnic groups reported in the zone are Konta (86.19%), Kaffa (5.37%), Tsara (3.25%), and Others (5.19%); and also Konta language is spoken as a first language by 85.14%, 6.71% Kaffa and 2.28% speak Tsara, the remaining 5.87% spoke other languages (Atnafu, 2021 unpublished).

According to the Konta zone finance and economic development bureau (2021) the total population of 214,072 people, of which 106,422 are male and 107,650 people are female. Among the total population of which 190,738 (89%) are rural inhabitants and 23,334 (10.9%) are urban inhabitants. The average population density of the zone is 55 persons per square km that are average of 2 hectares per person so the zone has sparsely populated.

3.1.5 Major Economic Activities

A rural community's livelihood mainly depends on agricultural practices that incorporate multiple tree species with different crops and animals. The major cash crops of the study area are maize, teff, and pulses. In addition, coffees are also a cash crops and earn foreign currency for the country. While important food crops include enset, sweet potatoes, cassava, and beans (KZoANRM,2021).

Konta Zone has a total area of 238,163 hectares(23 square km), of which 101,850 hectares are cultivated land; 15,200 hectares are cultivable land; 7250 hectares are grazing land; 89,283 hectares are forest land (natural and manmade forest land); 4,850 hectares are irrigable land; 2,950 hectares are irrigated land and 16,780 hectares are covered by other land uses. Of the 101,850ha (42.76%) cultivated land, 76,387 hectares are annual crops and 25,463 hectares are perennial crops. The rest of 136,313 hectares (57.24%) includes non-cultivable land such as grazing land, natural and community forest land, an area covered by water, market, and residential area, and accounts for other land uses(*ibid*).

3.2 Research Methods

3.2.1 Research Approach

To conduct this study, mixed research approaches were used. The quantitative approach was used to collect quantitative through questionnaires and measurements in the collection and analysis of data. Whereas, the qualitative approach data collecting approach to collect qualitative data through interviews and focus group discussions for the study.

3.2.2 Research Design

To conduct research in the study area, the researcher utilized a cross-sectional research design, because it allowed for collecting more than one case at a single point in time. And also descriptive designs were employed in seeking to describe a phenomenon accurately because descriptive research is a method used to obtain information relating to the existing status of an issue or phenomenon to describe "what and how exists" within the variables or conditions of the situation.

3.2.3 Types and Sources of Data

3.2.3.1 Types of Data

Both qualitative and quantitative data and primary and secondary types of data were employed in this study. The importance of collecting and considering primary and secondary as well as qualitative and quantitative data used to triangulate and supplement the diverse data generated from different sources which in return is used to make the data and the result of the research reliable.

3.2.3.2 Sources of Data

To achieve the objectives of the study, both primary and secondary data sources were used.

Primary data: this was generated from 3 groups of respondents. The first group was those selected household respondents for the household survey from the study area; the second group of data sources was key informants comprised of people who represent and reflect the opinion of the community member and experts; the third group was participants of FGDs.

Secondary data: secondary data were generated by searching different reviews of literature from books, research works, published and unpublished documents, and different activity reports of government and non-government institutions.

3.2.4 Study Population

According to KZBoFED (2021), there are 45 rural and 7 urban kebeles in konta zone and 45 rural kebele purposely selected study area. The researcher classified the 45 rural kebele into three clusters by considering their proximity to urban center. Out of these, 3 kebeles are selected (bakeferda, cheta, and konta koysha) by applying a simple random sampling technique. The total households of three kebeles were 1483, of which 498 households from bakeferd akebel, 399 households from chetakebele, and 586 households from konta koysha kebeles (kebele administrative office, 2022).The development agent, knowledgeable elders, administrative body of kebeles and expert from agricultural office, who are residing in three selected kebeles were considered for the study population.

3.2.5 Sample Size Determination and Sampling Techniques

3.2.5.1 Sample Size Determination

Multi-stage sampling techniques were employed for the selection of study households. In the first phase, purposive sampling was employed for the selection of the **45** rural kebeles of the Konta zone as a study area. In the second phase, cluster sampling technique (the selection of group of study (cluster) was based on their geographic area of kebeles and proximity to urban center) was employed to cluster the entire 45 rural kebeles in to three clusters (Chida, Ameya and Konta koysha). In the third phase, simple random sampling technique was applied to select the study sample kebeles from the three clusters (bakeferda, cheta and koysha) and finally systematic sampling technique conducted for the selection of study households in the study area.

To determining the sample size, the sample size determination formula was employed. Accordingly Yemane (1967), provides a simplified formula to calculate sample sizes and it was applied in this study. This formula used to calculate the sample size in 95% confidence interval level. The equation is described as follows:

$$n = \frac{N}{1+N(e)2} \qquad \text{……(1)}$$

$1483/1+1483(0.05)^2$

$1483/1+3.707$

1483/4.7075 = **315**

n = sample drawn from the total households = 315

N =total households =1483 (KAO, 2022)

e = degree of tolerance (5%)

1= the probability of an event occurring

In this regard, the total households of three kebeles were 1483, of which 498(33.5%) households from Bakeferda kebele, 399(27%) households from Cheta kebele, and 586(39.5%) households from konta koysha kebeles are taken for study(kebele administrative office, 2022). Accordingly, based on the above formula the sample size of his study was 315 and the response rate was 100%.

To determine the sample size among the three selected kebeles, the following proportional allocation method formula was utilized.

The formula where

$$\boldsymbol{pi} = (\boldsymbol{N}/\boldsymbol{Ni})\boldsymbol{n} \quad \text{---------- (2)}$$

pi = the required sample size of households in each selected kebele

N=a total number of households in each of three selected kebele

Ni =a total number of study households of three selected cluster kebele

n=total number of the sample size of study households in the study area

By using proportional allocation formula

Bakeferda…….. (498/1483)*315……..106

Cheta……. (399/1483)*315……....85

Kontakoysha…… (586/1483)*315……...124

3.2.5.2 Sampling Techniques

Both probability and non-probability sampling techniques are utilized in this study. The sampling frame of the study considered the entire list of households residing in the selected kebeles. A multi-stage sampling technique was applied in the research and the procedure that a researcher kept selecting a sample is discussed below. Rural households residing in the konta zone were the study population; while the sampling frames of the study populations were the names of households in the three randomly

selected kebele administration offices. In this study, household heads were the sampling unit of the study.

First stage- purposive sampling technique: the administrative structures of the zone have 7 urban and 45 rural kebeles. By using purposive sampling, the researcher selected 45 rural kebele for the study area. Since in all kebeles there are adopter farmers.

Second stage-cluster sampling technique: the researcher applied the cluster sampling technique for the selection of the study kebeles. By taking into account their proximity to the urban center and for convenience, the researcher classified the entire kebele into 3 clusters (Cluster 1, 2, 3 Chida, Ameya, and Koysha respectively.

Table 3.1: Cluster classification of Kebeles

No	chida cluster	No-	Ameya cluster			No-	Koysha cluster
	Bakeferda	1.	Quta	15	Dupa qechqecha	1	Kontakoysha
	Mojo	2.	Gimba	16	Cheta qechkecha	2	Okashe
	Kontaselam	3.	Gora	17	Chebera	3	Koyshadilla
	Anchano genet	4.	Sheta chare	18	Seri shawa	4	Oshkadencha
	Konta genet	5.	Ofa shetera	19	Yora shasho	5	Oshkaagare
	Bixet	6.	Cheka bocha	20	Bakeseda	6	Tolka
	Woshi	7.	Buba damota	21	Albe agare	7	Delbaalfaa
	Womba	8.	Chare doke	22	Gada shembera	8	Delba genet
	Kacharoba	9.	Opalashe			9	Koyashlome
	Chidashawra	10	Kodamaji				
	Keribela	11	Dukazale				
	Medayeja	12	Genji				
	Maraka	13	Shitashasho				
	Gadagari	14	Medigotera				

Source: Researcher's constructs (2022).

Third stage-simple random sampling: from the three clusters, one sample kebele was selected by using the lottery method, given that, the number of kebeles in each cluster is small enough frame acquired from the administration of each kebeles (KAO, 2022). The following table indicates the selection of study kebele from the three clusters.

Table 3.2: Selected kebeles from each cluster and sample households

No	Name of clusters	Name of selected kebeles	Households in selected kebeles	A representative sample of households in each kebeles pi= (Ni/N)n	Percentage
1	chida cluster	Bakeferda	498	**106**=498/1483*315	498/1483*100=33.5
2	Ameya cluster	Cheta	399	**85**=399/1483*315	399/1483*100=27
3	Koysha cluster	Kontakoysha	586	**124**=586/1483*315	586/1483*100=39.5
	Total	3	1483	***315***	100
4	Focus group discussion			24	
5	Key informants			7	
Total sample				**346**	

Fourth stage-systematic sampling technique**:** by using simple systematic sampling techniques, the actual households for the study survey were recruited by applying a proportionate systematic sampling technique based on the sampling frame obtained from the administration's office of each selected sample kebeles. Before recruiting the samples, the name of the household, repeated names, and those households not residing in the kebele at the time of data collection were checked and excluded (table 3.2).

3.2.6 Techniques of Data Collection

The study employed both primary and secondary sources of data collection. The source of primary data for this study was data collected from smallholder farmers included in the study. Sources of secondary data include documents review from government offices and other relevant organizations.

The household survey (Questionnaire): house survey was used in the study to collect quantitative data. The survey was conducted on the selected 315 household heads. It was handled by three enumerators who are development agents of the kebeles after receiving appropriate training. The training was organized and orientation was provided for these enumerators and discussions were made

with them to make the question clear. The household survey mostly assessed the impact of adopting modern agricultural inputs on household income and examined determinant factors affecting small household farmers in adopting improved agricultural technologies. Before the questionnaire is distributed to the actual respondents, a pre-test (pilot test) is carried out in the selected institution

Key Informant Interview: Individual key informants which embraces were experts (1 DA expert from each sample kebel), officials (1 from office), and knowledgeable (from each kebele) individuals who were identified carefully from the concerned government organization including and from sampled kebele. A total of 7 key informants were interviewed in this study. This was carried out by using prepared checklists to complement information generated through household survey, issue such as the role of adopting modern agricultural inputs and how the adoption of modern agricultural inputs impact the income of adaptors and non-adopter farmers and what determinants factors significantly affect the adoption of modern agricultural input and intervention measure undertaken to enhance farmers participation.

Focus group discussion: discussions were made with a community representative. In this regard, three focus group discussions (one from each kebele) were conducted with 24 individuals (8 each) including elders, youth, and women. The session was moderated by the researcher using guiding questions. The issue which was raised in FGD was those questions included in the survey questionnaire to get information on "how" and "what" it impact and determine farmers from adopting improved agricultural technologies and measures undertaken to enhance farmers' participation in the adoption of modern agricultural technologies.

Concerning key informants and focus group discussion, the researcher employed purposive sampling to pick participants as informants were selected based on their social position, roles in the community, knowledge of the community, and critical information rather than on representative consideration.

3.2.7 Method of Data Analysis

Descriptive statistics were employed to analyze data by using percentage, mean and frequency distribution. Inferential statistics such as the chi-square test and an independent sample t-test were applied used to identify variables that vary significantly between adopters and non-adopters. The chi-square test was conducted to compare some qualitative characteristics of adopters and non-adopters.

The t-test was used to observe if there is a statistically significant difference between the mean of the respective adopter and non-adopter categories concerning continuous variables. The econometric regression model was applied for analyzing the data which are estimated by using binary logistic regression and chi-square and t-test. All quantitative raw data gathered from the respondents were condensed and analyzed by using the Statistical Package for Social Science (SPSS) version 23.0 computer program.

3.2.7.1 Descriptive Analysis

In this study, the researcher applied a statistical package for Social Science (SPSS) version 23.0 computer program to analyze and interpret quantitative data obtained from closed-ended questionnaires. Descriptive statistical tools such as mean, standard deviation, percentage, and frequency distribution were utilized and the data was presented in the table. And also, inferential statistics, such as chai square and t-test were used to identify the relationship of the variables that significantly affect adopting improved agricultural technology and its impact on rural household income.

3.2.7.2 Econometric Regression Models

3.2.7.2.1 Binary Logistic Regression Model

The objective of the binary logistic regression model was to estimate the probability of a household adopting or not adopting modern agricultural input technology. The dependent variable is dichotomous therefore, following Gujarati; the binary logit model is specified as follows:

$$Y_i = \beta_0 + \beta_1 X_1 + - - - - + \beta_{12} X_{12} \ldots\ldots\ldots + \varepsilon \text{----------} \quad (1)$$

Where;

Xi is the vector of independent variables representing several demographic, asset size, intuitional support, socio-cultural, and political factors variables of i^{th} farmers. The dependent variable *Yi,* is equal to 1 if the household farmers adopted modern agricultural input technology and zero otherwise.

The above Equation (1) can be interpreted as describing the probability that a given smallholder farmer is deciding to adopt modern technology. The value of the parameters, β, measures the marginal impact of a unit change in the explanatory variables on the probability of technology adoption. The above linear model can be transferred into a cumulative probability function as follow, mainly to avoid the potential errors of having the predicted values, Y_i falling outside the (0, 1) range.

$P_I = F(X_i\beta)$ -- (2)

If the cumulative probability function $F(X_i\beta)$ is logistic, then we have the logit model of the:

$$pi = \frac{1}{1+e} - xi\beta \text{ – (3)}$$

The marginal effect of a particular variable on the probability that a particular household decide to adopt is given by:

$$\frac{\partial pi}{\partial xi} = f(x\beta)\beta k \text{-- (4)}$$

Where f (f(xβ)β_k) is the logistic density function given by:

$$f(x\beta) = \frac{e-x\beta}{(1+e-x\beta)z} \text{-- (5)}$$

In this study, the explanatory variables (X_i) were selected based on available related literatures on the subject at issue. The variables include**:** age of the household head, sex, education level, land size, family size, education, distance to deployment center, off-farm activity of household's, extension contact, member of association, number of oxen, number livestock, access to extension service, price of input, top down pressure, coercive agricultural modernization, compulsory purchase of input, access to credit, access to information, distance to FTC and distance to the nearest market. Therefore, the model for household adoption can be represented by:

Adoption=f(Aghhs, shhs,edulhhs, Fmsize, farmlandsize, numberoxen, numberLVST, priceinput, extadvice,,nonfarmincome,Accredit,Accinfo,distancefrommkrt,DistantfromFTC,SocialGP,Memberofin cooperativeassociation,,Topdpre,coermAgr,compurchase, ε)-- (6**)**

Where = ε is the random variable

LogitPi=β0+β1age+β2sex+β3edu+β4fs+β5fls+β6noxen+β7Lvst+β8prinput+β9 extadv+β10nofincom+β11accredit+β13dFTC+β14socialGP+β15mcooass+β16Toppre+β17coermAgr+β 18compurchase+ β19accinfo +ε---.**(7)**

3.2.8 Definition of variable

3.2.8.1 Dependent variables

Table 3.3 Definition of dependent variables

Variable	Symbol	Type	Measurement
Level of technology adoption	LTA	Dummy	Yes=1 No=0
Outcome variables Annual crop income	Inc-lev	Continuous	Birr

Source: researcher own construct (2023)

The main variables intended to be measured in this study were the level of technology adoption and income change entertained from improved agricultural technology adoption. The level of technology adoption is the rate at which the intended package of technology is implemented by farmers. It tells us to what degree the adoption rate could vary by a unit change of various factors.

3.2.8..2 Explanatory variables

The objectives of this study were to relate technology adoption with farmers' income and how the level of technology adoption is influenced by various factors. The definition of variables and the respective hypothesized effect on adoption are presented as follows:

Independent variables: It is hypothesized that farmers' decisions to adopt or reject new input technologies at any time are influenced by the combined effect of several factors. This includes both categorical and continuous variables such as sex of household head, age of household head, farmland size, education level, family size, number of oxen, number of livestock distance to the farmer training center, the off-farm activity of farmers, membership in the association, extension contact, access to credit, access to information, and distance to the nearest market, top-down pressure, coercive promotion of modern agricultural inputs, participation in a social group, participation in farmer day, etc., Based on the review of adoption literature, and the researcher's knowledge of the farming system of the study area, among a large number of factors that will expect to relate to farmer's adoption behavior and its impacts on income, (19) potential explanatory variables will considerer in this study.

