ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

FACTORS AFFECTING SMALLHOLDER FARMERS' ACCESS TO AGRICULTURAL EXTENSION SERVICES: THE CASE OF SODO ZURIA WOREDA, WOLAYTA ZONE, SOUTHERN ETHIOPIA

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JUNE, 2022

ADDIS ABABA,

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(GSR/6362/11)

THESIS SUBMITTED TO THE DEPARTMENT OF ECONOMICS, COLLEGE OF BUSINESS AND ECONOMICS,SCHOOL OF COMMERCE, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE IN DEVELOPMENT ECONOMICS

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APPROVAL

I hereby approve that the preparation and presentation of the thesis were supervised by the guidelines on supervision of thesis laid down by the University for Development Economics. I have read and evaluated the thesis prepared by TESFAYE TADESSIE, and I recommended that it be submitted as fulfilling the thesis requirement for the degree of Master of Science in development economics.

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TITLE: FACTORS AFFECTING SMALLHOLDER FARMERS' ACCESS TO AGRICULTURAL EXTENSION SERVICES: THE CASE OF SODO ZURIA WOREDA, WOLAYTA ZONE, SOUTHERN ETHIOPIA

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DECLARATION

I declare that this thesis that titled "FACTORS AFFECTING SMALLHOLDER FARMERS' ACCESS TO AGRICULTURAL EXTENSION SERVICES: THE CASE OF SODO ZURIA WOREDA" studyis the result of my own original workprepared under the guidance of my advisor Branu Denu (Ph.D). This thesis has been submitted in partial fulfillment of the requirement for the award of M.Sc. degree in development economicsand it has not beensubmitted before toany other university in Ethiopia, and that all source of materials used for the study have been properly acknowledge.

DECLARED BY STUDENT: **CONFIRMED BY ADVISOR:**

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Abstract

The study examined the factors affecting smallholder farmers' access to extension services, in the case of soddo zuriaworeda, wolaita zone in the southern part of Ethiopia. A multi-stage sampling technique was employed and 100 sample households were selected by using a formula for sample size determination.Both quantitative and qualitative data types were collected fromprimary and secondary sources. The data surveywerecollected usinghouseholds survey, key informant interview, focus group discussion,structured questionnaire, and checklists. The analysis was employed usingboth descriptive statistics and binary logit model.The resuls were presented in the form of tables and graphs through frequencies, percent, mean and standard deviation as well as statistical tests such as chi-square,. The result showed that out of 100 sample farm household heads, 28 do not access agricultural extension services due to weak links between farm households and agricultural extension agents, lack of effective coordination and communication between those farmers and concerned institutions i.e., agricultural extension, credit institution and other local administration.On the other hand, lack of agricultural input; (oxen holed, fertilizer and improved seed, ..), the limited size of farmland, illiteracy, lack of knowledge to use information technology,and distance to extension center are the major reasons (challenges) that made sample households' unable to access agricultural extension package. The regression model result revealed that the size of farmland, dependency ratio, the annual non-farm income of the household, access to credit, number of oxen, livestock owned, experience to use fertilizer, soil characteristics, price of farm input and household willingness to access extension service were found to significantly determine the smallholder farmers access to extension service at different significance levels with the expected sign. The result also revealed that the size of farm and grazing land, number of oxen, soil fertility, and experience in using fertilizer found a strong and positive effect on access to extension services. Thus, based on the above results it is possible to conclude that small farm households' access to agricultural extension services is not effective to result in an efficient agricultural productivity in the study area. Therefore, policy measures that could avert the above challenges are recommended to include measures like empowering and strengthening smallholder farmers' training, awareness,prizes for the successful ones, and field visitwith practical training (demonstration), delivering and facilitating basic agricultural inputs through agricultural extension services.

Keywords:*small hold farmers' agricultural extension service, binary logistic model.*

Acknowledgments

At first, all the honor and glory be extended to the exalted heavenly Almighty God, for his endless mercy, help, and love to me which is enabling me to complete my work difficulties. I would like to express my deepest and ultimate gratitude must go to my advisor Dr.Brehanu Denu for all his patience, for the time sacrificed in proofreading and bringing the necessary corrections, constructive comments and suggestions, as well as for his tolerance for my delay, problems, not being suffering and annoyed on my lateness (overdue). Without his advice, direction, and support, this work would have not been possible. I would also like to extend my deep gratitude with respect to the economics department coordinator for their invaluable contributions, discourse, and providing me an opportunity and for giving me a lot of the necessary support and fine-tuning for the success of this study.

Finally but most importantly, I would like to thank wolayta zone; soddo zuria district ARDB, and other woreda government and nongovernment institutions for their unreserved information and voluntary to give relevant data.

I want to thank my friends and families for the support and moral encouragement until to finish this work. Last, but not the least my special gratitude goes to all my classmates and lecturers who have given me supportduring the research. I would not have completed my research without the support of all these wonderful people.

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LIST OF ACRONYMS

ADLI	Agricultural development led industrialization
AES	Agricultural extension service
CAADP	Comprehensive Africa Agricultural Development Program
CSA	Central Statistics Agency
EEA	Ethiopian Economics Association
FAO	Food and Agricultural Organization
FDRE	Federal Democratic Republic of Ethiopia
FFD	Farmer Field Days
GDP	Gross Domestic Product
GoE	Government of Ethiopia
ICT	Information and Communication Technology
IPM	Integrated Pest Management
LDCs	Least Developing Countries
MoFA	Ministry of Food and Agriculture
MoFED	Ministry of Finance and Economic Development
NEPAD	New Partnership for Africa's Development
NIEO	New International Economic Order
NGO	Non-Governmental Organization
PADETES	Participatory Demonstration and Training Extension System
RCT	Randomized Control Trial
SDGs	SustainableDevelopmentGoals
SPFS	Special Program for Food Security
TFP	Total Factor Product
UNDP	United of Nation Development Program
USDA	United States Department of Agriculture ,
WB	World Bank

CHAPTER ONE

INTRODUCTION

Agriculture is the means of living for the Ethiopian people as a whole, and the agricultural sector is dominated mainly by the smallholder farming system. Agriculture, in general, and smallholder agriculture, in particular, contribute a significant role to poverty reduction and ensuring food security in Ethiopia, but agricultural productivity in Ethiopia including study area very low, even declining due to smallholder farming were subsistence and backwardness of the farming system.