Age of household head (Aghhs): It is a continuous variable that will measure in numbers; as age increases, households' probability of adopting modern agricultural input technology will expect to decrease; where younger farmers will expect to adopt, unlike elder farmers. The coefficient hypothesis will be negative. The

direction of influence is not, however, very clear and there are always mixed results from empirical analysis. Older farmers may have more experience, resources, or authority that would allow them more possibilities for trying new technologies. On the other hand, it may be that young farmers are more likely to adopt new technologies because they may have more schooling than older farmers and have been exposed to new ideas and hence more risk-takers (Assefa and Gezahegn, 2010 Berihu et al, 2014). It, therefore, hypnotizes that age of the household head has a negative or positive influence on the adoption of modern agricultural input technology adoption.

Sex of the household head (Shhs): This is a dummy variable that takes a value of 1 if the household head is male and 0 if female. Male farmers are more adopters of agricultural input technology. Women farmers are often missed in official agricultural statistics. Since women play a key role in agricultural systems, it is important to consider the role they provide (Berhe, 2014).

Education level (Edulevhhs): It is a continuous variable measured in the number of years of schooling; where educated farmers are believed to acquire, analyze and evaluate information on different adoption of modern agricultural input technology than non-educated farmers. Positive will be the coefficient expected from the final result. (Shiferaw and Tesfaye, 2006; Wubshet, 2016; essay, 2016).

Family size (Fmsize): it is the number of people living in a house as a parent, children, and relatives leaving under one household leader. It is a continuous variable that indicates the number of a person living in the house of the farmers. It is expected that as the size of the household increases, the adoption of new technology increases (positive relation). This indicates that family with large number is more involved in adopting the new technology during their farm production effort.

Farm land size (farmlandsize): This is a continuous variable measured in hectares. It refers to the net amount of land devoted to crop cultivation. Farm size can have different effects on the rate of adoption, depending on the characteristics of the technology and the institutional setting. If technology is subject to economies of scale, then large farms will achieve greater profits from innovations than small farms. High fixed costs reduce the tendency towards adoption by small farms, while large farms are identified as earlier adopters, as they have more flexibility in their decision-making, greater access to discretionary resources, more opportunities to test new technology, and an enhanced ability to bear risks associated with early technology adoption (Amsalu and Graaff, 2007). Hence, the coefficient will not determine or hypothesize in prior. In this study, farmers who have large land sizes are hypothesized to have a better status of technology adoption. It will be either positive or negative (Ahmed, 2015; Assefa and Gezahegh, 2010).

Number of oxen (numberoxen): it is measured as a continuous variable. The total number of oxen the household had. Since ox is the major means of production in the country, it is expected to have a positive effect on adoption (Sisay, 2016)

Number of livestock (numbeoflivestock): It implies the total livestock owned by the household head. It is a continuous variable and is measured in Tropical Livestock Unit (TLU). Livestock ownership affects the decision of farmers positively to use the improved sorghum variety since it enhances the ability of the farmer to have enough cash to purchase production input (Ermias, 2013). Therefore, livestock ownership for this study was expected positively affects the varietal exchange decision of the farmer.

Price of inputs (priceinput): new technologies may incur adoption costs through learning a new skill, implementing the new practice, the need for complementary practice, and the purchase of the technology itself. Hence, the cost of technology which will be paid in all forms to avail and adopt technology can be termed as the price of technology. It has been included in the selling offer of a particular technology. Technology in this study defined the selling price of the technology when it reached the farmer. The high price of technology is hypothesized to have a negative outcome in favoring the adoption of technology.

Extension advice (extadvice): Extension agents provide information on the availabilities of improved agricultural technologies and dictate how to adopt recommended agronomic practices. So farmers who have more contact with extension workers can improve their decision to adopt agricultural technologies. A positive relationship will, therefore, be expected between the number of extension contacts and technology adoption (Berhe, 2014; Tsibuk, 2015; essay, 2016).

Non/Off-Farm Participation (nonfarmincome): It is a dummy variable representing 1 if a household head participates in off-farm activities and 0 otherwise. It is the annual income in Birr from off/non-farm economic activities. The more off/non-farm income the farmer generates, the higher he/she resolves his/her financial constraints, the faster to adopt improved agricultural technology, and the better to adopt recommended agronomic practices in farming. It will therefore hypothesize that off/non-farm income has a positive influence on the adoption of modern agricultural input technology by farmers. (Tigist, 2010; Berihun et al, 2014).

Access to credit (Accredit): It is a dummy variable; representing 1 if the household has credit access and 0 otherwise. Those farmers having credit access are better adopters since they will have cash for the purchase of the inputs. The use of cash credit is one of the important factors that affect the adoption of technology. The use of credit affects the ability of a farmer to obtain the necessary improved agricultural technologies at

the right time and in suitable quantities (Nega and Senders, 2005; Shiferaw and Tesfaye, 2006). Thus, the use of credit will expect to be positively related to the adoption of technology.

Access to information (Accinfo); According to Meinzen (2012) as cited in Assefa, 2016) access to information is a critical dimension for technology choice and adoption. The decision to adopt innovations depends largely on access to agricultural information available to farmers (Daberkow and McBride, 2003 cited in Assefa, 2016; Solomon et al, 2012). Thus, access to information on improved agricultural will expect to be positively related to the adoption of technology.

Distance to farmer training center (DistantfromFTC): It is a continuous variable that will measure in kilometers; Distance between the farmer's residence and the development center measured in kilometer will expect to be negatively related to the adoption of technology (Zenaye, 2016; Berihun et al., 2014). This is because; proximity to the development center has the advantage of obtaining technical support from extension workers easily and faces lower transaction and transportation costs. A negative relationship will, therefore, hypothesize between distance to the development center and technology adoption. Membership of a cooperative association (compass) is a categorical variable; 1 represents if a household will a member of a certain farmers' association or cooperative and 0 otherwise.

Membership in cooperatives represents whether a household is a member of a cooperative or not. Cooperatives worldwide are committed to the concept of mutual self-help. This makes them natural tools for social and economic development and provides significant additional benefits to communities and social systems. Formal as well as informal associations, such as indigenous cooperation groups, enforce widely agreed standards of behavior and unite people with bonds of community solidarity and mutual assistance. As such, they embody important forms of social capital representing forums in which local communities can unite and act collectively (Messer and Towensly, 2003). Membership in an association will benefit for farmers to access inputs like improved seeds, fertilizer, and pesticides easily with an affordable price that is pertinent to increase agricultural production and thereby farm income. Hence; this variable was expected to be positively coefficient related to the adoption of improved agricultural technologies. Thus membership in the cooperative association in this study was positively hypothesized (Zinzye, 2016; Sisay, 2016; Kassie et al.., 2014).

Participation in a social group (SocialGP): it is exclusionary variable that can make the decision equation better. It is hypothesized that social group and the adoption of improved agricultural input in enhancing income have a positive relationship. It is a dummy variable for the social group: =1 if the household is a member of social group; 0 otherwise.

Top-down pressure (Topdpre); is a dummy variable; representing 1 if there is a top-down pressure to implement an improved agricultural technology plan and 0 otherwise. Those farmers being top-down pressure can be done for different reasons such as to implement a quota target system, to carry out government strategy, or to increase production and productivity. Thus, top-down pressure of improved agricultural technology will be hypothesized to be negatively related to the adoption of technology.

Coercive promotion (coerpromo) dummy variable; representing 1 coercive agricultural modernization and 0 otherwise. This was often used to promote farmers' relationship with the new agricultural knowledge and information system and it is built on uneven power relationships and coercion to elicit farmers' purchase of the necessary inputs to utilize modern agricultural technology, increasing farmers' distrust in the system. This uneven power structure and coercion will contribute a farmers not adopting modern agricultural technology and strengthening traditional agricultural production systems. Thus negative relationship will, therefore, hypothesize coercive agricultural modernization and improved agricultural technology adoption.

Compulsory purchase (compurchase): it is dummy variable; representing 1 compulsory purchase of improved agricultural technology and 0 otherwise. The lower purchases of improved agricultural input may be due to farmers' belief that it is not an appropriate part of their production scheme. Instead, they prefer compost and animal litter. High-interest loans and a perceived negative impact of the adoption of improved agricultural technology contributed to further distrust. Though farmers still find fertilizer to be inappropriate in their production practices, the newly expanded agricultural extension has pushed its use extensively. Thus negative relationship will, therefore, hypothesize to compulsory purchase of modern agricultural inputs and improved agricultural technology adoption.

Table 3.4 Summary of variable description and their expectation sign

Variables	Description of variables	Measurement	Expe cted sign
Age	Age of household head (Agehh):	The continuous variable measured in number	+/-
Family size	Number of members in a family	The continuous variable measured in number	+
Education	Education level of household	The continuous variable measured in years	+
Farm land size land	Area of farm land	Continues measured in hectares	+/-
Livestock holding	Number of livestock owned by	Number of livestock in TLU	+

	household head		
Oxen Number of	oxen owned farmers	Continues variable measured in number	+
Price of Technology	Cost price of technology	Dummy (yes=1 no=0)	-
Extension service	Number of extension contacts	Dummy (yes=1 no=0)	+
Off-Farm Participation	Non-farm activity of farmers	Dummy (yes=1 no=0)	+
Access to credit	Household head access to credit	Dummy (yes=1 no=0)	+
Access to information	Household head access to information about improved agricultural inputs	Dummy (yes=1 no=0)	+
Distance to FTC	Distance between farmer's residence and development center measured	Continues variable measured in kilometer	-
Membership of cooperative association	Being member of cooperative union	Dummy (yes=1 no=0)	+
Participation in social group	if household head participate in social group	Dummy (yes=1 no=0)	+
Top-down pressure	Uneven use of power for implementation improved agricultural package	Dummy (yes=1 no=0)	-
Coercive promotion	If household head participate in improved agricultural in coercive agricultural modernization	Dummy (yes=1 no=0)	-
Compulsory purchase	If household head purchase the newly expanded agricultural extension without demand	Dummy (yes=1 no=0)	-

3.4 Method of Data Presentation

The result of the research was presented in tabular forms. The data in the table were interpreted in frequencies, percentages, mean and standard deviations and tried to show the relationship between dependent and independent variables concerning the impact on enhancing income. The qualitative data collected from focus group discussions and interviews were interpreted and triangulated with the quantitative data.

3.5 Data Quality Assurance

A pilot survey was conducted to test a questionnaire before the final phase was conducted. The questionnaire was tested to verify consistency, concepts and logical flow, and connections between questions. It was tested through pilot testing. Also, proper detection was performed by a consultant and other experts who know the research to ensure the validity of the instruments.

In this regard, the reliability of the instrument was tested by using a pretest of the questionnaire with potential respondents from the sample kebeles to avoid the likelihood of the same respondent answering the questionnaire twice. The validity of the measurement was tested by both face and content validity to check how valid the data. After data collection, each questionnaire a unique code was given by the researcher. The researcher prepared the template and entered data using SPSS version 23.0. A frequency was utilized to check for missing values and outliers. A detected error was corrected using the code numbers after versioning of the original data.

The test of reliability (internal consistency) for the measurement of research instrument. Croanbach's alpha was employed for instrument reliability test. As shown on Table 3.5 shown, Croanbach's alpha value of technology adoption was 0.75 in the study area. It revealed that greater than critical value (>0.60). A scale with an alpha coefficient value of 0.60 or more is accepted as reasonably high (Fraenkel and Wallen, 2009). Accordingly, in this study the total items of the instrument had 0.75 Cronbach's Alpha value. We concluded that based on Croanbach's alpha value, this research instrument has high level of reliability.

Table 3.5. Instrument reliability statistics

Cronbach's Alpha	Cronbach's Alpha based on standardized items	Number of items
0.75	0.75	19

Source: Computed from survey data, 2022

3.6 Ethical Consideration

Before data collection, a formal letter was sent to the study area from the Department of Geography and Environmental Studies at Jimma University. During data collection, each respondent are informed about the purpose, scope, and expected outcome of the research, and appropriate informed verbal permission is obtained from each respondent. Anyone who does not want to participate can be excluded from the study; and during the interview, informants interested in avoiding certain questions or breaking off the interview may do so. To establish unidentified linkage, only the code, not the name of the respondents was registered on the questionnaire. During training data collectors, ethical issues were addressed as an important part of the research. In general, the process of data collection, analysis, and interpretation was free of any bias.

CHAPTER FOUR

4 Data Presentation, Analysis, and Interpretation

This part deals with the result of descriptive statistics, inferential statistics and regression output of the empirical model. The analysis was made in light of the objective of the study. Section 4.1 is about the category of adopters and non-adopters and their impact. Section 4.2 is about the descriptive analysis of the model variables. Section 4.3 deals with the result of the econometric analysis presented.

4.1 Demographic Characteristics Respondent Households

4.1.1 Sample Household Heads by Sex

Table 4.5 Distribution of sample household heads by sex

Sex of household			level of technology adopters		Total	Chi-square test
			No-adopters	adopters		
	Female	Frequency	21	13	34	NS
		%	6.7	4.1	10.8	
	Male	Frequency	159	122	281	
		%	50.5	38.7	89.2	
Total		Frequency	180	135	315	
		%	57.1	42.9	100	

Source: survey result, 2022. Note: NS not significant.

To determine the proportion of sex distribution of the farmers as indicated in table 4.7, of the total of smallholder farmers in the study area, 21(6.7%) and 13(4.1%) of non-adopters and adopters respondents were found to be female respectively. 159(50.5%) and 122(38.7%) respondents were found to be male adopters and non-adopters respectively. This indicates that female participation in agricultural farming activity is very low in study area. The chi-square test result was not found a significant difference between the levels of adoption and the sex of household heads. The finding implies that there was no relationship between the levels of adoption and sex of household heads in the study area. This finding in line with that of Mwangi and Kariuki (2015) who found that male-led households are more likely to embrace agricultural technology, because of their leading role;

facilitating the planning and operation of the farm to improve productivity and maintain the well-being of the family.

4.1.2 Sample Household Heads by Age

Table 4. 6 Distribution of sample household heads by age of a farmer

Item			level of technology adopters		Total	T-test
			Non-adopters	Adopters		
Age of households	16-30	Frequency	19	9	28	NS
		percentage	6.0	2.9	8.9	
	31-50	Frequency	132	113	245	
		percentage	41.9	35.9	77.8	
	51-65	Frequency	22	12	34	
		percentage	7.0	3.8	10.8	
	>66	Frequency	7	1	8	
		percentage	2.2	0.3	2.5	
Total		Frequency	180	135	315	
		percentage	57.1	42.9	100	

Source: survey result, 2022 Note: NS not significant.

To determine the proportion of the age group of respondents' results as shown in table 4-8 of the total smallholder farmers in the study area, 19 (6%) non-adopters and 9 (2.9%) of adopters respondents were found to be age group 16-30. 132(41.9) non-adopters and 113(35.9%) adopters were found to be age group 31-50. 22(7%) non-adopters and 12(3.8%) adopters were found to be age group 51-65. 7(2.2%)of non- adopters and 1(0.3) adopters are within the age group >64. This indicates that the majority of non-adopters are young. They are found within the age range 31-50 and this indicates young farmers did not adopt improved modern technology to enhance their production and productivity. Besides, the t-test of age between adopters and non-adopters was found to be insignificant. Thus, here we can conclude that there is no statistically significant difference between adopters and non-adopters in terms of age.

4.1.3 Sample Household Heads by Educational Level

Table 4.7 Distribution of sample household heads by educational level

Item			level of technology adopters		Total	Chai-square test
			Non-adopters	Adopters		
Educational level of	Illiterate	Frequency	46	29	75	

households		percentage	14.6	9.2	23.8	NS
	literate	Frequency	45	35	80	
		percentage	14.3	11.1	25.4	
	primary school(1-8)	Frequency	60	46	106	
		percentage	19.0	14.6	33.7	
	secondary school(9-12)	Frequency	29	25	54	
		percentage	9.2	7.9	17.1	
Total		Frequency	180	135	315	
		percentage	57.1	42.9	100	

Source: - survey result, 2022 Note: - NS not significant

In the study area, the education level of the sampled respondents ranges from 0 (illiterate) to 12th Grade. As indicated in table 4-9 above, the education states of smallholder farmers in the study area were assessed and analyzed. Accordingly, the findings 46(14.6%) and 29(9.2%) of non-adopters and adopters farmers were found illiterate. 45(14.3%) of non-adopter and 35(11.1%) of adopters were literate respectively. 60(19%) and 46(14.6%) of non-adopters and adopters were in primary school (grades 1-8) respectively. 29(9.2%) of non-adopter and 25(7.9%) of adopter were found secondary education level. The majority of non-adopters 60(19%) have academic qualifications in primary education (grades 1-8). Besides, the t-test of educational level between adopters and non-adopters was found to be insignificant. Thus, here we can conclude that there is no statistically significant difference between adopters and non-adopters in terms of educational level.

4.1.4 Marital status of Household heads

Table4-8 Marital status of Household heads

Description Item			level of technology adopters		Total
			Non-adopters	Adopters	
marital status of households	Married	Count	92	106	198
		%	29.2	33.7	62.9
	Unmarried	Count	3	5	8
		%	1.0	1.6	2.5
	Divorced	Count	57	11	68
		%	18.1	3.5	21.6
	Widowed	Count	28	13	41
		%	8.9	4.1	13.0
Total		Count	180	135	315
		%	57.1	42.9	100

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	32.327[a]	3	.000
Likelihood Ratio	34.739	3	.000
Linear-by-Linear Association	22.585	1	.000
N of Valid Cases	315		

Source: Own survey data 2022 ***, ** significant at 1%, 5% and non-significant respectively

As indicated in table 4-10 households were asked about their marital status to compare the proportion of married with that of unmarried, divorced, and widowed farmers. The majority of adopters 106(33.7%) were married, 5(1.6%) unmarried, divorced 11(3.5%) and widowed 11(9.16%). The majority of non-adopters 92 (29.2%) were married, 3(1%) were unmarried, divorced 57(18.1%) and 28(8.9%) were widowed. Hence, there was a difference in the marital status of sampled household heads to statuses of adoption in the improved agricultural input. In addition, the chi-square test indicates that marital status was found correlation and significant difference at a 1% probability level between adopters and non-adopters in terms of marital status.

4.1.5 Households by Family Size

Table4.9 Distribution of the family size of households

Description			level of technology adopters		Total
			Non-adopters	Adopters	
family size of households	below 3	Count	11	10	21
		%	3.5	3.2	6.7
	4-7	Count	93	67	160
		%	29.5	21.3	50.8
	above 8	Count	76	58	134
		%	24.1	18.4	42.5
Total		Count	180	135	315
		%	57.1	42.9	100

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.267[a]	2	.875
Likelihood Ratio	.266	2	.875
Linear-by-Linear Association	.007	1	.936
N of Valid Cases	315		

Own Survey data, 2022

As presented in the above table 4-11 distribution farmers by family size. Based on this, 10(3.2%) and 11(3.5%) of adopters and non-adopters have below 3 family size respectively. Majority 67(21.3%) of adopters and 93 (29.5%) of non-adopters have 4-7 family members in study area. 58(18.4%) adopters and 76(24.1%) non-adopters had above 8 family members in study area.

As indicated in table, the chi-square test reveals that the size of households was not correlated and no significant difference between the levels of adoptions in the study area. This implies that there was no relationship between household size and the level of adoption in the study area.

4.2 Level of Adoption of Improved Agricultural Technologies

Table 4.10 Category of sample respondents by the adoption of modern agricultural technologies

Response item	Adopters		Non-adopters	
	Number	Percent	Number	Percent

Have you adopted any improved agricultural technologies?	135	42.9	180	57.1
Total	135	42.9	180	57.1
Of the following Which item do you have adopted?	Adopters		Non-adopters	
	Frequency	Percentage	Frequency	Percentage
Fertilizer and urea	59	43.7	0	0
Chemical pesticide	30	22.2	0	0
Full package(fertilizer, urea and improved seed)	46	34.1	0	0
Crop rotation	0	0	155	86.1
Total	135	100	145	86.1

Source: survey result, 2022

According to the above table 4-5 Out of the 315 questionnaires administered 135 were adopter of agricultural input technology and 180 were non-adopter of improved agricultural technologies.

As indicated in above table, from the total sample respondents of adopters 59(43.7 %) were use Fertilizer and urea, 46(34.1 %) full package (Fertilizer, Improved seed and urea), and 30(22.2 %) uses chemical pesticides. 155(86.1%) non-adopters respondent use crop rotation. This indicates that the majority of farmers in the study area depended on traditional farming.

4.3 Economic Factors

4.3.1 Sample households by farm Land size (in hectares)

Table: 4-12 Distribution of sample households by farm size (in hectares)

Size of farm land in hectare * level of technology adopters Cross tabulation*					
Size of farm land			level of technology adopters		Total
			Non-adopters	Adopters	
size of farm land size in hectare	less than 1 hectare	Frequency	99	5	79
		percentage	31.4	1.6	33
	between 1 to 2 hectare	Frequency	74	65	164
		percentage	23.5	20.6	44.1
	greater than 2 hectare	Frequency	7	65	72
		percentage	2.2	20.6	22.9

Total	Frequency	180	135	315
	percentage	57.1	42.9	100.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-s
Pearson Chi-Square	109.850[a]	2	.000
Likelihood Ratio	126.776	2	.000
N of Valid Cases	315		

Source: computed from own survey, 2022 Note: *, **, indicates statistically significant at 1%, and 5% respectively

Table 4-12 shows farmland size of household heads. As indicated in the table, the findings 99(31.4%) non-adopters and 5(1.6%) adopter farmers had farm sizes of less than one hectare. The majority of 74(23.5%) and 65(20.5%) non-adopter and adopters farmers had farm land sizes between 1-2 hectares respectively. In conclusion, the majority of the non-adopter farmers had less than one hectare which affects the adoption of agricultural input technology of farmers.

Moreover, the chi-square test indicates that a type of farmland size owned by household heads was found significant difference between the adopters and non-adopters. In conclusion, farm land size and adopting improved agricultural technology are associated with one another at a 1% statistically significant level. The same result was found by Akudugu et al., 2012; Salasya et al., 2007; Saleem et al., 2011. Farm land size was found as one of the most important factors that significantly affected adoption decisions. This means that farmers who have relatively large farmland sizes will be more initiated involved in adopting the new agricultural production technologies, and the reverse is true for small-size farmland.

4.3.2 Sample Households by Oxen (in number)

Table 4-13 Distribution of sample households by Oxen (in number)

Crosstab				χ^2
How many number of oxen do you have	Adopter		Non- adopters	
One oxen	Frequency	24	29	.000*
	percentage	7.6	9.2	
Two	Frequency	57	42	
	percentage	19	13.3	

>two oxen	Frequency	26	43	
	percentage	8.3	13.7	
No oxen	Frequency	28	66	
	percentage	8.8	20.9	
Total	Freq.	135	180	
	Perc.	42.9	57.1	

Source: own survey data, 2022 Note: *, **, indicates statistically significant at 1%, and 5% respectively

As presented in table 4-13, 57(19%) of adopters and 42(13.3%) of non-adopters have two oxen respectively. 26(8.3%) of adopters and 43(13.7%) non- adopters have two and more than two oxen respectively. Finally, 24(7.6%) and 28(8.8%) of adopters 29(9.2%), and 66(20.9%) of non-adopters have one and no oxen respectively. Moreover, the chi-square test indicates that a number of oxen owned by household heads was found significant difference between the levels of adoption. In conclusion, oxen and adopting improved agricultural technology are associated at a 1% statistically significant level. Most oxen-based operations of farming require pairs of oxen. Thus, farmers with one ox and those with no oxen use by rent and borrow from neighbors. Oxen are key asset in the rural areas of the country. This indicates that a number of oxen is one of the important variables, which increases farmers' decision to use modern agricultural inputs technology and ensure food security. It is, therefore, conclude that the larger the number of oxen the household has, the more they adopt modern agricultural input technology.

4.3.3 Sample Households by Livestock (in number)

Table 4-14 Distribution of sample households by livestock (in number)

Crosstab						
Item	Alternatives		level of technology adopters		Total	χ^2
			Non-adopters	Adopters		
Do you have livestock?	No	Frequency	104	1	105	.000*
		percentage	33	0.3	33.3	
	Yes	Frequency	76	134	210	
		percentage	24.2	42.5	66.7	
Total		Frequency	180	135	315	
		percentage	57.1	42.9	100.0	

How many number of oxen do you have?	Adopters		Non-adopters		
Less than 2	Frequency	29		87	
	percentage	9.2	18.4	37.6	
3-6	Frequency	55	71	126	
	percentage	17.5	22.5	40	
Greater than 7	Frequency	43	33	76	
	percentage	13.7	10.5	24.2	
No livestock	Frequency	8	18	26	
	percentage	2.5	5.7	8.2	
Total	Frequency	135	180	315	
	percentage	42.9	57.1	100	

Source: field survey, 2022 Note: *, **, indicates statistically significant at 1%, and 5% respectively

Livestock holding is expected to have a positive influence on the farm household‘s decision to adopt improved agricultural technology. According to the survey result of table 4-14, about 134(42.5%) of adopters and 76(24.1%) of non-adopters farmers from the sample households are the owner of the livestock. About 1(0.3%) of adopters and 104(33%) of non-adopters farmers respondents expressed that they do not have livestock. Hence, the analysis has shown that there was a statistically significant difference between non-adopters and adopters at a 1% level of significance. This implies that the adopters have more chance of obtaining financial income by selling their livestock to purchase improved agricultural technologies.

About the size of livestock holding, 29(9.2%) of adopters and 58(18.4%) of non-adopters have less than 1 livestock, 55(17.5%) of adopters, and 71(22.5%) of non-adopters have range of 3-6 livestock, 43(13.7%) of adopters and 33(10.5%) of non-adopters have greater than 7 and 8(2.5%) of adopters and 18(5.8%) of non-adopters have had no livestock. This implies that as livestock, the value increases the income of the smallholder farmers’ increases which leads to increases in the purchasing power of improved agricultural technologies for the smallholder farmer.

4.3.4 Sample Household's Off-farm Activity

Table: 4-15 Distribution of sample household's off-farm activity

Response item	Alternative	Adopter		Non-adopter		$\chi 2$
off/non-farm participation		Number	Percent	Number	Percent	
	Yes	37	11.7	97	30.8	.000*
	No	98	31.1	83	26.3	
Total		135	41.9	180	59.1	
kinds of non-farm activity		Adopter		Non-adopter		
		Number	Percent	Number	Percent	
Trading		27	20.8	12	9.2	
Laborer		1	0.8	43	33.1	
Handcraft		9	6.66	12	9.2	
Selling wood		0	0	26	20	
Total		37	28.5	93	71.5	

Source: field survey, 2022 Note: *, **, indicates statistically significant at 1%, and 5% respectively.

According to table 4-15 out of the total sample households, 37(11.7%) adopters and 97(30.8%) non-adopters have non-farm income participation through their family members. 98(31.1%) of adopters and 83(26.3%) of non-adopters have no non-farm income. Hence, a chi-square ($\chi 2$) analysis indicated that there was a statistically significant difference in non/off-farm income among adopters and non-adopter at a 1% level. This implies that most of the smallholder farmers in the study area were not participated in non-farming activities to raise income level.

In addition, focus group discussions with smallholder farmer

> *A focus group discussion has also been made with the smallholder farmer participant. They agreed that involvement in non-farm activity was not implemented by many farmers. Most farmers are engaged in agricultural activity rather than non-farm activities of farmers.*

Regarding with kind of off-farm activity farmers engaged in trading, laboring, handcrafts, and selling wood was found to be the major non/off-farm activities of farmers in the study area.

4.4 Institutional Factors

4.4.1 Institutional Support to Households

Table4-16 Distribution of sample households for extension contact

Response	Alternative	Adopter		Non-adopter		χ^2
		Frequency	Percentage	Frequency	Percentage	
Did you get an advisory or guidance service from an extension agent?	Yes	9	2.9	52	16.5	
	No	126	40	128	40.6	
	Total	135	42.9	180	57.1	.000**
If yes, how many times have extension agents visited you?		**Adopter**		**Non-adopter**		
		Frequency	Percentage	Frequency	Percentage	
Once in three month		0	0	20	15	
Monthly		29	22.5	79	59.4	
Weekly		51	39.5	14	10.5	
Twice weekly		47	36.4	15	11.3	
No extension agent		2	1.6	5	3.76	
Total		129	100	133	100	
During which farm operation extension agent visit you?		**Adopter**		**Non-adopter**		
		Frequency	Percentage	Frequency	Percentage	
During input provision		9	7.1	2	1.6	
During sowing		42	33.1	25	19.5	
During herbicide application		8	6.3	17	13.3	
During credit collection		4	3.1	72	56.2	
During input provision, sowing and herbicide application		28	22	7	5.5	
Total		36	28.4	5	3.9	
		127	100	128	100	
How do you evaluate your extension agent's role in the adoption of improved agricultural		**Adopter**		**Non-adopter**		
		Number	Percent	Number	Percent	

technology?				
High	66	48.9	16	8.8
Medium	56	41.5	78	43.3
Low	13	9.6	86	47.7
Total	135	100	180	100

Source: Field Survey, 2022 Note: *, **, indicates statistically significant at 1%, and 5% respectively

Extension agents have a major role in the adoption of modern agricultural input technology. Table 4.16 shows us from the total respondent, 9(2.9%) adopters and 52(16.5%) non-adopters response they were in contact with extension agents. 126(40%) of adopters and 128(40.6%) of non-adopters responded they were no contact with extension agents. The result implies that even if extension agents placed in the kebele and motor cycle has given, they are not giving enough service in the study area. This indicate that lack of contact with extension agent was considered a major problem for the adoption of modern agricultural input technology of smallholders in the study area. Besides, a chi-square test found access to extension services has a systematic association with their status of adoption at 1% statistically significant level.

> *An interview has also been made with the key informants on the case of extension service given to farmers. They agreed that the role of extension agents was unsatisfactory to apply the adoption of modern agricultural input technology in the study area.*

About the frequency of visits of extension agents, 29(22.5) of adopters responded monthly, 51(39.5%) adopters responded weekly, 47(36.4%) adopters responded twice weekly, 2(1.6%) of adopters responded they do not contact the extension agent respectively. 20(15%) of non-adopters responded they was contact with an extension once in three months. Majority 79(59.4%) of non-adopters responded they was contact with an extension monthly. 14(10.5%), and 15(11.3%) non-adopters responded they was contact with an extension weekly and twice weekly respectively and 5(3.76%) of non-adopters response were no extension agent.

At the time of farm operation and extension agent's visit, 9(7.1%), 42(33.1%), 8(6.3%), 4(3.1%), and 28(22%) adopters responded during input provision, during sowing, during herbicide application, during credit collection, and during input provision respectively. 2(1.6%), 25(19.5%), 17(13.3%), 72(56.2%), and 7(5.5%) adopters responded during input provision, during sowing, during herbicide application, during credit collection, and input provision respectively. 2(1.6%), 25(19.5%), 17(13.3%),

72(56.2%), and 7(5.5%) non-adopters responded during input provision, during sowing, during herbicide application, during credit collection, and input provision respectively.

As indicated in table 4.16 from the total number of adopter farmers 66(48.9%) evaluate extension agent's role in the adoption of modern technology was high. 56(41.5%) and 13(9.6%) of adopters evaluate the extension agent's role in the adoption of modern technology as medium and low respectively. 16(8.9), 78(43.3%), and 88(47.7%) of non-adopters evaluate extension agents' role in the adoption of modern technology as high, medium, and low respectively.