This chapter is an introductory part of the thesis and it discusses about the background, problem of statement, research questions, and objectives of the study, the significance of the study, scope and limitation of the research.

1.1. Background of the study

The agricultural sector plays an important and vital role in different aspects of the country‘s socio-economic development of its people. Growth in the agriculture sector is two to four times more effective in raising incomes among the poorest compared to other sectors. The share of agricultural productivity in developing countries accounts for 60 – 80% of their total population, (FAO, 2016; Negatu et al., 2016).

Agriculture is also crucial to economic growthwhich accounted for 4 percent of global gross domestic product (GDP) and in developing countries, it accounts for more than 25% of GDP in 2018. Agriculture, in general, and smallholder agriculture in particular, has multiple goals. In Ethiopia, agriculture accounts for over 40% (38% recently) of GDP, out of which 95% of the production comes from smallholder farmers, and 80% of export (MoARD, 2010; Zerihun, et al, 2016).Itis also the means of survival and livelihood for the majority of the people in Ethiopia. But agriculture-driven growth, poverty reduction, and food security are at risk, especially in the world’s most food-unsecured nations (World Bank, 2020). Agriculture in Ethiopia is characterized by low technology, low productivity and output, heavy reliance on nature, and, hence, subject to natural calamities such as drought and famine. As a result, the majority of the rural population is vulnerable to a persistent and frequent food insecurity threats. Indeed, poverty

is pervasive, deep, and persistent. Despite huge efforts to disseminate technologies (mainly fertilizer and to some extent, improved seeds) to smallholders, also, the majority (76.1%) of these smallholder farmers live in rural areas and depend either directly or indirectly on agriculture (Abdul-Hanan, 2016).

There are 1.4 billion poor people living on less than US$1.25 a day. One billion of them live in rural areas where agriculture is their main source of livelihood. Many of the productivity gains accrued to smallholder farmers, supported through research and extension services. Approximately 2.5 billion people live directly from agricultural production systems, either as full- or part-time farmers (FAO, 2008a). Smallholders provide over 80 percent of the food consumed in a large part of the developing world, contributing significantly to poverty reduction and food security. Increasing fragmentation of landholdings, coupled with reduced investment support and marginalization of small farms in economic and development policy, threaten this contribution, leaving many smallholders vulnerable (IFAD, 2013). According to IFAD, the productivity of smallholder agriculture and its contribution to the economy, food security, and poverty reduction depend on the services provided by well-functioning ecosystems.

Smallholder farmers comprise the majority of the world's undernourished population and most of those living in absolute poverty (UN Millennium Project, 2005a; IFAD, 2011a).Also, smallholder family farming agriculture remains to be the key and leading sector in the overall economic development of many developing countries in the world (Quan, 2011). According to Quan (2011), the majority of these farmers are engaged in Crop production.In addition to producing staple crops for domestic markets; smallholder farmers produce large shares of traditional exports in these countries (CIA Factsheet, 2016).

The difficulties in increasing production for these farmers in Ethiopia include low access to new agricultural technologies, traditional methods of cultivation, and low institutional support are identified as factors that keep smallholder production at subsistence level in the country rather than unproductive soil and limited farmland, plant diseases, pests, drought, environmental degradation, and rapid population growth (MoFED, 2012). Generally in Ethiopia, particularly in the study area,smallhold farmers' lack of access to improved seeds or fertilizers and pesticides further adds to their hardships.In addition, lack of reliable markets and little available pricing of

agricultural input/output/ information. Those households were significantly smaller than 1hectares of farmland.

Smallholders may become even more isolated from the economic environment, instead of being part of the solution and driving the growth process. Moreover, Smallholder farmers may face high risks and multiple challenges in the study area as well as in Ethiopia while lacking the skills, technologies, and financial services to produce a marketable surplus—or to supply more quality and quantity output. These challenges that require tailored solutions of agricultural extension service packages.

Among the many institutional support services that need to catalyze the transformation process, the agricultural extension service plays a crucial role, since it contributes to the development of the skill and knowledge of farmers to adopt new and improved technologies (seed varieties and animal breeds, implements, chemicals, and practices), and the approaches and processes with which the skill development and access to information are realized.

1.2. Statement of the problem

Ethiopia has struggled for many years to respond to the challenges of food insecurity and rural poverty arising from many adverse factors (FDRE, 2010). Household food security largely depends on external factors including rainfall patterns, land degradation, climate change, population density, low levels of rural investment and the global market (WFP/FAO, 2011).

As stated by International Food Policy Research Institute; 2018, for inefficient productivitycaused wereinadequate and unreliable rainfall, soil degradation, civil war and ethnic conflicts, poor transport, and infrastructure in the rural areas, misguided economic policies such as land tenure, geographical diversity, rapid population growth, outdated production technology and small landholding of small household farmers, lack of storage, disease, inadequate nutritional knowledge, heavy workloads for women, etc. Getachew Deriba (2020) his policy working paper also pointed outthat, the traditional factors of production, land, labor and capital, lack of the knowledge system makes real difference between the rich and poor; however, knowledge, scientific invention, technology, and innovationhas made peasants highly vulnerable to famine and food insecurity Adugna and Wegayehu (2012); Bereket (2010). This can be substantiated by the UN release which indicated the proportion of the Ethiopian population

living below a poverty line of 1USD a day was 50% of the total population(FAO, 2010); and recently stated by Tkue Hayate Sied (2018). As this results, themajority of smallholder farmers facing severe and chronic food insecurity, unable to invest in agricultural inputs (chemical fertilizer, improved seeds), or withstand seasonal risks of crop failure or animal deaths. They face continuous poverty, hopelessness, and finallyalways lives under poverty level (lessthan $1/day).

According to Mengstu Mersa (2020) studies indicated that major agricultural development in wolayta zone, soddo zuria district is characterized by a subsistence farming system using backward traditional farm tools and farming practices, with low productivity that is unable to produce a sufficient amount of food for the local livelihoods, rapidly growing population. As he stated that, a various factors can be cited for the slow growth of agriculture such as the trend of the conventional farming system as a result of poor extension service coupled with climatic change, reduced soil fertility, recurrent and prolonged drought periods, weak agricultural researchbase, inadequate financial service, poor infrastructure and market service, environmental degradation (population growth, deforestation, pollution, depletion of ozone layer, destruction of biodiversity, decline of water resources, inappropriate chemical utilization), and fragmentation of landholdings. Furthermore, the lack of improved technologies, non-participatory training systems had been contributed to the slow growth of agriculture and inefficient agricultural productivity.