4.4.2 Sample Households for the Price of Agricultural Inputs

Table4-17 Distribution of sample household's price of agricultural inputs

Response	Alternative	Adopter		Non-adopter		χ^2
		Frequency	Percentage	Frequency	Percentage	
Do you think that the price that you pay for any agricultural technologies is affordable?	Yes	33	10.3	1	0.3	0.003**
	No	102	32.4	179	56.8	
	Total	135	42.7	180	57.1	
If No, what do you think is the reason?		Adopter		Non-adopter		
		Frequency	Percentage	Frequency	Percentage	
High price of the agricultural input		88	65.2	69	38.3	
Lack of financial resources to buy them		20	14.8	110	61.1	
any others		1	0.74	0	0	
Total		109	80.75	179	99.4	

Source: Field Survey, 2022 Note: *, **, indicates statistically significant at 1%, and 5% respectively

New technologies may incur adoption costs through the learning of a new skill, implementing the new practice, the need for complementary practice, and the purchase of the technology itself. Hence, the cost of technology which will be paid in all forms to avail and adopt technology can be termed as the price of technology. It has been included in the selling offer of a particular technology. The high cost of inorganic fertilizer was found to be the most determinant factor to adopt improved agricultural technologies adoption and have a negative influence on the farm household's decision to adopt

improved agricultural technology. According to table 4-17, about 33(10.3%) of adopters and 1(0.3%) of non-adopter farmers from the sample household responded that the price that they pay for any agricultural technologies is affordable. About 102(32.4%) adopters and 179(56.8%) non-adopter farmer respondents express that the price they pay for improved agricultural technology is not affordable. This can be explained that farmers are highly sensitive to the price of farming inputs in which a higher input price will have a lower rate of adoption level. In conclusion, in the study area high prices of technology has negative outcome in favoring the adoption of technology. Hence, a chi-square ($\chi 2$) analysis indicated that there was a statistically significant difference in the price of input among adopters and non-adopter at a 5% level.

Regarding the reason, out of total sample of adopters, 88(65.2%) of adopters and 69(38.3%), non-adopters responded that the high price of agricultural input is a problem for adopting improved agricultural technology. 20(14.8%) of adopters and 110(61.1) of non-adopters reason out for not adopting improved agricultural technology due to lack of financial resources.

4.4.3 Sample Households for Access to Credit

Table 4-18 Distribution of sample households for access to credit

Response item	Alternative	Adopter		Non-adopter		χ^2
		Number	Percent	Number	Percent	.013**
Did you get access to credit	Yes	20	6.3	4	1.2	
	No	115	6.3	176	55.8	
	Total	135	43	180	57	
Which source do you obtain credit?		Adopter		Non-adopter		
		Number	Percent	Number	Percent	
Microfinance		75	55.5	18	10	
NGO		10	7.4	4	2.2	
Cooperative		9	6.6	-	-	
Private lender		34	25.2	12	6.6	
Total		128	87.3	34	18.8	
What kinds of credit you obtain?		Adopter		Non-adopter		
		Number	Percent	Number	Percent	
Cash		109	80.7	34	18.9	
Seed		10	7.4	15	8.3	
Fertilizer and urea		9	6.6	4	2.2	

Pesticide	-	-	5	2.7
All	-	-	-	-
Total	128	94.8	58	32.1
What is the reason you take cash credit?	Adopter		Non-adopter	
	Number	Percent	Number	Percent
To purchase fertilizer and urea	18	13.3	3	1.67
To purchase improved seed	1	0.74	0	0
To purchase chemical pesticide	1	0.74	0	0
Any other	1	0.74	58	32.2
Total	21	15.52	61	33.87

Source: field survey, 2022 Note: *, **indicates statistically significant at 1%, and 5% respectively

Credit is the most important development tool that could enable resource-poor farmers to get access to modern agricultural technologies like chemical fertilizer, chemical pesticides, and improved seeds. Lack of credit for inputs like inorganic fertilizer and improved seed has a negative influence on the increases of improved agricultural production. As indicated in table 4-18 majority of 115(36.5) adapters and 176(55.9%) non-adopters respondents did not have access to credit while only 20(6.3%) adopters and 4(1.2%) of non-adopters accessed credit. The chi-square ($\chi 2$) analysis indicated that there was a strong and statistically significant difference in access to credit among adopters and non-adopter at a 5% level. The survey results are in line with Ogeto et al. (2012) who found that the majority (80.7%) of the sorghum farmers in Nakuru County had no access to credit, Chenoa, Maria, and Teno (2018) made similar revelations that the majority of the smallholder farmers in their study did not have access to credit. In contrast, Kebede et al. (2017) established that 62% of Irish potato farmers accessed credit in their study. The study results imply that most of the farmers had low access to credit. Credit accessibility may reduce constraints experienced during production as credit facilitates the timely acquisition of farm inputs. However, since credit access was poor farmers' ability to acquire the much-needed agricultural inputs on time was affected hence expected to reduce their level of productivity and production.

The study result on the various sources of credit shows 75 (55.5%) of adopters and 18(10%) of non-adopters get credit from microfinance, 10(7.4%) of adopters and 4(2.2%) of non-adopters get credit from NGO, 9(6.6%) of adopters get credit from cooperatives. 34(25.2%) of adopters and 12(6.6%) of non-adopters get credit from private lenders.

About the kinds of credit obtained by farmers 109(80.7%) of adopters and 34(18.9%) of non-respondents get cash credit, 10(7.4%) of adopters and 15(8.3%) of non-adopters get seed, 9(6.6%) of adopters and 4(2.2%) of non-adopters get fertilizers and urea and 5(2.7%) of non- adopters get pesticide.

The survey results on reasons why most of the respondents take credit indicate 18 (13.3%) of adopters take credit for the purchase of chemical fertilizer and urea, and 58(32.2%) of non-adopters take credit for the purchase of any other things.

4.4.4 Access to Technological Information

Table 4-19 Access to technological information by sample households

Response item	Alternative	Adopter		Non-adopter		X^2
		Number	Percent	Number	Percent	
Did you get access to technological information?	Yes	8	2.5	44	14	0.00*
	No	127	40.4	136	43.1	
	Total	135	42.9	180	57.1	
If yes, from whom did you obtain information about agricultural input accesses and use?		Adopter		Non-adopter		
		Number	Percent	Number	Percent	
From extension		50	37	34	18.8	
From mass media (radio, magazine, Newspaper)		31	23	69	38.3	
from relatives, friends, or neighbors		3	2.2	5	2.78	
from all source		43	31.86	28	10.6	
Total		127	94.	136	75	
If no, what are the barriers to effective communication on improved agricultural technologies?		**Adopter**		**Non-adopter**		
		Number	Percent	Number	Percent	
Poor extension services		7	5.2	28	1.55	
Inaccessible electronic media		1	0.74	7	12.3	
Less social networks		1	0.74	13	7.2	
Total		9	6.6	48	21.05	

Source: Field Survey, 2022 Note: *, **, indicates that the coefficients are statistically significant at 1%, and 5% respectively

Access to information is critical for the farmers to adopt any modern agricultural technology available, access to information makes farmers more knowledgeable about the existing technologies, and accessed information will assist farmers in the decision-making process either to adopt or not adopt the available technologies (Tobon, 2011). As presented in table 4-19 from the total respondent, the majority 127(40.4%) of adopters and 136(43.1%) of non-adopters responded that they did not get access to technological information. This implies that most smallholder farmers did not have access to information about modern agricultural technologies thus not having access to information on the existing agricultural technologies does hinder the adoption of modern agricultural technologies by the smallholder farmers in the area of study. Hence, a chi-square ($\chi 2$) analysis indicated that there was a strong and statistically significant difference in access to information among adopters and non-adopter at a 5% level.

About source of accessing information, 50(37%) adopters and 34(18.8%) non-adopters get technological information from extension.31 (23%) adopters and 69(38.3%) non-adopters get information from mass media (newspaper, radio, and magazine). This indicates that the major respondents of non-adopters accessing information related to agriculture and agricultural production activities in the study area were from mass media. 43(31.6%) of adopters and 28(10.3%) of non-adopters get information from all source (newspaper, radio, magazine and relatives...etc.).

Regarding the barriers to effective communication on improved agricultural technologies 7(5.2%) of adopters and 28(15.5% of non-adopters) responded poor extension service is a barrier to effective information exchange about improved agricultural technologies.

4.4.5 Distance from Household Head Residence to Nearest Market Center (km)

Table 4-20 Distribution of sample household's distance from to nearest market center (km)

Variable	level of technology adopters	N	Mean	Std. Deviation	T-test	Total sample(315)	
						Mean	SD
Distance from household head residence to the nearest market center	Adopters	135	7.99	3.926	.657 NS	.7.89	3.884
	Non-adopters	180	7.79	3.842			

Source: - Survey result, 2022 Note: Ns—not significant

Respondents are asked about the distance to the nearest market because it was important for farmers to get the maximum price through the reduction of transportation cost. It is believed that a farmer was encouraged to adopt more soybeans when soybean technology is available near the consumption center at the right time. In this study, the sampled respondent travel ranges from 1 to 10 km and on average the total sample respondent was travel 7.89 km. The average non-adopter sample respondent was travel 7.79 8km while adopter was travel 7.99 km with statistically non-significant mean difference among the groups (Table 4-20). This show that an increase in the market distance make high transportation cost and a low opportunity to get production input. According to the t-test analysis, there was a statistically insignificant difference in distance to the nearest market among users and no- users.

4.4.6 Distance from Household Head Residence to Farmer Training Center (km)

Table 4-21 Distribution of sample household's farmer training center (km)

Variable	level of technology adopters	N	Mean	Std. Deviation	T-test	Total sample(315)	
						mean	SD
Distance from household head residence to the nearest FTC	Adopters	135	4.3017	3.31380	.000*	5.0664	3.329055
	Non-adopters	180	5.8311	3.34431			

Source: Field Survey, 2022 Note: *, **statistically significant at 1%, and 5% respectively

According to the survey result of table 4-21, respondents are asked about the distance to the nearest farmer training center because an increase in FTC distance makes the high loss of new and updated information about a new package of technology and low opportunity to get extension advice. In this study, the sampled respondent travel ranges from 1 to 8 km and on average the total sample respondent was travel 5.0664 km. The average non-adopter sample respondent was travel 5.8311km while adopter was travel 4.3017 km with statistically significant mean difference among the groups.

This show that an increase in FTC distance makes the high loss of new and updated information about a new package of technology and low opportunity to get extension advice. The finding implies that the distance of agricultural institutions from the household has been affecting the adoption of improved agricultural technology. Besides, the t-test indicates that distance from the farmer training center was found significant difference between the levels of adoption at a 1% probability level. From the result, it is possible to conclude that those households who are situated in nearby places do quickly decide to

adopt improved agricultural technology adoption because the better extension contact and better opportunity to get various skill training.

4. 5 Socio-Cultural Factors

4.5.1 Participation in a Social Group

The membership of household heads in a social group is expected to have a positive influence on the farm household‘s decision to adopt improved agricultural technology due to better access to information, opportunity to get money and help of others in the debo form. According to the survey result, about 132(41.9%) adopters and 166(52.7%) non-adopter farmers from the sample household responded that they participate in social groups. About 3(1%) of adopters and 14(4.4%) of non-participant farmer respondents express they do not participate in a social group.

Regarding kind of selection for participation, 8(6%) of adopters and 11(6.1%) of non-adopters participate in equb, 14(10.4%) of adopters and 33(18.3%) of non-adopters participate in edir, 28(20.7%) of adopters and 48(26.6%) of non-adopters participate in debt and 80(59.3%) of adopters and 74(41.1%) of non-adopters were participate in all social group i.e. equb,idir and debo. This show that the role of a social group is essential to get money, exchange information, share experience, to help each other in the study area. Besides, the chi-square test indicates that participation in social group was found significant difference between the levels of adoption at a 1% probability level. In conclusion, social group participation significantly influences and has a positive relationship with the adoption of improved agricultural technology in the study area.

Table4-22 Sample household participation in the social group

Response item	Alternative	Adopter		Non-adopter	
		Number	Percent	Number	Percent
Do you participate in a social groups?	Yes	132	41.9	166	52.7
	No	3	1	14	4.4
	Total	135	42.9	180	57.1
if yes, in which social group does you participate		Adopter		Non-adopter	
		Number	Percent	Number	Percent

Equb	8	6	11	6.1
Edir	14	10.3	33	18.3
Debo	28	20.7	48	26.6
equb,idir and debo	80	59.3	74	41.1
Total	130	96.3	166	92.1

Source: Field Survey, 2022 Note: *, ** statistically significant at 1% and 5% respectively.

4.5.2 Sample Households for Membership of a Cooperative Association

Table 4-23 Distribution of sample households for membership of a cooperative association

Response item	Alternative	Adopter		Non-adopter	
		Number	Percent	Number	Percent
Are you member of farmers 'cooperatives?	Yes	31	10	111	35
	No	104	33	69	22
	Total	135	43	180	57

Source: Field Survey, 2022 Note: *, **statistically significant at 1%, and 5% respectively.

Membership in cooperatives represents whether a household is a member of cooperatives or not. Cooperatives worldwide are committed to the concept of mutual self-help. This makes them natural tools for social and economic development and provides significant additional benefits to communities and social systems. Formal as well as informal associations, such as indigenous cooperation groups, enforce widely agreed standards of behavior and unite people with bonds of community solidarity and mutual assistance. Membership to an association will benefit for farmers to access inputs like improved seed, fertilizer and pesticides easily with an affordable price that is pertinent to increase agricultural production and thereby farm income. As indicated table 4.23 from the total numbers of adopter farmers 31(10%) and 111(35%) of non-adopters are members of the farmers associations. The remaining 104(33%) adopters and 69(22%) non-adopters are not members of the farmer's associations. This indicates that the majority of farmers in the study area are not members of farm cooperative and they do not get agricultural input technologies at affordable price from an association. Hence, the chi-square

($\chi 2$) analysis, there was a statistically significant relation at a 1 % probability level in members of cooperative association between statuses of adoption.

In focus group discussions most smallholder farmers agreed that the establishment of farmers' cooperative association has been a long time since its establishment, it focused on the supply of sugar and oil and occasionally on the purchase of coffee and sometimes cash crop, but it is not focused on the supply of resources by organizing and strengthen the union. Not only do this but because of mismanagement, ineffectiveness and infrastructure problems, farmers do not want to be a member of the association.

4.6 Political Factors

4.6.1 Top-down pressure of Improved Agricultural Technology

Table4-24 Sample household response of top-down pressure

Description			level of technology adopters	
			Non-adopters	Adopters
Do you think there is a top-down pressure to implement an improved agricultural technology plan?	No	Frequency	45	15
		percentage	14.3	4.8
	Yes	Frequency	135	120
		percentage	42.9	38.1
Total		Frequency	180	135
		Percentage	57.1	42.9
Description			**level of technology adopters**	
			Non-adopter	Adopters
If you say yes, whom does it focus on?	Leaders	Frequency	44	33
		Perc.	17.2	12.9
	rich and vast agricultural land	Frequency	34	17
		Perc.	13.3	6.6
	model farmers	Frequency	1	5
		Perc.	0.4	2.0
	leaders, rich and vast agricultural land and model farmer	Frequency	56	66
		Perc.	21.9	25.8
Total		Frequency	135	121
		Perc.	52.7	47.3

Description item			Level of technology adopters	
			Non-adopters	Adopters
If you say yes, what is the reason for top down pressure reason?	to implement targeted quota	Frequency	107	75
		Perc.	59.4	55.5
	To carry out government strategies	Frequency	11	13
		Perc.	6.1	9.6
	To increase production and productivity	Frequency	17	33
		Perc.	9.4	24.4
	Total	Frequency	135	121
		Perc.	75	89.6

Source: field survey, 2022 Note: *, **, *** statistically significant at 1%, 5%respectively.

Table 4-24 shows the pressure to implement improved agricultural technology among household heads. As indicated in the table, 15(4.8%) household heads adopters and 45(14.3%) non-adopters respondents express there was no top-down pressure to implement an improved agricultural technology respectively. The majority of adopters 120(38.1%) and 135(31.1%) non-adopter farmers from the sample household responded during their farming career top-down pressure was applied to expand the new extension system and achieve the targeted quota plan of improved agricultural input. The study is consistent with the study of Spielman et al. (2012). He revealed that as the purveyors of input packages, extension agents often see themselves as little more than fertilizer and credit distributors, rather than extension specialists. Additionally, as extension agents are also charged to serve in the capacity of debt collectors for farmers who have borrowed to purchase and use capital-intensive inputs, tensions between the government-endorsed extension and farmers have increased as the power relations shift from knowledge exchange to creditor/debtor (Spielman et al. 2012). To succeed in this role as creditor, extension often focuses on wealthier, party-affiliated, farmers rather than resource-poor farmers; and, since extension agents are responsible for selecting participants for on-farm demonstrations and participation in extension activities, the impact on and participation of the most vulnerable farmers is likely to be more minimal (Assefa et al 2008). Besides, the chi-square test found a top-down pressure and improved agricultural technology adoption by household heads found a significant difference between the statuses of adoption at a 5% probability level. The finding suggests that there was a relationship between the statuses of adoption in the study area.

In addition, in focus group discussions most smallholder farmers said that:

> *The leader of kebele administrators to extend their authority and also to gain acceptance and extension agents emphasizes their acceptance by saying that he has recorded better performance of improved modern agriculture technology and to be better than others they apply a power related activities to implement the given quota plan of improved agricultural technologies which is not based on the amount of land to be cultivated because it is a government strategy. This has led us to have a distorted view of improved agricultural technology and extension agents.*

About the focus area of top down pressure, 33(12.9%) and 44(17.2%) of adopters and non-adopters of sample respondents responded that top-down pressure focuses on leaders to adopt improved agricultural technology respectively. 34(13.3%) and 17(6.6%) of non-adopters and adopters were respondents' responses that top-down pressure for implementation of improved agricultural technology focused on rich, and vast agricultural land owner households farmer respectively. Majority of 56(21.9%) non-adopters and 66(25.8%) adopters respondent response that top-down pressure focus on the leader, rich and vast land owner household respectively. In conclusion, the findings show top-down pressure to implement targeted quotas for improved agricultural technology.

Regarding the reason for top-down pressure to implement modern agricultural inputs, about 107(41.8 %) and 75(55.5%) of non-adopters and adopters of sampled household heads responded that the main reason for top-down pressure to implement modern agricultural technology was to implement targeted quota plan. while out of 11(6.1%) non-adopters and 13(9.6%) adopters respondents were reason to carry out government strategies. 17(9.4%) non-adopters and 33(24.4%) adopters said to increase the production and productivity of smallholder farmers in the study area.

4.6.2 Coercive Promotion of Improved Agricultural Technology.

Table4-25 Sample household response to coercive promotion

Response item			level of technology adopters		X^2
			Non-adopters	Adopters	
Are there any coercive promotions that you would like to use to keep you updated using improved agricultural	No	Frequency	98	41	0.000*
		Perc.	31.1	13.0	
	Yes	Frequency	82	94	

technology during your farming career		Perc.	26.0	29.8	
Total		Frequency	180	135	
		Perc.	57.1	42.9	
Description of item			Level of technology adopters		
			No	yes	
If you say yes, what is the for reason the coercive modernization of agriculture	To implement targeted quota	Frequency	107	75	
		Perc.	59.4	55.5	
	To carry out government strategies	Frequency	11	13	
		Perc.	6.1	9.6	
	To increase production and productivity	Frequency	17	33	
		Perc.	9.4	24.4	
Total		Frequency	135	121	
		Perc.	75	89.6	

Description Item			**Level of technology adopters**	
			No	Yes
If you say yes, what are the advantages of participation in coercive modernization?	A better understanding of technology	Frequency	40	61
		Perc.	22.6	34.5
	Increased production and productivity	Frequency	9	16
		Perc.	5.1	9.0
	No change	Frequency	29	14
		Perc.	16.4	7.9
	Not determine	Frequency	5	3
		Perc.	2.8	1.7
Total		Frequency	83	94
		Perc.	46.9	53.1

Source: field survey result, 2022. Note:*, **statistically significant at 1% and 5% respectively.

According to table 4-25 survey result, about 41(13%) adopters and 98(31.1%) non-adopter farmers from the sample household responded that no coercive agricultural modernization system was implemented to apply newly released modern agricultural technology input during their farming career. About 94(29.8%) of adopters and 82(26%) of non-adopter farmer respondents express there was a

coercive modernization during their farming career. This implies that pushing improved agricultural input as a necessary component ultimately reduces the likelihood of adoption of sustainable intensification practices and in many ways limits farmers' abilities or desires to invest in their land. Besides, the chi-square test found coercive modernization systems have a systematic association with the status of adoption. The study is coherent with the study of Anne Cafer and Sandy Rikoon (2017). The study reveals that coercive modernization is a politicized extension system, working with a marginalized population, not only fails to achieve national and international development goals but promotes active resistance to that system and farming has become a life of coerced modernization and shrinking means of production.

Regarding the reason for coercive modernization, the majority of 75(55.5%) and 107(59.4%) adopters and non-adopters of sample respondents there was a coercive promotion to implement a targeted quota of modern agricultural input in the study respectively. 13(9.6%) and 11(6.1%) of non-adopters and adopters were respondents' responses to carrying out government strategy. 17(9.4%) of non-adopters and 33(24.4%) of adopters sample household respondents responded to increasing production and productivity.

With regarding the profit/advantage of coercive promotion of improved agricultural input, about 61(34.5 %) and 40(223.6%) of adopters and non-adopters of sampled household heads responded they gained a better understanding of technology, 9(5.1%) non-adopters and 16(9%) of adopters respondents were increased production and productivity, 29(16.4%) non-adopters and 14(7.9%) of adopters said no change,5(2.5%) of adopters and 3(1.7%) no-adopters expressed not determine in the study area.

In addition, in focus group discussions most smallholder farmers said that:

> *When a new package of improved seed is released the government brings it to the kebele without evaluating the productivity and any other factors, it is directly implemented as a government strategy. Even if it has already been sown and on its field, the re-cultivation strategy will be implemented saying that this field is suitable for demonstration.*

Finally, the findings show that coercive modernization had been done to achieve the target quota plan of improved agricultural technology and has a negative relationship with adoption in the study area.

4.6.3 Compulsory Purchase of Improved Agricultural Technology.

Table4-26 Sample household response to compulsory purchase

Item			level of technology adopters		Total	X^2
			Non-adopters	adopters		
Have you ever purchased improved agricultural inputs compulsory?	No	Count	26	27	53	NS
		%	8.3	8.6	16.8	
	Yes	Count	154	108	262	
		%	48.9	34.3	83.2	
Total		Count	180	135	315	
		%	57.1	42.9	100	
Item			level of technology adopters		Total	
			Non-adopters	adopters		
If you say yes, what do you do with the improved agricultural technology which you have compulsorily purchased	It sows	Count	7	12	19	
		%	2.7	4.6	7.3	
	It not be sown but put for next year	Count	33	39	72	
		%	12.5	14.8	27.3	
	Even though it sows, it is not cared for	Count	30	39	72	
		%	11.4	14.8	26.2	
	Sell to merchants at a lower price	Count	85	18	103	
		%	32.3	6.8	39.1	
Total		Count	155	108	263	
		%	58.9	41.1	100	
Item			level of technology adopters		Total	
			Non-adopters	adopters		
If you say yes, what are the effects of being compulsory to purchase improved agricultural technologies	Distorted perception of technologies	Count	18	31	49	
		%	6.9	11.9	18.8	
	Improved on-farm performance	Count	1	7	8	
		% o	0.4	2.7	3.1	
	Paid and kept from going out of the store	Count	22	5	27	

Source: field survey result, 2022. Note: *, **statistically significant at 1% and 5% respectively. NS: - not significant

As shown in table 4-26, adopters 27(8.6%) responded no and 108(34.3%) responded there was a compulsory purchase of modern agricultural input whereas, non-adopters 26(8.3%) responded no, and 154(48.9%) responded household head there was compulsory purchase agricultural input in the study

area. Besides, the chi-square test was not found a significant difference between the level of adoption of household heads and the compulsory purchase of improved agricultural input. The finding implies that there was no relationship between the level of adoption of smallholder farmers and the compulsory purchase of improved agricultural input in the study area.

Concerning compulsory purchase input, 7(2.7%) and 12(4.6%) of non-adopters and adopters of sample respondent's responses it sows respectively. 33(12.5%) and 39(14.8%) of non-adopters and adopters sample households expressed they have put it for next year. 33(12.5%) and 39(14.8%) of non-adopters and adopter response that even if the purchased agricultural input sow, they do not give essential care. 30(11.4%) of non-adopters and 39(14.8%)of adopters purchase at the maximum price and sell to the merchant at the minimum price. The result of the interview with kebeles chairpersons, extension agents, and the zone agricultural officers shows that there was no one farmer purchased improved agricultural technology like chemical fertilizer compulsory. Smallholder farmers can pay and take what they want according to their needs. Instead, they say there were supply problems.

But, in focus group discussions most smallholder farmers said that:

> *Adopting improved agricultural inputs like fertilizer is compulsory, if we refuse to adopt, bring the land certificate by signature of the family saying that we will give up together and submit the land to the land bank and the land will be confiscated….Because the land belongs to the government; because you've got land owned by the government. We are afraid that we pay without our demand.*

With regard, about 107(41.8 %) and 75(55.5%) of non-adopters and adopters of sampled household heads responded that the main reason for top-down pressure for implementing modern agricultural technology was to implement targeted quota. while out of 11(6.1%) non-adopters and 13(9.6%) adopters respondents were reason to carry out government strategies. 17(9.4%) non-adopters and 33(24.4%) adopters said to increase the production and productivity of smallholder farmers in the study area.

4.8 Econometric Analysis

4.8.1 Binary Regression Model Results

The coefficients of the binary logistic regression model were estimated using the Maximum Likelihood Method (ML) by SPSS Program. The quality of conciliation was tested using the Hosmer and Lemeshow statistic, which is one of the most reliable test to reconcile the logistic regression model. Before taking the variables into the model, some assumptions were tested among the explanatory and dependent variables. The test results of some of the regression assumption have been described as follows;

Multi-collinearity: Before fitting the model it is necessary to carry out a multi-collinearity test because multi-collinearity may cause a lack of significance of individual independent variables. SPSS version 23 was employed to compute the VIF values. As a rule of thumb, if the VIF of a variable exceeds 10, there is multi-collinearity. To avoid serious problems of multi-collinearity, it is quite essential to omit the variable with values 10 and more from the logit analysis (Gujarati, 2003). Thus, the variance inflation factor (VIF) was employed to test the degree of multi-collinearity among the continuous variables. As shown in table 27, the values of the VIF for continuous variables such as family size, size of cultivated land, number of oxen, number of livestock, age, distance from market, and distance from farmer training center of the respondents were found to be small (i.e. VIF values less than 2), indicating the data have no serious problem of multi-collinearity. Similarly, the contingency coefficient, which measures the association between various categorical variables based on the Chi-square, was computed to check the degree of association or the existence of a multi-collinearity problem among the categorical explanatory variables. The decision rule for contingency coefficients states that when its value approaches 1, there is a problem of association between the dummy or categorical variables, i.e., the values of contingency coefficients range between 0 and 1, with zero indicating no association between the variables and values close to 1, indicating a high degree of association.

Based on the correlation coefficient results, the computation reveals that there was no problem of association among the dummy/categorical and explanatory variables. Hence, after a screening of the best variables among the hypothesized variables multi-collinearity problems were checked for

continuous and dummy variables respectively. Accordingly, there was no multi-collinearity problem in both cases. After checking it, model analysis was conducted.

Table 4-27. The maximum likelihood estimates of the binary logit model

Variables	B	df	Sig.	Exp(B)
Aghhs	.880	1	.131	2.411
Shhs	.399	1	.651	1.490
Edulevhhs	-.127	1	.677	.881
Fmsize	.381	1	.352	1.463
Farmlandsize	2.591	1	.000*	13.340
Nunmberoxen	2.185	1	.000*	8.891
Numberlivestock	7.351	1	.000*	.001
Nonfarmincome	-.103	1	.880	.902
Priceinputs	-5.090	1	.000*	.006
Extadvice	-.891	1	.288	.410
Accredit	-2.746	1	.036**	.064
Accinfo	-1.376	1	.136	.253
Distancesfromarket	-.028	1	.695	.972
DistancefromFTC	.249	1	.027**	1.283
SocialGP	.445	1	.722	1.560
Memberofincooperative association	-3.270	1	.000*	.038
Top-down pressure	-17.910	1	1.000	.000
Coercivepromotion	.915	1	.185	2.496
Compulsorypurchaseof agriculturalinputs	1.003	1	.265	2.727
Constant	11.289	1	1.000	79930.884
-2Log likelihood----------325.062				
Model chi-square----------0.000				
Correctly predicted Non-adopters---95				
Correctly predict adopter----------93.3				
Overall percentage ----------94.3				

Source: model output 2022. Note: **,* indicates that the coefficient is statistically significant at 5%, and 1%, respectively.

Measures of Goodness of Fit: It was checked and validated that the model fits the data. The likelihood ratio test statistics exceeds the Chi-square critical value at less than 1 probability level. This implies that the hypothesis, which says all coefficients except the intercept are zero, was rejected. The quality of conciliation was tested using the Hosmer and Lemeshow statistic, which is one of the most reliable test to reconcile the logistic regression model.

The Omnibus Tests of Model Coefficients show that the full model has significant prediction performance(x^2=325.062;df=19 ;p<0.001). This implies that we accept the null hypothesis since p<0.05. The value of the Pearson Chi-square test shows the overall goodness of fit of the model at less than a 1% probability level. Given the set of the independent variable, the model summary of logistic regression implies that, the full model explains about 86.4 %(Nagelkerke R Square) variation on the dependent variable (appendix--1 table…3).

From all sampled smallholder farmers, the performance of the full model about 94.3% of respondents correctly predicted adopters and non-adopters categories by the model. The correctly predicted adopters (sensitivity) and correctly predicted non-adopters (specificity) of the model were 93.3 and 95 respectively. Thus the model estimated groups of adopters and non-adopters accurately. The maximum likelihood estimate of the parameters and the effect of independent variables on the adopter's status of sampled household heads were analyzed and presented in Table 4.27. The column, exp (B), gives the exponential of expected value of β raised to the value of the logistic regression coefficient, which is the predicted change in odds for a unit increase in the corresponding explanatory variable.

4.8.2 Factors Affecting the Adoption of Improved Agricultural Technology

An attempt was made to examine factors affecting the adoption level of improved agricultural technologies adoption using econometrics analysis.

In this study, the dependent variable is either adopters or non-adopters. To explain this binary variable, it is necessary to construct a model that relates the dependent variable to a vector of independent variables. The logit model was employed in this study to estimate the effects of the hypothesized independent variables on the adoption level of smallholder farmers.

19 both binary and continuous responded independent variables which are discussed in the descriptive statistics were included in the model. These variables were selected by testing the existence of multi-

collinearity using the Variance Inflation Factor (VIF) and contingency coefficients, in addition to their significance in the descriptive statistics.

The binary logit model identified seven significant variables out of the hypothesized 19 variables that determine household heads' level of adoption of improved agricultural technology in the study area. Among the significant factors considered in the model, four variables, farm land size, number of oxen, number of livestock, and distance of household from farm training center were found to have a positive influence on the level of adoption of household heads, and three factors such as price inputs, access to credit, and membership in the cooperative association of household heads were found to have a negative influence on household heads' level of adoption (Table 4-27).

Livestock holding (TLUHH): Livestock holding was in line with the prior expectation and was found to be statistically significant at 1% with a positive relationship. This implies that, that households with more livestock holding do minimize the capital constraints to purchase agricultural inputs as well as capacitate their risk-taking behavior to use modern agricultural technology like chemical fertilizer, and improved seed. This study was consistent with the research findings of Debelo Duressa (2015) and Sisay Debebe (2016). Their results suggested that improving herd size (e.g. improving access to veterinary service) will have a positive impact on raising adoption and expected use of modern agricultural input technology.

Farmland size (farmlandsize) is strongly significant at 1 percent and positively related to technology adoption. This implies that the increase in total land size holding of sample respondents had a positive influence on adoption of improved agricultural technologies. Greater land size serves as a security against the risk of crop failure. Farmers with more plots of land may be able to allocate part of their land for the new technology and thus are more likely to adopt new technology than those who have small farm sizes. Land being a scarce factor of production, farmers with small plots of land often do not take the risk of adopting a technology, which is unknown to them. They often learn and follow the progressive farmers with larger farm sizes and who adopt technology faster than those with smaller land sizes. The result was consistent with the study of Mohammed and Lakew (2013), and Miruts (2016).

Distance from household to farmers' training center: it is an exclusionary variable that can make the decision better. It has a positive sign as expected and is significant at a 5 percent probability level. The positive relationship tells us that the nearer the household is to the farmer's training center, the higher the

probability of adopting improved agricultural technologies. The result was that conclude that those households who are situated in nearby places do quickly decide to adopt. This is because; proximity to the development center has the advantage of obtaining technical support from extension workers easily and faces lower transaction and transportation costs. The study is consistent with the study of (Zenaye, 2016; Berihun et al., 2014).