As studies of (Alimaz Balta; Ayele Tessema and Debebe H/Wold, 2015) highlighted generally on assess to household food security situation and coping strategy in Sodo Zuria District, but not studied detail how to coping strategy and associated factory in their studies.

Many studies have also demonstrated the existence of a strong relationship between extension services and food security among households in different country in different time. For example, Evenson and Mwabu(1998), found a positive and significant relationship between farm productivity and agricultural extension services. However, According to Lipton et al.(2004); cited in Haile (2008) and Tizita Damtew (2017), state that irrigated agriculture can reduce poverty through increased production and income, and reduction of food prices.

To eradicate the deep-rooted poverty at the household level, the Government of Ethiopia (GoE) has also introduced and begun implementation of policies to minimize risk through full or supplementary irrigation(MoFED,2010; tizitadamtew,2017). But the problem is not only

increamenting use of irrigation while multi-directional problem, even to use irrigation, but it's also unachievable without strong agricultural extension support. However, smallholder farmers' often struggle even to produce enough for their own consumption, and such a shift could be one threat to smallholder farmers, especially those living in this research conducted areas (wolayta zone, particularly in sodo zuria rural woreda).The Wolaita zone represents one of the major food deficit and famine-prone parts of Ethiopia. (Ayele Tessema, 2008). Soddo Zuria district is one of the 13 Woredas in the Wolaita zone. famine and droughts are common problems in the woreda. As a consequence, still now the woreda receives handouts in the form of emergency food aidaswell as supported by the government through Poverty Reduction Programs such as safety net and other package programs.

However, several studies had demonstrated on irrigation, credite, infrastructure input only. Dispite this, there were still incapable to reduce poverty, and ensure food security either in study area or in country level. Also, there have not yet been studies on smallholder farming housholds in the current study area and the country as a whole. Therefor this study mainly focused on to identify the problem hindered smallholder farmers' access to agricultural extension services leads to improve their agricultural productivity to reduce poverty, improve income of smallholder family and ensure food requerment atleast household level of the study area.

In this regard, the commercialization of the smallholder sector is seen as an important pathway. Extension service is one of the critical change agents required for the transformation of subsistence farming to modern and commercial agriculture beyond food requirement (availability) at the household level, this is critically important in promoting household food security, wealth, and employment creation (OECD, 2015)

This helps very poor households to meet their basic needs by improving their overall economic welfare, protect them against risks of crop loss due to insufficient rainwater supplies, promote their use of yield-enhancing farm inputs which in the long run enable them to move out of the poverty trap particularly in the study area.

There fore, a sustainable, equitable, and just economic transition, agriculture and the rural areas must be an integral and functional part of the economic growth.

1.3. Research Objectives

1.3.1. General Objective

The generalobjective of the study is factoraffects small holder farm households access to agricultural extension servicesin Sodo zuria woreda, wolayta zone, southern NNPS of Ethiopia.

1.3.2. Specific Objectives

- ✓ to assess to what extent smallholder farmers' have access to agricultural extension services concerned in to study area
- ✓ To identify determinants(factors) of access to extension services by smallholder farmers'
- ✓ To improve the efficiency of agricultural productivity by effective access of improved agricultural inputs trough by agricultural extension experts
- ✓ To reduce the deep and purposive poverty and food insufficience at least householde level

1.4.Research question

This study tried to answer the following the basic questions derived from its objectives

- ✓ What are the determinants of smallholder farmer's access to agricultural extension service?
- ✓ What is the effect of agricultural extension provision impediments on agricultural productivity of smallholder farmers?
- ✓ How can smallholder farmers' access to agricultural extension service effectively?
- ✓ Have smallholder farmers' accessed to extension service in their agricultural productivity is a major roles than other institutional service?

1.5.Scope of the Study

The subject scope of this study was covered to the factors and associated problems of smallholder farmers to access agricultural extension services. This study was delimited within the regarding time shortage and Geographic scope of the study has covered to only Sodozuria woreda, wolayita zone, SNNPR, Ethiopia.

1.6.Limitations of the Study

Due to the wide scope and problems of managing all factors which can determine smallholder farm household livelihood and wellbeing status.The study was particularly targeted on what influential factors affect smallholder farmers' access to agricultural extension services. In addition to these, during data collection lack of literature, particularly on smallholder farmers' wellbeing or agricultural activity and wellbeing status nexus in Ethiopia was also the drawbacks that have challenged this study. Indeed, the Lack of finding updates and time finding and gathering relevant information from the study conducted area, analyzing and coding collected data from expected sample participants, and accessing secondary data from the concerned body were also the bottleneck of this study.

1.7. Significance of the Study

Research on issues concerning determinants of participation of smallholder farmers' access to extension service for the rural poor is crucial for formulating programs that ensure food insecurity, increase farm productivity, break out from a vicious circle of poverty among small farm households and alleviate other problems associated with rural who engaged agricultural activity livelihoods. The study gives a clue for and input for local administrators serves as a source of reliable information for farmers and policymakers regarding the actions that should be undertaken so as to improve all farm households' participation in extension service equally. It might also be used as a reference and initiate other researchers who are interested in conducting different research works from different perspectives on the field which improve the performance of the dominant sector, for policymakers (such as woreda officials and planners.)

1.8. Organization of the thesis

The research has been organized into five chapters. The first chapter introduces the background of the study, key problem, asks the relevant questions, states the general and specific objectives and their scope, limitations of the research, and other relevant topics. This chapter is relevant to the study because it puts the research into perspective and helps to check digressions. The second chapter presents a review of relevant literature and the concept, contribution, and role of agricultural extension services systemand methods of agricultural productivity as well as provides the theoretical and analytical background.The third chapter methodology of the study contains the research design adopted, the data requirement and the sources of the data, the data

collection tools and instrument employed the sampling technique, the key data variables, and the framework for data analysis and reporting. This chapter provides a guide as to the conduct of the field survey.The fourth chapter focus on the different results and interpretation. The fifth chapter is the end of the research and gives a solution, conclusion, and set of recommendations based on the body or result of the research.

CHAPTER TWO

REVIEW OF RELATED LITRATURE

In Ethiopia, the approach to agricultural extension has been changing over time (Davis et al., 2010). The Ministry of Agriculture and Natural Resources (MoANR) has adopted a Participatory Extension System, a modified version of the Participatory Demonstration and Training Extension Systems (PADETES) implemented in the country since 1995 (MoA, 2010; Belay 2003). In principle, the Participatory Extension System aims at reinforcing farmers' participation and increasing the agricultural extension coverage through the formation of farmers' groups and by through social information system. In the recent development of the Ethiopian Agricultural Extension System, the participatory approach is complemented by a "scaling-up" of technologies or the establishing of best practice for technology transfer at larger scales.

In spite of the reforms, implementation of agricultural extension in Ethiopia still features the classical model of technology transfer adopted in the past. Farmers are not adopt new practices recommended as "one-size-fits-all" often with little consideration of demographic, socio-economic and psychological variations across the country – which is contradictory to the "best-fits" approach to agricultural advisory services (AAS) (Birner et al., 2006). A persistent problem that faced the Ethiopian agricultural extension is a failure to distinguish between behavioral change and farmers perception (Abate, 2007).Though, farmers access to agricultural inputs, access to credit services from micro finance institutions, participating in development agent service program, and access to other institutional servicess is challenging for poor farmers to competent with large-scaled farmers. Practically, this means they have limited access to extension services, a lack of knowledge which impedes technology adoption... for those resource-poor farmers.

However, agricultural extension is used as an instrument for achieving the poverty reduction, food security and sustainable land-management goals and also of the country (MoFED, 2010; Rahmato, 2008). They also involve a multiple activities of agriculture and rural development

Definition of terms and concepts

1.8.1. Definition and concept of smallholding farmers

A smallholder is a small farm operating under a small-scale agriculture model. Definitions vary widely for what constitutes a smallholder or small-scale farm, including factors such as size, food production technique or technology, involvement of family in labor, and economic impact.

In many developing countries, smallholding is a small plot of land with low rental value, used to grow crops. By some estimates, there are 525 million smallholder farmers in the world. These farms vary in land sizes, production, and labor intensities. The distribution of farm sizes depends on a number of agroecological and demographic conditions, as well as on economic and technological factors. Smallholders are critical to local and regional food systems, as well as livelihoods, and especially so during periods of food supply chain disruptions. In low-income countries, women make up 43 percent of smallholding agricultural labor but produce 60–80 percent of food crops (Bunnett, 2002; Nagayets and Oksana,2005; FAO, 2015).

The simplest and conventional meaning of a smallholder is the case when the land available for a farmer is very limited (Chamberlin, 2008; Hazell et al., 2007). However, the meaning goes far beyond this conventional definition and consists of some general characteristics that the so-called small farms or smallholders generally exhibit. Chamberlin has identified four themes on the basis of which smallholders can be differentiated from others. These themes include size of landholding, wealth or captal, market orientation, and level of vulnerability to risk (Chamberlin, 2008). Nevertheless, the smallholder may or may not exhibit all these dimensions of smallness simultaneously (Agerie, 2013).

However, it is well known that “small farmers in Ethiopia account for most of the Ethiopian population and the food grain production” (Betre, 2006). In Ethiopia, smallholder farmers cultivate about 95% of the total cropped land and produce more than 90% of the total agricultural output. The average landholding size of 1.18 hectares per farm household CSA (2007/08) in

Ethiopia meets the conventional meaning of small farms (less than two hectares per household). Even far beyond that, the smallholders in Ethiopia are known for their resource constraints such as capital, inputs, and technology; their heavy dependence on household labor; their subsistence orientation; and their exposure to risk such as reduced yields, crop failure, and low prices (Betre, 2006; Mahelet, 2007).

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

1.8.2. Policies and Strategies of Smallholder Commercialization

Policymakers have recognized the importance of increased smallholder market participation (commercialization) in improving agricultural productivity and thereby tackling national poverty and food insecurity (Republic of Kenya, 2010). This recognition is justified on the basis that many of the African economies are heavily dependent on the agricultural sector which contributes significantly to Gross Domestic Product (GDP) and accounts for over 75% of the national employment (Republic of Kenya, 2005). This is a clear indication of the low labor productivity in the country's agricultural sector. In this regard commercialization of smallholder agricultural producers through increased participation in output markets have been promoted as one of the best strategies to address low agricultural productivity that has led to high levels of poverty and food insecurity among rural farming households in developing countries (Jaleta et al., 2009; Thurlow et al., 2007; Wickramasinghe and Weinberger, 2013). Even the market liberalization policy agendas that were widely promoted in sub-Saharan Africa (SSA) in the 1980s and 1990s under structural adjustment programs (SAPs) were broadly aimed at stimulating and enhancing agricultural commercialization. Though these liberalization policies were aimed at opening up new market-led opportunities for economic growth, their results were mixed in most countries. Even to date, many smallholder producers continue to engage in subsistence agriculture and thus unable to benefit from commercialization opportunities presented by the liberalized markets (Olwande and Mathenge, 2011; Siziba et. al., 2011; Wollverton et al., 2014).

According to FDRE (government of ethiopia) formulation policy and strategies, the agricultural development led industrialization (ADLI), in (1993) was launched to overcome the agricultural problem and transform countries economy, based on the implementation of the growth in

production and productivity has been considered in the policy formation. ADLI has served as a main strategy guiding three most recent five year plan, such as; SDPRP (2002/3-2004/5); PASDEP (2005/6-2009/10); and GTP-I and GTP-II (2010-2015) and 2015-2020) respectively.

Moreover participatory demonsration and training extension system(PADETES), its main objective to improve the participation of smallholder farmers to extension service and demonstrate improved agricultural technologies for enhancing their productivity, income and to ensure food security and self-sufficiency.