A number of oxen: the model output illustrates that households' number of oxen has a positive and significant effect on the adoption of modern agricultural technology at a 1% significance level. This implies that if other variables held constant, as the number of oxen increase, the probability of a household becoming adopting will increase. The study is in line with the study of Sisay (2016), he revealed that ox is the major means of production in the country, it is expected to have a positive effect on adoption

Member of cooperative society: it is negatively correlate to technology adoption at 1% significance level. This implies that a farmer who is not a member of cooperative association has no chance to obtain service like as a source of credit, distribution of agricultural technologies like inorganic fertilizer and improved seed with affordable price, supplying basic materials like sugar and oil to the society. Therefore, farmers cannot easily adopt improved agricultural technology on time through an affordable price as well as through credit determine a farmer participation in technology adoption.

Price of technology: the logistic regression resulted that price of technology has a negative impact on the adoption of improved agricultural technology at a 1% significant level. Due to the high cost of inorganic fertilizer, the smallholder farmers in the study area tend to produce agricultural productivity without using inorganic fertilizer or using less than the recommended rate. These ways of production practice of smallholder farmers have a negative consequence for the adoption improved agricultural technology. This can be further explained that farmers are highly sensitive for the price of farming inputs in which higher input price will have lower rate of adoption level.

Access to credit: Credit access had significant and negative impact on adoption of improved agricultural technologies in the study area. As a result, policies and strategies should give more emphasis on strengthening the credit service to facilitate adoption of improved agricultural technologies in the study area.

4.9 Econometrics model of Impact Analysis

Farm income enables households to purchase their basic needs of life; per capita expenditure reflects the effective consumption of households and therefore provides information on the food security status of households. Before proceeding to estimate the treatment effect of technology, we have to be sure that the reliability of participants and controls have a uniform distribution on the observed and non-observed characteristics of sample households. The average difference in household income as well as expenditure between the adopters and non-adopters of the intended technology.

Table.4-28 Impacts of modern agricultural inputs use on household' income

	level of technology adopters	N	Mean	Std. Deviation	Std. Error Mean
total farm income in annual basis(Ethio-birr)	Yes	135	59450.22	2006.744	172.713
	No	180	57717.17	1439.457	107.291
total annual farm expenditure(Ethio-birr)	Yes	135	12563.16	966.688	83.199
	No	180	11015.89	1148.588	85.611
adopters production outcome income in Ethio-birr with/out inputs from 4 timad(0.5 hectars)	yes	135	36778.52	175.084	15.069
	No	180	19851.13	967.989	72.150

Income and expenditure difference between adopters and non-adopters		t-test for Equality of Means						
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
total farm income in annual basis(Ethio birr)	Equal variances assumed	8.925	313	.000	1733.050	194.189	1350.970	2115.130
	Equal variances not assumed	8.524	231.562	.000	1733.050	203.325	1332.446	2133.654
total annual farm expenditure(Ethio-birr)	Equal variances assumed	14.283	313	.000	1547.274	122.336	1506.569	1987.979
	Equal variances not assumed	14.636	308.815	.000	1547.274	119.379	1512.375	1982.173

adopters production outcome income in Ethio-birr with/out inputs from 4 timad(0.5 hectars)	Equal variances assumed	12.325	313	.000	16927.39	189.036	1161.562	2089.899
	Equal variances not assumed	12.325	286.415	.000	16927.39	198.753	1609.855	2115.191

Source: model output 2022.

The above table 4-28, t-test shows the results from the actual t-test. It provides supportive evidence about the effect of technology on household welfare performance. The study focused on the impact of improved agricultural technology on the total income of the household. The income of a household indicates the ability of a household to purchase its basic needs of life and hence it ultimately shows the livelihood performance of the farmers as stated in Nguezet et.al. (2011).

In the Group statistics, the 3rd column Mean results analysis shows that the farm income of the sample household who were adopting the improved agricultural technology earned Birr 59450.22 and while those non-adopters earned Birr 57717.17 on the average basis at a mean difference birr 1733.05 respectively. This study is coherent with the study of Wordofa et al (2021). Their study result reveals that households using improved agricultural technologies had on average, 23,031.28 Birr higher annual farm income compared to those households not using such technologies.

The last independent sample test table t-test for Equality of Means column – Sig. (2-tailed) shows the p-value for those differences. If the p-value is smaller than 0.05, the test suggests that there is a statistically significant difference (at the 5 % level). Thus, the p-value is smaller than 0.05, the test suggested that there is a statistically significant difference (at the 5 % level). In particular, the result of the descriptive statistics shows that the annual income earned from sales of the crop is Birr 36778.52 for adopters while it is Birr 19851.13 for non-adopters on an average basis (Appendix…2 table-3).

The impact analysis result showed, after controlling for pre-intervention differences between the adopter and non-adopters of improved seed and fertilizer (full package) technology packages, the gross income of adopters increased by 2.9% (Birr 1733.05) on an average annual basis and crop income increased by 46% (Birr 16927.12). This implies that adopting farming technology has a significant contribution to both aggregate income and crop income in particular. The t-test analysis revealed that

the mean difference in income and expenditure level between the two groups was statistically significant at a 1% probability level.

CHAPTER FIVE

5 Summary, Conclusion, and Recommendation

5.1 Summary

The adoption of modern agricultural input technologies is very essential to increase the agricultural production of smallholder farmers in Ethiopia. The major problem in the agricultural sector of Ethiopia is the traditional to use of backward technologies. Hence the application of modern agricultural input technology has a great role in productivity enhancement of the sector.

Konta zone is one of the potential areas for agricultural production in the region. The majority of farmers in the study area are smallholder farmers. This study was conducted to analyze the role of adoption of modern agricultural input technology in enhancing income of smallholder farmers. For this study both primary and secondary sources of data, multi-stage sampling techniques, cross-sectional data collection, an interview, and FGD were used to carry out the study. Accordingly, 3 rural kebele purposely selected out of 45 kebele in the study area, and 315 questionnaires were distributed across the 3 kebele and returned successfully. Out of the 315 questionnaires administered 135(42.9%) were adopters of agricultural input technology and 180(57.9%) were non-adopter of improved agricultural technology.

Data analyses were done with the help of descriptive and econometric methods using SPSS version 23 computer software. The Chi-square test and t-test were used to test the variation among farmers across the non-adopters and adopters groups. The logistic regression model was used to analyze factors affecting adoption decisions and the productivity and production of modern agricultural technologies.

The result of descriptive statistics indicated that 43.7% of adopters used fertilizer and urea, 34.1% of adopters used improved seed, and 22.2% of adopters used chemical pesticides. The findings show that the majority of farmers 180(57.1%) were non-adopters of modern agricultural input technology. This indicates that the majority of farmers in the konta zone were doing their agricultural production without the use of modern agricultural input technology.

The result implied that the position of a male and female household headed in the participation was not similar which means the female smallholder farmers were more challenging than male household-headed farmers. The size of farmers had to be positively related to agricultural input technology

adoption such as improved seed variety, chemical fertilizer, and pesticide. The majority of the adopter farmers had greater than one hectare which affect the adoption of agricultural input technology of farmers. There is a positive relationship between the adoption of improved agricultural technology and the number of oxen, the number of livestock, and the distance from the farmer training center. The high price of the input, lack of access to credit, and membership in the cooperative association are considered major problems to the adoption of modern agricultural input technology for smallholders in the study area. Based on the findings, the study recommends that strengthening the promotion of full-scale technology adoption will have a crucial role in improving the livelihood of households in the study area. In doing so, managing the possible determining factors that affect the adoption of improved agricultural technology should be a precondition.

5.2 Conclusion

This study finding was focused on the role of adopting improved agricultural technology in enhancing the income of rural household's in konta zone. Based on the demographic characteristics of the household (sex, age, education level, and family size), asset size of the household (farm size, number of oxen, number of livestock, and off-farm activity), institutional factors (the price of the input, access to credit, access to extension contact, access to information, distance to the nearest market and distance to farmer training center), social-cultural factors(membership in the cooperative association and social group participation) and political factors(top-down pressure, coercive modernization and compulsory purchase of agricultural input) to investigate problems of modern agricultural technology of smallholder farmers.

The result from the binary logit model identified that out of the 19 explanatory variables, seven had shown a significant relationship with the adoption of improved agricultural technologies. Accordingly, land size, number of oxen, number of livestock, and distance of household from farm training center were found to have a positive influence on the adoption level of household heads whereas the high price of improved technology, access to credit, and membership in the cooperative association of household heads was found to have a negative influence on the adoption level smallholder farmers. The study found that smallholder farm households using improved agricultural technologies had a better household income compared to those not using these technologies. Therefore, the adoption of improved

technology has a dual impact on household wellbeing; yield increasing and cost reduction. With this respect, allowing farmers to interact with farming technology not only have a direct impact on the income and expenditure but also has a direct substitution effect on other livelihood aspects. This leads to a conclusion that adopting technology will be one of the basic instruments to enhance the leaving standard of farming community. Technology effect tends to optimized by addressing the possible influencing factors.

5.3 Recommendation

Based on the findings of this study, the following points are recommended to improve farmers' adoption of improved agricultural technologies in the konta zone

- To enhance the agricultural productivity of smallholder farmers, the participation should incorporate both sexes equally. The finding of this study indicates the need to encourage females' household head farmers' level of adoption of modern agricultural input as compared to male participants. Therefore the government and non-governmental organization should give especial focus on empowering female house hold head by giving especial treatment like especial extension service, facilitating especial credit service, and other incentives which is encourage female-headed smallholder farmers to adoption of agricultural technologies in the study area.
- A lot needs to be done to improve the level of adoption since the majority of smallholders were not adopting improved agricultural technology. If better support services for smallholders in the form of technical advice and discussion and listening to their opinions, demand-based implementation, capacity building training to use inputs like fertilizer and other improved technologies, this way can bring a change in the agricultural system. Thus, the extension workers and other concerned bodies in the study area should improve the participation of smallholder farmers, through discussion and listening to their opinions and enable them to develop agriculture by themselves.
- Nearness to farmers training center is significant and positively affects adoption of improved agricultural technologies. This is because farmer who are near to FTC are advantageous to learn from FTC exemplary practices and the extension agent spent more time to visit. Therefore the extension service frequencies of visits should increase for the farmers who are far from FTC,

farmers' training center (FTC) should be strengthening with farm materials and serve to all farmers by demonstrating recommended improved agricultural technologies in the study areas.

- The size of livestock holding had a significant positive impact on the adoption of improved agricultural technology technologies. So, the farmers and zone livestock production office should have played their part in strengthening the existing livestock production system by providing improved health services, using high-yielding breeds, and disseminating artificial insemination in the study areas.
- Number of oxen has a significant and positive influence on the adoption of modern agricultural input technology by smallholder farmers in the study area. Farmers who have a large number of oxen was better adopter of modern agricultural input technology, and those farmers who have no or a small number of oxen was non-adopter of modern agricultural input technology. Different farm operation like tillage, seed coverage, and trashing was done by oxen. Therefore, government, policymakers, and other stakeholders should give special attention to health protection and enhancing the number of oxen to farmers by providing credit services to buy ox and promoting to modern mechanization system in the study area.
- Farm land size is significant at 1% and positively correlated with the probability of adoption of modern agricultural input technology as hypothesized prior. Land is a very important asset for farmers for agricultural production. Therefore governments and stakeholders should emphasize farmers giving awareness and training to increase crop production of small land size farmers by applying the adoption of modern agricultural input technology in the study area.
- The negative influence of access to credit on the adoption decision of modern agricultural technologies call for concerned bodies to strengthen and create loan access for farmers to get the technology along with the credit has a considerable role in the adoption and ultimately for the improvement of livelihood. As a result, policies and strategies should give more emphasis on strengthening credit service to facilitate adoption of improved technologies in the study area.
- The negative influence of member in cooperative association on adopting modern agricultural input call for concerned bodies to give special attention to promoting and strengthening the cooperative union. The promotion of cooperatives for collective action among smallholder farmers would greatly enhance the adoption of improved agricultural technologies. Therefore, it

is necessary to ensure accessibility by removing the malpractice seen in the institution, establishing transparency and accountability, and establishing a transparent system to provide appropriative service. By creating awareness for farmers about the importance and membership fees, easing farmer liquidity constraints through credit provision to poor farmers may greatly increase farmer participation in cooperatives which in turn enhances the participation of smallholder farmers in modern technology input.

- High price of technology has a significant influence against the adoption of improved agricultural technologies. Therefore, the fertilizer subsidy program should be strengthened by effectively targeting smallholder's farmers and promoting increased use of organic manure such as farm yard manure compost and vermi-compost.

Future Study Suggestion

- The study was limited to smallholder farmers in three *kebeles* of konta zone on the role of adopting improved agricultural technologies in enhancing the income of rural households. Therefore, the further study recommended that in the future should look for other *kebeles.*

6 Reference

Abebaw, D., & Haile, M. G. (2013). The impact of cooperatives on agricultural technology adoption: Empirical evidence from Ethiopia. *Food Policy*, *38*, 82–91.

Abebe, Z. D., &Sewnet, M. A. (2014). Adoption of soil conservation practices in North Achefer District, Northwest Ethiopia. Chinese Journal of Population Resources and Environment, 12(3).

Adunea Dinku Dissasa (2017). Factors Affecting Adoption of Row Planting Technology on Wheat Production in Munesa District, Oromia Region, Ethiopia. Journal of Agricultural Extension and Rural Development.11 (2).

Akalu Teshome, Graaff, J. and Menale Kassie (2015). Household-Level determinants of soil and water conservation adoption phases: Evidence of North-Western highlands of Ethiopia. *Journal of Environmental Management,* (2016).

Akudugu, M., Guo, E., Dadzie, S. (2012) Adoption of Modern Agricultural Production Technologies by Farm Households in Ghana: What Factors Influence their Decisions? Journal of Biology, Agriculture and Healthcare 2(3).

AlemayehuKeba. (2019). Adoption of improved maize varieties: the case of Kiremu district, Oromia regional state, Ethiopia, Master thesis submitted to Jimma University.

Alemu, Dawit (2012). The Political Economy of Ethiopian Cereal Seed Systems: State Control, Market Liberalisation and Decentralisation. Future Agricultures Policy Brief 048.

Ali, A., &Abdulai, A. (2010).The adoption of genetically modified cotton and poverty reduction in Pakistan.*Journal of Agricultural Economics*, *61*(1), 175–192.

Amsalu A, De Graaff J (2007). Determinants of adoption and continued use of stone terraces for soil and water conservation in an Ethiopian highland watershed. *Journal of Economics 61:294–302.*

Annan, B. O. (2018).Farming technology adoption by smallholder farmers in Ghana.*Review of Agriculture and Applied Economics*, 2.41-47.

Anne cafér and Sandy Rikoon (2017). Coerced Agricultural Modernization: A Political Ecology Perspective of Agricultural Input Package in South Wollo, Ethiopia. *Journal of Rural Social Sciences, 32(1), 2017, pp. 77–97.*

Asfaw S, Shiferaw B, Simtowe F, Lipper L (2012). Impact of modern agricultural technologies on smallholder welfare: Evidence from Tanzania and Ethiopia. Food Policy 37:283-295

Asfaw, S., Shiferaw, B., Simtowe, F., &Hagos, M.,(2011).Agricultural technology adoption, seed access constraints, and commercialization in Ethiopia.Journal of Development and Agricultural Economics, 3(9), 436–447

Assefa, Yoseph, Johnnie Van Den Berg, and Des E. Conlong (2008). "Farmers' perceptions of sugarcane stem borers and farm management practices in the Amhara region of Ethiopia." *International Journal of Pest Management* 54(3):219–26.

AtnafuAbera(2020).Teachers' participation in decision making in government secondary school of Konta special woreda, South Nation Nationality People Regional State, Master thesis, Jimma University, unpublished

Awotide, B. A., Karimov, A. A. and Diagne, A. (2016) 'Agricultural technology adoption, commercialization and smallholder rice farmers' welfare in rural Nigeria', Agricultural and .Food Economics.Agricultural and Food Economics.

B. Kassa, B. Kassa and K. Aregawi. (2014). Adoption and impacts of agricultural technologies on farm income: evidence from southern Tigray, Ethiopia. International Journal of Food and Agricultural Economics pp. 91-106.