1.8.3. Large versus small scale farmers – growing landlessness

The reality is that customary land rights are no longer the central issue in many African countries including Ethiopia. Smallholder farmers are often in competition with large-scale farmers who receive preferential state support despite strong evidence that smallholder farmers are more equitable and more efficient per unit of land. Small farmers have already been or are currently being pushed into vulnerable ecological areas outside their traditional home areas. Although more than half of the arable land that is idle especially in Africa, the land area in some countries is near maximum population density given the present agricultural technology and lack of soil fertilization. Africa, not normally associated with landlessness, is now witnessing growing numbers of vulnerable landless people, particularly in South Africa, Zimbabwe, Kenya, Ivory Coast, and Namibia. The landless are the product of intensifying demographic pressures in rural areas, retrenchment or eviction of powerless minorities and farmworkers from farms and plantations, and marginalization of pastoralists. Subsistence food needs are forcing smallholder farmers to expand the area under cultivation into forests and more and more marginal and fragile areas characterized by poor rainfall, degraded soils, and deforested lands,in contrast to large-scale farmers and foreigners who manage to procure land of high economic value. In some cases, large-scale farmers own large tracts of land that are underutilized at the same time as small farmers are struggling to farm their small plots with poor soils Jua and Nkwisi (2001).As argued by Jua and Nkwisi, African governments, pressurized to encourage private enterprise and foreign investment, have lacked the political will to challenge the production base underpinned by large-scale commercial farmers because of their supposed superiority of production and diversified and complex portfolio of products at the farm level. Large-scale farming tends to receive unqualified

state support and protection of land rights against smallholders' demands for land redistribution. By contrast, smallholders on customary tenure lands no longer have sufficient land nor even secure land rights to the land that they currently farm.

1.8.4. Basic concept of agricultural Extension

There are many definitions, philosophies, and approaches to agricultural extension, and the views of what extension is all about have changed over time. Extension originally was conceived as a service to "extend" research-based knowledge to the rural sector to improve the lives of farmers. It thus included components of technology transfer, broader rural development goals, management skills, and informal education, such like FTC. The traditional view of extension in Africa was very much focused on increasing production, improving yields, training farmers, and transferring technology. Today's understanding of extension goes beyond technology transfer to facilitation; beyond training to learning, and includes assisting farmer groups to form, dealing with marketing issues, and partnering with a broad range of service providers and other agencies. Thus many people are now using the phrase, "agricultural advisory services," instead of extension which can imply a top-down approach and may ignore multiple sources of knowledge. In its broadest sense, the extension is an educational process with communication being its core component and interaction with its partners (farmers). The authors Ban and Hawkins (1996) define the term extension as the conscious use of communication of information to help people form sound opinions and make good decisions. As a system, extension facilitates the access of farmers, their organizations, and other market actors with knowledge, information, and technologies; facilitates their interaction with partners in research, education, agribusiness, and other relevant institutions; and assists them to develop their own technical, organizational and managerial skills and practices (Christoplos, 2010). The agricultural extension can be defined as the entire set of organizations that support and facilitate people engaged in agricultural production to solve problems and to obtain information, skills, and technologies to improve their livelihoods and well-being (Birner, Davis, Pender, Nkonya, keram, Ekboir, et al., 2006). This can include different governmental agencies (formerly the main actors in extension), nongovernmental organizations (NGOs), producer organizations and other farmer organizations, and private sector actors including input suppliers, purchasers of agricultural products, training organizations, and media groups (Neuchâtel Group, 1999; Dula, 2018).

The objective of extension: The objective of extension is to change farmers' outlook toward their difficulties. The extension is concerned not just with physical and economic achievements but also with the development of the rural people themselves. Extension agents, therefore, discuss matters with the rural people; help them to gain a clearer insight into their problems and to decide how to overcome these problems (Arnon, I., 1989).

The functions of an extension agent: - Assist farmers to identify and overcome problems, Assist farmers to make better use of resources (technology), introduce new technologies (new varieties of crops (improved seed), fertilizer uses, breeds, etc.).

Extension Communication sharing of ideas and information, bypassing on ideas, advice, and information, he/she hopes to influence the decisions of farmers. He/she may also wish to encourage farmers to communicate with one another; the sharing of problems and ideas is an important stage in planning group or village activities. The agent must also be able to communicate with superior officers and research workers about the situation faced by farmers in their area (Alston *et al.*, 2000; Anderson. , 2010).

Farm Visits are the most common form of personal contact between the agent and the farmer and often constitute over 50 percent of the agent's extension activities. Because they take up so much of the agent's time, it is important to be clear about the purpose of such visits and to plan them carefully. Farm visits can: familiarize the extension agent with the farmer; enable them to give specific advice or information to the farmer (Davis et al.,2012).

Office calls just as the extension agent visits the farmer, so he can expect that from time to time the farmer will visit him at his office. Such a visit is often a reflection of the interest, which the agent may have aroused among the local farmers. The more confidence local farmers have in the extension agent, the more likely they are to visit him (LDCs, Gollin, 2010; Johnston and Mellor, 1961).

Group meetings calling the members of a group of the inhabitants of a local community together for a meeting is the commonest group extension method. Although there may be an air of informality about such meetings, they will nevertheless need to be carefully thought out and planned (Dula, 2018).

Farm walks-as stated by USAID(2013), a farm walk involves a group of farmers visiting a farm and walking around it with the host farmer and the extension agent. The purpose of a farm walk are:-to give farmers an opportunity to see how new technology has been tried, tested, or adopted by one of their neighbors; Implementation Monitoring and Evaluation and Follow Up to give farmers an opportunity to see a technology which has been developed by one of their neighbors; to give farmers an opportunity to analyses a farming system and identify opportunities for improvement. Used in this way, a farm walk is a useful supplement to the Problem Census in gaining farmer participation in the process of assessment and could be considered as one of the techniques associated with PRA, to give farmers an opportunity to reach an agreement on how a particular problem can be tackled, or to plan and implement new ideas as a group. This is often particularly important with approaches to farming such as Integrated Pest Management (IPM) which are not very successful when implemented by a single farmer whose neighbors use chemical pest control techniques; they can also be used as an activity to assist group formation.

Why is extension important? An extension is essentially the means by which new knowledge and ideas are introduced into rural areas in order to bring about change and improve the lives of farmers and their families. Extension, therefore, is of critical importance. Without an agricultural extension, farmers would lack access to the support and services required to improve their agriculture and other productive activities. The critical importance of extension can be understood better if its three main elements are considered: Knowledge, Communication, and farm households.

1.8.5. Agricultural" extension and "rural" extension

Agricultural" extension**:-**agents have already been commandeered to take on tasks involving construction of postharvest on-farm infrastructure, marketing and processing, farm management and the organization of farmers into special agricultural interest groups. Agricultural extension agents are prepared to strengthen – whether in terms of productivity, management or organization – the capacity of those who cultivate the land, for agriculture is their discipline and their expertise.

"Rural extension":- include micro-enterprise development, non-formal literacy education, family planning, nutrition, health and other rural, nonagricultural areas needing attention.

Rural development is often discussed together with agricultural development and agricultural extension. In fact "agricultural extension" is often termed "rural extension" in the literature.

1.8.6. The role of extension services in agriculture

Agricultural extension programs have been one of the main conduits of addressing rural poverty and food insecurity as well as wellbeings of rural livelihoods. This is because, it has the means to transfer technology, support rural adult learning, assist farmers in problem-solving and get farmers actively involved in the agricultural knowledge and information system, (Lindau, Neuchâtel Group, 2000). An extension is defined by FAO(FAO, 2010). As “systems that should facilitate the access of farmers, their organizations and other market actors to knowledge, information and technologies; facilitate their interaction with partners in research, education, agribusiness, and other relevant institutions (credit, subsidize from the government for poor food and health farmers..); and assist them to develop their own technical, organizational and management skills and practices”. Thus, agricultural extension is a major component to facilitate development since it plays a starring role in agricultural and rural development efforts, (Abbeam et al., 2018), argued that extension provides a source of information on new technologies for farming communities which when adopted can improve production, incomes, and standards of living of farm households. Extension service providers make an innovation known to farm households, act as a catalyst to speed up adoption rate and also control change and attempt to prevent some individuals in the system from discontinuing the diffusion process (Agric Food Econ,2016).

1.8.7. The Role of Agricultural Extension programs

A major role of the agricultural development policy in most countries is to increase food production at a similar rate to there at which the demand for food is increasing and at a cost, which is competitive on world markets. It is appreciated more and more that such development must be sustainable, and that often it must be done in a different way than it was in the past. An effective agricultural extension organization is critically important in this situation, especially in

less industrialized countries. The major role of extension in many countries in the past was seen to be the transfer of new technologies from researchers to farmers. Now it is seen more as a process of helping farmers to make their own decisions by increasing the range of options from which they can choose and by helping them to develop insight into the consequences of each option (Ban & Hawkins, 1996). Extension worker has now become part and parcel of rural development strategy in most nations of the world. The World Bank has also contributed significantly of late, towards strengthening extension organizations in less developed nations. There is enormous faith in extension's potential to work with rural people. Like it is said that Rome was built in order, it was not mastered minded by one individual at a place rather it evolved through the hard work of several people around the world for over more than a century now Kumar &Hansra (2000). The level and dynamics of agricultural productivity affect well-being, structural transformation, and development in LDCs (Gollin, 2010; Johnston and Mellor, 1961). Agricultural productivity growth is, therefore, an essential precondition for poverty reduction in the short and medium-term, contributing through several channels. Rising agricultural productivity helps to lower food prices, effectively raising real rural and urban wages, since food is a major component of wage goods, and benefiting landless and other rural food-deficit households (Block, 2010); Sahn, Dorosh, and Younger, 1999). "Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life"(World Food Summit, 1996;Dula, 2018).

1.8.8. The effectiveness of agricultural extension service,

Public agricultural extension services have long served as a key policy level to accelerate the dissemination of knowledge and skills and promote the adoption of modern technologies, (Swanson and Rajalahti, 2010). However, while many developing country governments spend heavily on these services, the existing evidence on their effectiveness is mixed(Anderson and Feder (2007); Benin et al. (2007); Davis et al. (2012). Extension services have been widely criticized for being selective at reaching farmers, for having weak accountability, and for being financially unsustainable (Rivera and Qamar, 2003; Anderson and Feder, 2004; Gautam, 2000). A growing skepticism has led to calls to reform or strengthen the implementation of these services, for instance, by decentralizing provision, improving incentive structures, and increasing

agent monitoring. Understanding the potential of agricultural extension services in increasing farmer learning and experimentation is a first step to establishing the adequacy of investing more resources to improve the governance of these services. Agricultural extension to provide farmers with information about locally relevant inputs and practices, as to increase their productivity, livelihoods, and management of natural resources. Furthermore, the goal was to deliver the information at scale. The first approach consisted of farmer field days (FFD), one-day events in which farmers observed demonstration plots for promoted inputs and received information from extension agents, input companies, and community-based organizations. The second approach consisted of a mobile-based extension program, e-extension that delivered agricultural information to farmers via text messages to their phones throughout the entire agricultural season. Also, Some recent evidence suggests that simply training lead farmers and relying on them to spread agronomic messages -without any additional incentives- might not be effective (Kondylis et al., 2017; Yishay and Mobarak, 2013). The information provided to farmers through these delivery methods could still be sufficiently targeted to match farmers' agro-ecological zones. The profitability of a largely unknown type of chemical fertilizer, some evidence on the effectiveness of other forms of intensive extension services, such as farmer field schools (Waddington et al., 2014; Kondylis et al., 2017). There is limited rigorous evidence on the effectiveness of other potentially scalable extension services provided by public agencies in developing countries, (Emerick et al., 2016; Maertens and Michelson, 2017).

As Maertens and Michelson (2017) stated and the Ministry of Agriculture (MoA) explained approximately 70% of its budget on extension and research. A large fraction of this goes towards employee salaries, including that of extension workers Muyanga et al. (2006). However, there is not sufficient capacity to reach farmers through individual visits, and the reported ratio of extension workers to farmers in the least developing nations is low at 1:1500. In the evaluation sample, 86% of farmers have never received a visit from an extension worker and instead, they cite the radio and their social networks as their main sources of information.

To counteract the effects of the enduring (generic) problems and enhance the contributions of the success factors, the agricultural extension service globally is undergoing several changes. According to Van den ban and Hawkins (1996), an extension system should encompass five goals: (1) transferring knowledge from researchers to farmers (2) advising farmers in their

decision making (3) educating farmers to be able to make similar decisions in the future (4) enabling farmers to clarify their own goals and possibilities (5) stimulating desirable agricultural development (Gebremedhin, Hoekstra , and Tegegne, 2006).

Farmer Field Days: Farmer Field Days are one-day educational events where farmers can observe results from demonstration plots (hosted by a farmer in the area) and learn about various technologies and management practices from extension workers. As part of a broader program to increase smallholder farmer productivity.

Productivity

Agricultural productivity is measured as the ratio of agricultural outputs to agricultural inputs. While individual products are usually measured by weight, their varying densities make measuring overall agricultural output difficult. Therefore, the output is usually measured as the market value of final output, which excludes intermediate products such as corn feed used in the meat industry. This output value may be compared to many different types of inputs such as labor and land (crop yield). These are called partial measures of productivity.