Barrett, C.B., (2008). Smallholder market participation: concepts and evidence from eastern and southern Africa. Food Policy 33, 299–317.

Beegle, K., Christiaensen, L., Dabalen, A., & Gaddis, I. (2016).Poverty in a rising Africa. Washington, DC: The World Bank.

BeneditoCunguaraandIkaDarnhofer (2011).Assessing the impact of improved agricultural technologies on household income in rural Mozambique. Austria Centre for Development Research, University of Natural Resources and Life Sciences, Gregor Mendel Strasse 33, 1180; Vienna, Austria. Food Policy 36 (2011) 378–390

Berhanu, Kassahun and Colin Poulton (2014). The Political Economy of Agricultural Extension Policy in Ethiopia: Economic Growth and Political Control. *Development Policy Review* 32(S2):s197–s213.

Berihun Kassa Hailu,Bihon Kassa Abrha,Kibrom Aregawi Weldegiorgis(2014). Adoption and impact of Agricultural Technologies on Farm Income: Evidence from Southern Tigray,Northern Ethiopia. International Journal of Food and Agricultural Economics ISSN 2147-8988 Vol. 2 No. 4, (2014), pp. 91-106.

Bewket, W. (2007). Soil and Water Conservation Intervention with Conventional Technologies in Northwestern Highlands of Ethiopia: Acceptance and Adoption by Farmers. Land use Policy, 24:404-416.

Bezu, S., Kassie, G. T., Shiferaw, B., & Ricker-Gilbert, J. (2014). Impact of improved maize adoption on welfare of farm households in Malawi: A panel data analysis. *World Development, 59,* 120–131.

Biru, W. D., Zeller, M., & Loos, T. K. (2020). The impact of agricultural technologies on poverty and vulnerability of smallholders in Ethiopia: A panel data analysis. *SocialIndicators Research, 147,* 517–544.

C.R. Kothari (2004) Research methodology: methods and techniques. Jaipur (India): New Age International (P) Ltd., Publishers.

Challa, Merga (2013). Determining Factors and Impacts of Modern Agricultural Technology Adoption in West Wollega, Munich, GRIN Publishing GmbH.

Charlie, P.S. (2012) Agricultural extension: a time for a change.

CIMMYT (International Maize and Wheat Improvement Center), 1993. The Adoption of Agricultural Technology: A Guide for Survey Design Economics Program,Womenin Mexico City, Mexico .

CSA (2013). The Federal Democratic Republic of Ethiopia Central Statistical Agency

Debelo Duressa (2015). Does the adoption of Quncho teff increase farmers' crop income? Evidence from smallholder farmers in Wayu Tuqa district, Oromia Regional State, Ethiopia. *Journal of Economics and Sustainable Development*. ISSN 2222-1700 (Paper), ISSN 2222-2855 (Online). Vol.6, No. 17, 2015.

DegefuKebede, MengistuKetema, NigussieDechassa, FeyisaHundessa (2017). Determinants of adoption of wheat production technology packages by smallholder farmers: Evidence from eastern Ethiopia.Turkish Journal of Agriculture-Food Science and Technology, 5(3): 267-274.

Diao, X. (2010).Economic importance of agriculture for sustainable development and poverty reduction:

Egziabher, Kidanemariam, Erik Mathijs, JozefDeckers, KindeyaGebrehiwot, Hans Bauer, and MietMaertens (2013). The Economic Impact of a New Rural Extension Approach in Northern Ethiopia. University of Leuven: Geo- Institute, Dept. of Earth and Environmental Sciences, Division of Bio economics, working paper 2013/2.

Faltermeier, L., and A. Abdulai. 2006. The adoption of water conservation and intensification technologies and farm income: A propensity score analysis for rice farmers in Northern Ghana. Unpublished.

Gbegeh, D.B., and Akubuilo, J.C.C. (2013).Socio-Economic Determinants of Adoption of Yam Minisett by Farmers in River State in Nigeria.Wudpecker*Journal of Agricultural Research* 2 (1), 33-38.

Gebremedhin, Berhanu, D. Hoekstra, and Azage Tegene (2006.) Commercialization of Ethiopian Agriculture: Extension Service from Input Supplier to Knowledge Broker and Facilitator." Working Paper No. 1, Improving Productivity and Market Success of Ethiopia Farmers Project, International Livestock Research Institute: Nairobi, Kenya.

Gebremedhin, Berhanu, Moti Jaleta, and Dirk Hoekstra (2009). Smallholders, Institutional Services, and Commercial Transformation in Ethiopia. *Agricultural Economics* 40(s1):773–87.

Genius, M., Koundouri, M., Nauges, C, and Tzouvelekas, V. (2010). Information Transmission in Irrigation Technology Adoption and Diffusion: Social Learning, Extension Services, and Spatial Effects.

GishuNigatu. (2018). "Determinants of Adoption of Improved (BH-140). Maize Variety and Management Practice, in the Case of South Ari, Woreda, South Omo Zone, SNNPRS, Ethiopia", International Journal of Research Studies in Biosciences (IJRSB), vol. 6, no. 9, pp. 35-43, 2022. http://dx.doi. org/10.20431/2349-0365.0609004.

Gregory, P. J., Paul, D., &Shahidur, R. (Eds.).(2013). Food and agriculture in Ethiopia—progress and policy challenges.Food Security, 5, 475–476.

Hassen Beshir (2014). Factors affecting the adoption and intensity of use of improved forages in North East Highlands of Ethiopia. *American Journal of ExperimentalAgriculture,* 4(1): 12-27, 2014.

Hailu, B. K., Abrha, B. K., & Weldegiorgis, K. A. (2014). Adoption And Impact Of Agricultural Technologies On Farm Income: Evidence From Southern Tigray, Northern Ethiopia. *International Journal of Foodand Agricultural Economics:* Vol. 2 No. 4.

Jain R. Arora A & Raju S. (2009). A Novel Adoption Index of Selected Agricultural Technologies: Linkages with Infrastructure and Productivity: Agricultural Economics Research Review 22; pp 109-120

Juma, O. M. (2009). Essays on farm technology adoption, Technical Efficiency and productivity in smallholder food crop agriculture in Kenya.

Kariyasa, K., &Dewi, Y. A. (2013).Analysis of factors affecting adoption of integrated crop management farmer field school (icm-FFS) in swampy areas.*International Journal of Food and AgriculturalEconomics*, *1*(2), 29-38.

Kassa, B., Kassa, B., &Aregawi, K. (2014).Adoption and impact of agricultural technologies on farm income: Evidence from southern Tigray, northern Ethiopia. *International Journal of Food and AgriculturalEconomics*, *2*(4), 91–106.

Kassie M, Shiferaw B, Muricho G (2011). Agricultural technology, crop income, and poverty alleviation in Uganda. World Dev 39(10):1784–1795

Kassie, M., Marenya, P., Tessema, Y., Jaleta, M., Zeng, D., Erenstein, O., et al. (2018). Measuring farm and market level economic impacts of improved maize production technologies in Ethiopia: Evidence from panel data. *Journal of Agricultural Economics*, *69*(1), 76–95

Kebede,B., Ewang, P.N., & Okoyo, E.N.(2017).Factors affecting the productivity of smallholder potato growers in Bore District, Guji Zone, Oromia regional state, Ethiopia.

Khonje, M., Manda, J., Alene, A., Kassi, M. (2015.). Analysis of Adoption and Impacts of Improved Maize Varieties in Eastern Zambia. . *World Development,* 66, 695-706.

Lakew Wondimu and Mohammed Edris (2013). Are fertilizers and improved seeds complimentary or substitute in the process of adoption: a case study of northern Ethiopia.Wudpecker journal of agricultural research(Vol.2 (11), pp.286-293.

Lavison, R. (2013).Factors influencing the adoption of organic fertilizers in vegetable production in Accra MSc thesis, Accra Ghana.Journal of service science and management.

Lefort R. (2012). Free market economy, 'developmental state' and party-state hegemony in Ethiopia: The case of the 'model farmers'

Little, Peter, Priscilla Stone, TewodajMogues, Peter Castro, and NegatuWorkneh (2006). Moving in Place: Drought and Poverty Dynamics in South Wollo,Ethiopia.*Journal of Development Studies* 42(2):200–25.

Loevinsohn M, SumbergJ,Diagne A (2012). Under what circumstances and conditions does the adoption of technology result in increased agricultural productivity? Protocol London: 59: EPPI Center, social science research unit, Institute of Education, University of London.

Mahdi Egge, P. Tongdeelert, S. Rangsipaht and S. Tudsri.(2012). Factors affecting the adoption of improved sorghum varieties in the aware district of Somali regional state, Ethiopia.Kasetsart J. (Soc. Sci).33:152 -160.

Manda, J., Alene, A. D., Gardebroek, C., Kassie, M., &Tembo, G. (2016). Adoption and impacts of sustainable agricultural practices on maize yields and incomes: Evidence from rural Zambia. *Journal ofAgricultural Economics, 67*(1), 130–153.

Mekonen T, Karelplein K (2014). Productivity and Household Welfare Impact of Technology Adoption: A Micro-econometric Analysis. United Nation University and Maastricht University.

Mekonnen, T. (2017) Productivity and Household Welfare Impact of Technology Adoption: Micro-Level Evidence from Rural Ethiopia, United Nations University Working Paper 07.

Mendola M. (2007). Agricultural technology adoption and poverty reduction: A propensity-score matching analysis for rural Bangladesh, Elsevier, Food Policy 32,372–393

Miah, M., Afroz, S., Rashid, M. and Shiblee, A., (2015). Factors affecting of Improved Sesame Technologies in some selected areas in Bangladesh: An empirical study, *scientific journal of Krishi foundation*, The Agriculturalists 13(1): 140-151 (2015), ISSN 2304-7321

Mignouna, B., Manyong, M., Rusike, J., Mutabazi, S., &Senkondo, M. (2011). Determinants of Adopting Imazapyr-Resistant Maize Technology and its Impact on Household Income in Western Kenya: AgBioforum, 14(3), 158-163.

Miruts Fitsum (2016). "Analysis of the Factors Affecting Adoption of Soybean Production Technology in Pawe District, Metekele Zone of Benshangul Gumuz Regional State, Ethiopia." World Scientific News **53**(3): 122-137.

MoFED (Ministry of Finance and Economic Development). 2016: *Rural development policy and Strategies.* Economic Policy and Planning Department. Addis Ababa, Ethiopia

Morris, M. L. (2007). Fertilizer use in African agriculture: Lessons learned and good practice guidelines. World Bank Working Paper Series.

Moyo, S., Norton, G.W., Alwang, J., Rhinehart, I., & Demo, M.C. (2007). Peanut research and poverty reduction: Impacts of variety improvement to control peanut viruses in Uganda. American Journal of Agricultural Economics 89 (2), pp, 448–60.

MulugetaAlemitu (2011). Factors affecting adoption of improved Haricot bean varieties and associated agronomic practices in *Dale woreda, SNNPRS* (Doctoral dissertation, Hawassa University).

Natnael A B.(2019). Impact of Technology Adoption on Agricultural Productivity and Income: A case study of Improved *Teff*Variety Adoption in North-Eastern Ethiopia. Agri Res& Tech: Open Access J. 2019; 20(4): 556139. DOI: 10.19080/ARTOAJ.2019.20.556139

Negash, M. (2011).Analyzing the determinants of farmers' preference for adoption strategies for climate change Evidence from north shoa zone master thesis, Addis Ababa University.

Negera Eba and Getachew Bashargo (2014). Factors affecting adoption of chemical fertilizer by smallholder farmers in Guto Gida Distirict, Ethiopia. *Science, Technology andArts Research Journal,* April-June 2014, 3(2): 237-244.

Nguezet, P.M, Diagne A, Okoruwa V.O, Ojohomon V, 2011. Impact of improved rice technology on income and poverty among rice farming households in Nigeria; contributed paper prepared for the 25th conference of the Centre for the Studies of African Economies (CSAE).

Nina de Roo(2020). The socio-political dimensions of agricultural technology promotion in Ethiopia: PhD thesis, Wageningen University, Wageningen, the Netherlands.

Norton RD (2004). Agricultural development policies: concepts and experiences

Obayelu A, Ajayi O, Oluwalana E, and Ogunmola O.(2017). What Does Literature Say About the Determinants of Adoption of Agricultural Technologies by Smallholders Farmers? *Agriculture Research and Technology: Open Access Journal*, 6(1), 555676. DOI: 10.19080/ARTOAJ.2017.06.555676.

Ogeto, R.M., Mshenga, P., Cheruiyot, E., & Onyari, C.N. (2012). Influence of institutional factors on sorghum production in Nakuru County, Kenya. *Journal of Agricultural Economics and Development*, 1(16), 130-137,

Pankaj, R.D. and Narayan, R.J.,(2016).Factors Affecting Adoption of Recommended Cauliflower Production Technology in Nepal. *Turkish Journal of Agriculture - Food Science and* Technology, 4(5), 378-383.

Planel, Sabine (2014). A View of a Bureaucratic Developmental State: Local Governance and Agricultural Extension in Rural Ethiopia. *Journal of EasternAfrican Studies* 8(3):420–37.

Rogers, E.M. (1995). Diffusion of Innovations.4th edition. Free Press, New York.

Sanchez, P.A., G.L. Denning, and G. Nziguheba. 2009. The African green revolution moves forward. Food Security 1: 37–44.

Sezgin, A., Kaya, T., Kulekci, M. and Kumbasaroglu, H. (2011). Factors affecting the adoption of Agricultural innovations in Erzurum Province, Turkey. *African Journal of Business Management*, Vol. 5(3), pp. 777-782, Feb., 2011. ISSN 1993-8233.

Shiferaw B, Kassie M, Jaleta M, Yirga C (2014). Adoption of improved wheat varieties and impacts on household food security in Ethiopia. Food Policy 44:272-284. Elsevier Ltd.

Shita, A., Kumar, N., & Singh, S.(2018). Agricultural technology adoption and its determinants in Ethiopia: A reviewed paper. *Asia Pacific Journal of Research, 1*(55), 99–104

Shita, A., Kumar, N., and Singh, S. (2020). 'The impact of agricultural technology adoption on income inequality: a propensity scores matching analysis for rural Ethiopia', Int. J. Information and Decision Sciences, Vol. 12, No. 1, pp.102–114.

Sisay Debebe (2016). Agricultural technology adoption, crop diversification and efficiency of maize-dominated smallholder farming system in Jimma Zone, South-Western Ethiopia. PhD Dissertation, Haramaya University, Ethiopia.

Solomon Y, Endrias O. (2018). Participatory Demonstration of Maize (Zea Mays L.)Variety with its Full Packages in South Ethiopia.Adv Crop Sci Tech 6: 342.

Spielman D.J.,Kelemwork D., Alemu D.(2012). Seed, fertilizer, and agricultural extension inEthiopia.

Teklewold, H., Kassie, M., Shiferaw, B., &Köhlin, G. (2013). Cropping system diversification, conservation tillage and modern seed adoption in Ethiopia: Impacts on household income, agrochemical use and demand for labor. *Ecological Economics*, *93*, 85–93.

Tesfaye, S., Bedada, B., &Mesay, Y. (2016).Impact of improved wheat technology adoption on productivity and income in Ethiopia. African Crop Science Journal, 24(1), 127–135.

Tigist, p. (2010).Adoption of conservation tillage technologies in metemaWereda, North Gonder zone, Ethiopia master thesis, Haramaya University.

Tsegaye mulugeta habtewolde(2020).Impacts of Improved Agricultural Technologies Adoption on Multidimensional Welfare Indicators in Rural Ethiopia: A Dissertation Submitted to The Department of Economics Presented in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in Economics Addis Ababa University Addis Ababa, Ethiopia Addis Ababa University School of Graduate Studies Approval Sheet.

Tsegaye mulugeta (2012).Impacts of Adoption of Improved Wheat Technologies on Households' Food Consumption in Southeastern Ethiopia. Selected Poster prepared for presentation at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguaçu, Brazil, 18-24 August 2012.

Tsibuk Berhe (2015). Factors Affecting Adoption of Quncho Teff Variety: The Case of Medebayzana Woreda, North-Western Administrative Zone of Tigray Region, Ethiopia. M.Sc. Thesis, Haramaya University, Haramaya, Ethiopia.