Agricultural productivity may also be measured by what is termed total factor productivity (TFP). This method of calculating agricultural productivity compares an index of agricultural inputs to an index of outputs. This measure of agricultural productivity was established to remedy the shortcomings of the partial measures of productivity; notably that it is often hard to identify the factors that cause them to change. Changes in TFP are usually attributed to technological improvements.

Agricultural productivity is an important component of food security. Increasing agricultural productivity, especially amongst smallholder farms, is an important way to decrease the amount of land needed for farming and slow environmental degradation through processes like deforestation. Due to high population pressure. Since agriculture has such large impacts on climate change, Project Drawdown described "Sustainable Intensification for Smallholders" as an important method for Climate change mitigation.

Agricultural productivity is variously measured, and large-scale farming is often less efficient than small sustainable farms. Industrial single crop creates a high output per worker whilst,

small-scale farmers produce more food per acre of land. Smallholder farmers address inequities in land and water distribution by enforcing allocation proxies.

Total-factor productivity (TFP), also called multi-factor productivity, is usually measured as the ratio of aggregate output (e.g., GDP) to aggregate inputs.. The rate of TFP growth is calculated by subtracting the growth rates of labor and capital inputs from the growth rate of output(Gordon 2017; Sickles&Zelenyuk, 2019).

Technology growth and efficiency are regarded as two of the biggest sub-sections of Total Factor Productivity, the former possessing "special" inherent features such as positive externalities and non-rivals which enhance its position as a driver of economic growth.

Total Factor Productivity (TFP) is often considered the primary contributor to GDP Growth Rate. While other contributing factors include labor inputs, human capital, and physical capital. Total factor productivity measures residual growth in the total output of a firm, industry, or national economy that cannot be explained by the accumulation of traditional inputs such as labor and capital. Since this cannot be measured directly the process of calculating derives TFP as the residual which accounts for effects on total output not caused by inputs (Management Science,2013.).

It has been shown that there is a historical correlation between TFP and energy conversion efficiency. Also, it has been found that integration (among firms for example) has a causal positive impact on total factor productivity.

The equation below (in Cobb–Douglas form) is often used to represent total output:

$Y=Ax\ k^{\alpha}xL^{B}$, (Y) as a function of total-factor productivity (A), capital input (K), labour input (L), and the two inputs' respective shares of output (α and β are the share of contribution for K and L respectively). As usual for equations of this form, an increase in either A, K or L will lead to an increase in output. {\displaystyle Y=A\times K^{\alpha}\times L^{\beta}}Natividad, G. (2014).

Small-scale agriculture often sells products directly to consumers. Disintermediation gives the farmer the profit that would otherwise go to the wholesaler, the distributor, and the supermarket.

About two-thirds of the selling price would be lost for product marketing. Meanwhile, if farmers sell their products directly to consumers, they recover the totality of their products (Kumarian Press US, 2014).

Small farms have many economic advantages. Local farmers generate a local economy in their rural communities. An American study showed that small farms with incomes of $100,000 or less spend almost 95 percent of their farm-related expenses within their local communities. The same study took into comparison the fact that farms with incomes greater than $900,000 spend less than 20 percent of their farm-related expenses in the local economy. Thus, small-scale agriculture supports the local economy.

Local purchasing is a preference to buy locally produced goods and services rather than those produced farther away. It is very often abbreviated as a positive goal, "buy local" or "buy locally', that parallels the phrase "think globally, act locally", common in green politics.

On the national level, the equivalent of local purchasing is import substitution, the deliberate industrial policy or agricultural policy of replacing goods or services produced on the far side of a national border with those produced on the near side, i.e., in the same country or trade block.

Before industrialization and globalization became widespread, there were so many incentives to buy locally that no one had to make any kind of point to do so, but with current market conditions, it is often cheaper to buy distantly-produced goods, despite any added costs in terms of packaging, transport, inspection, wholesale/retail facilities, etc. As such, one must now often take explicit action if one wants to purchase locally produced goods.

These market conditions are based on externalized costs, argue local-economy advocates. Examples of externalized costs include the price of war, asthma, or climate change, which are not typically included in the cost of (for example) a gallon of fuel. Most advocates for local economics address contracting and investment, as well as purchasing.

Agricultural alternatives are being sought, and have manifested themselves in the form of farmers' markets, farmed goods sold through the community cooperatives, urban gardens, and even school programs that endorse community agriculture.

Subsistence agriculture occurs when farmers grow food crops to meet the needs of themselves and their families on smallholdings. Subsistence agriculturalists target farm output for survival and mostly local requirements, with little or no surplus. Planting decisions occur principally with an eye toward what the family will need during the coming year, and only secondarily toward market prices.

Despite the primacy of self-sufficiency in subsistence farming, today most subsistence farmers also participate in trade to some degree, though usually for goods that are not necessary for survival, which may include sugar, iron roofing sheets, bicycles, used clothing, and so forth. Most subsistence farmers today operate in least developing countries. Although their amount of trade as measured in cash is less than that of consumers in countries with modern complex markets, many have important trade contacts and trade items that they can produce because of their special skills or special access to resources valued in the marketplace.

Subsistence agriculture generally features small capital/finance requirements, mixed cropping, limited use of agrochemicals (e.g. pesticides and fertilizer), unimproved varieties of crops and animals, little or no surplus yield for sale, use of traditional tools (e.g. hoes, machetes, and cutlasses), mainly the production of food crops, performed on small peicesplots of land, reliance on unskilled labor (often family members), and (generally) low yields (Waters, 2008;Books, 2007).

A farm is an area of land that is devoted primarily to agricultural processes with the primary objective of producing food and other crops; it is the basic facility in food production, from Wikipedia. The name is used for specialized units such as arable farms, vegetable farms, fruit farms, dairy, pig, and poultry farms, and land used for the production of natural fibers, biofuel, and other commodities. It includes ranches, feedlots, orchards, plantations and estates, smallholdings, and hobby farms, and includes the farmhouse and agricultural buildings as well as the land. In modern times the term has been extended to include such industrial operations as wind farms and fish farms, both of which can operate on land or sea.

Farming originated independently in different parts of the world, as hunter-gatherer societies transitioned to food production rather than food capture. It may have started about 12,000 years

ago with the domestication of livestock in the Fertile Crescent in western Asia, soon to be followed by the cultivation of crops. Modern units tend to specialize in the crops or livestock best suited to the region, with their finished products being sold for the retail market or further processing, with farm products being traded around the world.