Toborn, J. (2011). Adoption of agricultural innovations, converging narratives, and the role of Swedish agricultural research for development. Discussion, paper version 2011-01-28)

Wake, R. D., &Habteyesus, D. G. (2019).Impact of high-yielding wheat varieties adoption on farm income of smallholder farmers in Ethiopia.*International Journal of Agricultural Extension*, *07*(01), 45–59

Wooldridge, J., M. (2009).*Introduction to Econometrics*: A Modern Approach. 4th edition. Mason, Ohio. South Western Educational Publishing

Wordofa, M. G., &Sassi, M. (2017). Impact of farmers' training centers on household income: Evidence from propensity score matching in Eastern Ethiopia. Social Sciences, 7(1), 1–12.

Wordofa Muluken *G.*,Jemal Y. Hassen, Getachew S. Endris, Chanyalew S. Aweke, Dereje K. Mogesand Debbebe T. Rorisa(2021).Impact of Improved Agricultural Technology Use on Household Income in Eastern Ethiopia: Empirical Evidence from a Propensity Score Matching Estimation. Journal of Land and Rural Studies 9(2) 276–290, 2021.

Workineh Ayenew,TayechLakew, and Ehite Haile Kristos(2019). Agricultural technology adoption and its impact on smallholder farmer's welfare in Ethiopia.African Journal of Agricultural Research.Vol. 15(3), pp. 431-445.

World Bank. (2015). Ethiopia poverty assessment: Poverty global practice—Africa region. Document of the World Bank. Report No. AUs6744.

Wossen, T.; Abdoulaye, T.; Alene, A.; Feleke, S.; Ricker-Gilbert, J.; Manyong, V.; Awotide, B.A(2017). Productivity and Welfare Effects of Nigeria's e-Voucher-Based Input Subsidy Program. World Dev. 2017, 97, 251–265.

Yemane. (1967). Statistics Tools and sample size determination: Determining Sample size determination for the population.

Yigezu A. Yigezu, Chilot Yirga and Aden Aw-Hassan (2015). Modeling farmers' adoption decisions of multiple crop technologies: The case of barley and potatoes in Ethiopia. *International Conference of Agricultural Economists*, August 8-14, 29th Milan, Italy.

Yu, B., Nin-Pratt, A., Funes, J., and Asrat, S. (2010). Cereal Production and Technology in Ethiopia.Discussion Paper 12. Washington, D.C. International Food Policy Research Institute.

Zeng, D., Jeffrey Alwang, G. W., Norton, B. S., Jaleta, M., &Yirga, C. (2017).Agricultural technology adoption and child nutrition enhancement: Improved maize varieties in rural Ethiopia. *Agricultural Economics*, *48*(5), 573–586.

Household questionnaires

Jimma University

College of Social Science and Humanities

Department of Geography and Environmental Studies

MA. In urban and regional development planning questioner

Dear respondents:

The objective of this questionnaire is to assess the role of adopting improved agricultural technology in enhancing rural households' income in **Bakeferda, Cheta** and **Konta Koysha** kebele in Konta Zone. Your information is critically important for this research output as well as the future sustainable use of inputs in the study area. Any kind of information you provide in this interview will be kept confidential and will be used for research purposes. Hence, considering the above objective, you are kindly requested to provide appropriate answers to the following questions. I highly appreciate in advance your kind cooperation in providing the necessary information.

Sincerely, your

Adamu wondimu

Instructions

- ✓ No need of writing your name
- ✓ For multiple-choice questions indicate your answers by ticking the letter of your choice, and
- ✓ For open-ended questions write your answer briefly on the given blank space
- ✓ Dear enumerators please **(✓)** Put this mark on the empty box for close-ended questions.

Part one: Demographic characteristics of household

This part of the questionnaire should be given to the household head. If the head is absent for three days, the questionnaire should be transferred to the next oldest members of the family.

1.1 Age of household head----------

1.2. Sex of household head 1.male ☐ 0.female ☐

1.3. Education level of household head ----------

1=can't read and write (illiterate) ☐ 2= literate (can read and write) ☐ 3. Primary school (1-8) ☐ 4.secondary school (9-12) ☐ other levels, specify----------

1.4. Marital status: 1. Married ☐ 2. Unmarried ☐ 3.Divorced ☐ 4. Widowed ☐

1.5. Family size in the ranges of age-M----------F----------Total----------

Part 2. Adoption of modern agricultural technologies

2.1. Have you adopted any improved agricultural technologies? 1. Yes ☐ 0.No ☐

2.2. If your answer to question number 2.1 is **yes**, which improved agricultural technologies have you adopted? (Multiple answers are allowed)

1. Fertilizer and Urea ☐ 2 Pesticides. ☐ 3. Full package (fertilizer, urea and improved seed) ☐ 4.crop rotation ☐ 5.Any other, specify.....

2.3. If yes for the above question **2.1** how much land size is under the adopted agricultural technologies on your farm?

1. For all land under cultivation ☐ 2. More than half (0.5 ha) of under cultivation ☐
3. Less than half hectares (0.5 ha) ☐ 4. Not determined ☐

2.4. If **Yes** in your own opinion what are the benefits of adopting any improved agricultural technologies that you have adopted on your farm? (Multiple answers allowed)

1. Increased output yields ☐ 2.Increased Agricultural income ☐ 3.Improved life ☐
4.saved more money ☐ 5.No change or constant ☐ 6.any other specify_____

2.5 In your opinion, what was the status of agricultural input used by farmers through years?

1. Increasing ☐ 2.decresing ☐ 3.constant ☐ 4.can't determined ☐

2.6. Issues on the role of enhancing income analysis

1. What is your total farm income on annual basis (please put your response in terms on Birr)

No	Household annual income base in 2012/2013	Annual income in birr
1.	Crop sale	
2.	Sales of fruit & vegetable	
3.	Livestock sale	
4.	Livestock products (e.g. butter or milk)	
5.	Off-farm activity (business other than agriculture)	
6.	Rental income	
7.	Other (please specify)	

2. What was your total farming and consumption expenditures on annual basis (please put the expenditure in terms of Birr)

No	Household annual consumption expenditure base 2012/13	Annual expenditure in birr
1.	Consumption expenditure (Expenditure for food, cloth, other...)	
2.	Labor (any labor cost-related farming activity).	
3.	Purchase of farm tools	
4.	Purchase of fertilizer	
5.	Purchase of seeds	
6.	Purchase of chemicals inputs	
7.	Rent of farm machinery	
8.	Other expenses---------	

3. If you **are adopters of improved agricultural technologies**, how much you produced from a hectare of cultivated land (4 Timid/0.5ha cultivated land).

No-	Improved agricultural input technology	With inputs in			
		2012		2013	
		Yield (quintal)	Income (Birr)	Yield (quintal)	Income (Birr)
1.	Maize				
2.	Barely				
3.	Wheat				
4.	Boloqe				
5.	Beans				
6.	Teff				

7.	Peas				
8.	Sorghum				
9.	Other specify----------				

4. If you are **not adopters of improved agricultural technologies** (improved seed, fertilizer, inoculants, chemicals...) how much have you produced from a hectare of cultivated land (4 Timid/0.5ha cultivated land).

No-	Agricultural activities	Without inputs in			
		2012 Ec.		2013 Ec.	
		Yield (qt)	Income (Birr)	Yield (qt)	Income (Birr)
1.	Maize				
2.	Barley				
3.	Wheat				
4.	Boloke				
5.	Beans				
6.	Teff				
7.	Peas				
8.	Sorghum				
9.	Other specify---				

5. Please fill the level of production that can be earned through using improved agricultural inputs and the level of income earned in 2012/2013 as requested here below:

No-	Type of crop	Plot size in hectare (Timad)	Total production/annum	Consumption (Qt)/annum	Sold	
					Quantity	Birr
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						

Part Three: - Factors affecting Adoption of Improved Agricultural Technologies

3.1 Economic factors

1. Asset size of households

1.1 farm land size----------hectare

1.2. Number of oxen----------

1.3 livestock

1. Did you have livestock? 1. Yes ☐ 0. No ☐

2. If for (Q1.3) is **yes**, indicate the number of livestock owned: ----------

1.4. Off/ non-farm participation

2.1 Did you have an off-farm /non-farm income source? 1. Yes ☐ 0. No ☐

2.2 If your answer for (Q1.4) is **yes**, specify the kinds of activities? (Ticking multiple answers is allowed)

1. Trading ☐ 2. Laborer ☐ 3.handicraft ☐ 4.Selling of firewood ☐

5. Others, specify ----------

3.2 Institutional factors

1. Extension services

1.1. Did you get an advisory or guidance service from an extension agent? 1. Yes ☐ 0.No ☐

1.2. If your response to Q1.1 is **yes**, how many times have extension agents visited you?

1. Once in three month ☐ 2.Monthly ☐ 3.Weekly ☐ 4.Twice-weekly ☐ 5.no extension agent assigned ☐

1.3. During which farm operation extension agent visit you?

1 During input provision ☐ 2.During sowing ☐ 3.During herbicide application ☐

4. during credit collection ☐ 5.During input provision, sowing and herbicide application ☐

6. During yield collection ☐ 7.Other, specify----------

1.4. If your response to Q1.1 is **No,** what is the major reason? ----------

1. 5. How do you evaluate your extension agent's role in the adoption of improved agricultural technology?

1. High ☐ 2. Medium ☐ 2. Low ☐

1.6. If your answer is low could you mention the major constraints? ----------

2. Input price

1. Do you think that the price that you pay for any agricultural technologies is affordable?

1. Yes ☐ 0.No ☐

2. If your answer for Q1 is **No,** what do you think is the reason?

1. High price of the agricultural input ☐

2. Lack of capital/ financial resources to buy them ☐ 3.lack of supply 4. Others specify……..

3. Access to credit

2.1. Did you get access to credit? 1. Yes ☐ 0. No ☐

2.2. Which source do you obtain credit from? (Multiple answers is possible)

1. Microfinance ☐ 2.NGO ☐ 3.coopratives ☐ 4. Privet lenders ☐ 5.other, specify------
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2.3. What kinds of credit did you obtain? Multiple answers are possible

1. Cash ☐ 2.seed ☐ 3.fertilizers ☐. 4. Pesticides ☐ 4. All ☐

2.4. What is the reason you take credit? Multiple answers are possible

1. To purchase fertilizer ☐ 2.To purchase improved seed ☐

3. To purchases chemical pesticide ☐ 4.other, specify----------

2.5. If your response to question number 3.1 is **No,** what is the major reason? ----------

4. Access to information

4.1. Have you ever heard about improved agricultural technologies? 1. Yes ☐ 0.No ☐

4.2 If you say **yes** for Q4.1, where or from whom did you obtain information about agricultural input accesses and use?

1. from extension ☐ 2.From mass media (radio, magazine, Newspaper) ☐
3. from relatives, friends, or neighbors ☐
4. From others sources, specify……

4.3. If you say **No** for (Q4.1), what are the barriers to effective communication on improved agricultural technologies?

1. Poor extension services ☐ 2.Unaccessible electronic media ☐

3. Less social networks ☐ 4.can.t be determined ☐ 5.specify, if others……..

5. Distance from household head residence to the nearest market center is in the range--------- km

6. Distance from household residence to farming training center (FTC) ----------km

3.3. Socio-cultural factors

1. Participation in social group

1.1. Do you participate in a social groups? 1. Yes ☐ 0. No ☐

1.2. If you say Yes for Q 1.1, in which social group does you participate? Multiple answers is possible

1. Equb ☐ 2 Edir ☐ 3. Debo ☐ 4.Equb, Idir and Debo ☐ 5.others specify----------

2. Cooperative association

3.1. Are you a member of in cooperative association?? 1. Yes ☐ 0. No ☐

3.2. If you say **yes, for Q 3.1,** what benefit do you obtain from a cooperative association? Multiple answers is possible

1. Improved seed, ☐ 2. Pesticide ☐ 3 fertilizers ☐ 4. Others specify……..

3.4. Political factors

1. In your opinion, do you think there is a top-down pressure to implement an improved agricultural technology plan? 1. Yes ☐ 0. No ☐

2. If you say **yes for Q1**, what is the reason?

1. to implement targeted quota ☐ 2. To carry out government strategies ☐ 3. To increase production and productivity ☐ 4.if others, specify…….

3. If you say **yes for Q1**, whom does it focus on?

1. Leaders ☐ 2.rich and vast agricultural land ☐ 3.poor ☐ 4.model farmer ☐ 5.leader, rich and vast agricultural land ☐ 6. If others, specify……...

4. If you say **No** for Q1, mention the process by which the plan goes down?----------
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5. Is there any coercively promotions that you would like to use to keep you updated using new and improved agricultural technology during your farming career**?**

1. Yes ☐ 0. No ☐

6. If you say **yes** for Q5, what you advantaged from participation? Multiple answers is possible.

1. Better understanding of technology ☐ 2. Increased production and productivity ☐
3. No change ☐ 4. Not determine ☐ 5. If others, specify…….

7. If you say **yes** for Q5, what are the reasons for coercive promotion of improved agricultural technologies**??**? Multiple answers is possible.

1. To carry out government strategies ☐ 2. To increase production and productivity ☐

3. To improve on-farm performance ☐ 4.To increase purchases of agricultural inputs ☐ 5. The resistance of farmer to adopt improved agricultural inputs ☐

6. If others, specify----------

8. If you say **No** for Q1, what are the reasons**??**?----------
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9. Have you ever been purchased improved agricultural inputs compulsory?

1. Yes ☐ 0. No ☐

10. If you say **yes to Q9,** what do you do with the improved agricultural technology which you have compulsory purchased? Multiple answers is possible

1. It sows ☐ 2. It not be sown but put for next year ☐

3. Even though it sow, it is not cared for ☐ 4. Sell to merchants at a lower price ☐

5. If others specify……

11. If you say **yes for Q9**, what is the effects to being compulsory to purchase improved agricultural technologies? Multiple answers is possible

1. Distorted perception of technologies ☐ 2. Improved on-farm performance ☐

3. Paid and kept from going out from the store ☐ 4. Made to sell livestock ☐

5. Made a debtor of micro finance ☐ 6. Distorted perception of technologies, Paid and kept from going out from the store, made to sell livestock and Made a debtor of micro finance ☐

6. If others specify_____

12. If you say Q9 is **No,** how do you adopt improved agricultural technologies?? Multiple answers is possible

1. Based on demand ☐ 2. Based on expert advices ☐ 3.-Field visiting and experience sharing ☐ 4.If others specify_____

13. Mention the effect, if you do not compulsory purchase an improved agricultural technology--

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Part 3. Interview Questionnaire

Interview Guidelines

Name of the office _____

Your responsibility in office_____

This interview guideline is prepared to direct the interviews to be conducted with office experts, DA, and local administrators or responsible bodies.

1. What is the current performance of adopting improved agricultural technologies by smallholder farmers in all seasons in konta zone?

2. How do you evaluate the extension agent's role?

3. How do you describe smallholder farmers and their access to credit?

4. How do you describe the provision of improved seed, fertilizer, and pesticides to smallholder farmers?

5. How do you evaluate the outcome of the adoption of improved agricultural technologies and their productivity between someone who adopts and who don't adopt technologies?

6. What do you think are the major determining factors affecting the adoption of Agricultural technology among smallholder farmers? Regarding economic, political, and social?

7. What do you think can be done to improve the adoption of technology among smallholder farmers in the study area?

Part 5. Focus Group Discussion

Focus Group Discussion Guidelines

Name of the kebele _____

Participants responsibility----------

This focus group discussion is prepared for the direct discussion with women, elder, and younger households in each kebele.

1. What is the current performance of adopting improved agricultural technologies by smallholder farmers in all seasons in konta zone?
2. Do you observe there is a difference between products someone who adopt technology and who don't adopt it?
3. How do you evaluate the extension agent's role?
4. How does the rural household adopt improved agricultural technology?
5. How do you describe the provision of improved seed, fertilizer, and pesticides to smallholder farmers?
6. What do you think are the major determining factors affecting the adoption of Agricultural technology among smallholder farmers?
7. What do you think can be done to improve the adoption of technology among smallholder farmers in the study area?

Conclusion: ***Thank you for your time and I hope your responses to the questions will contribute a lot to my research work.***

Thank You!!!!!!