Modern farms in developed countries are highly mechanized. In the United States, livestock may be raised on rangeland and finished in feedlots and the mechanization of crop production has brought about a great decrease in the number of agricultural workers needed. In Europe, traditional family farms are giving way to larger production units. In Australia, some farms are very large because the land is unable to support a high stocking density of livestock because of climatic conditions. In less developed countries, small farms are the norm, and the majority of rural residents are subsistence farmers, feeding their families and selling any surplus products in the local market (Gregor, 2009).

1.8.9. OVERVIEW OF ETHIOPIA'S AGRICULTURAL EXTENSION

A limited extension system began in 1930- 1974 with the establishment of AMBO agricultural school during the time of Emperor Haileselassie I. The real agricultural extension system began in early 1950s' with the establishment of the college of agriculture and mechanical arts at Haramaya University. Since 1963, MoA was mandated to expand extension work with the support of USAID-APP.This period witnessedthe compressive agricultural package program and establishment of an extension implementation department (EPID) within MoA.

The delivery of extension services, particularly to farmers through improved farm technology and access to input and output markets, encourages the vision of improving the economic well-being of its actors. Moreover, the government of Ethiopia launched a strategy which is known as the Agricultural Development Led Industrialization (ADLI) in 1993 that sets out agriculture as a primary stimulus to generate increased output, employment, and income for the people, and as the springboard for the development of the other sectors of the economy Kassa&Abebaw (2004); Gebremedhin, Jalata, & Hoekstra (2009). One of the major components of ADLI is the national extension package program known as Participatory Demonstration and Training Extension System (PADETES). The objective of PADETES are to achieve sustainable development in rural areas through increasing farm productivity (yield), reducing poverty, increasing the level of

food security, increasing the volume and variety of industrial raw materials (primary products), and producing for the export market, Kassa, (2003); Ethiopian Economics Association (EEA ,2006). But for instance, between 1998 and 2012 the average number of Ethiopians in need of food assistance fluctuated between 3 million and 14 million (IRIN, 2012). The country ranks 173rd out of 187 nations in terms of the Human Development Index (UNDP; Kiptot et al., 2013).

"New" Extension System (PADETES) in Ethiopia: The strategy of food security in Ethiopia is tied with the overall development strategy of Agricultural Development-Led Industrialization (ADLI). This strategy was aimed at the structural transformation of the economy in which a high growth of agricultural development is envisaged to contribute to raising the share of industry and social services in terms of outputs and employment. The strategy also visualizes export-led growth, which feeds into an interdependent agricultural and industrial development. By and large, the strategy of ADLI focuses primarily on agricultural development and this is to be attained through the improvement of productivity in small-holdings and expansion of large-scale commercial farms, particularly in the lowlands. To complement the ADLI strategy, the government of Ethiopia has adopted Participatory Demonstration and Training Extension System (PADETES) as the National Agricultural Extension System since 1994/95. This agricultural extension four system was developed after a critical evaluation of the past extension approaches practiced in Ethiopia. This system, therefore, acknowledges present thinking in extension philosophy that considers research, extension, and education to be part of the agricultural knowledge system. According to the new agricultural extension system, execution of extension programs is the sole responsibility of the Regional Agricultural Bureaus /RABs/ while the Federal Ministry of Agriculture (MoA); recently (MoANR) has the mandate of formulating agriculture-related policies, coordinating inter-regional development programs and/or projects, providing technical advice and training services to increase the technical competence of extension staff members of the Regional Agricultural Bureaus. Thus a decentralized extension system is envisaged for the realization of participation at grass-roots levels. The system also gives special consideration to the package approach to agricultural development. The term "package" is defined as a group of separate items packed together as a single unit. Extension packageis therefore defined as a package consisting of different elements which, among others, include technical information /improved technology and agricultural practices/ agricultural production inputs, inputs credit, and suitable extension methods. In

addition, maintaining the relationship between research and extension and conducting practical-oriented training programs are essential components of the new extension system. The national agricultural extension program which is sometimes called the extension package program focuses on environmentally conscious agricultural intensification which is to be implemented both in surplus producing and drought-prone /moisture stress areas of the country. The extension package program assists small-scale farmers to improve agricultural productivity through the dissemination of research-generated information and technologies. Participating farmers are provided with agricultural production inputs for the agricultural development activities they want to undertake. Farmers applying for inputs credit are required to pay advance payment before receiving the input credit. The rates for advance payment vary according to the types of technologies to be used and the resource level of the farming communities. Loan for crop-based packages is repaid immediately after harvest, whereas for other extension packages different repayment arrangements can be made depending on the types of the development program to be undertaken, (Waktola, 2000).

According to the above researcher, Cereals-based dry land extension packages cover the major staple food crops such as maize, wheat, teff, and sorghum. The contents of this package are improved seeds, chemical fertilizers (diamoniumphophate and urea), herbicides, and tied ridges for moisture conservation. Local seeds are also considered as one of the options along with improved technologies in areas where farmers believe that their local varieties are superior to that of improved ones. Because of the lack of agro-ecology-based fertilizer recommendations, the package recommends 100 kg DAP and 50 kg UREA per hectare for cereals-based dryland extension packages across the country. The high economic value crops extension package in Ethiopia including the study area includes pulses, vegetables, and cereal crops. This package is designed for risk aversion and generating cash income for the household. The livestock development extension package includes dairying for milk production, fattening for meat production, poultry for egg production, and apiculture (bee-keeping for honey production). The strategy for milk production is by way of artificial insemination, crossbred heifers supply, and establishment of full-service stations, while the egg production strategy is to be conducted through the provision of improved breeds of laying hens and cockerels.However, Farmers do not seem to participate actively in the development of the extension package. Participation is minimal due to quotas imposed on Development Agents (DA). Looking at the adoption of

dryland technology packages in the visited areas of the country, it is possible to conclude that very few farmers have been able to adopt some of the dry land technology packages. Beneficiary farmers in this case see adoption from the point of view of the change in knowledge, change in attitude, and change in practice. As observation of this study area shows that, most farmers do not seem to know about technology package. Even those farmers who are aware of the packages often lack the practical skills on how to implement them on their plots. Farmers' inability to adopt technology packages can stem from a variety of causes. But as some study realized that inadequate information flow from Development Agents to farmers, lack of alternative appropriate technologies that can suit the various needs of dryland farmers, lack of resources or inputs credit for undertaking the package program, untimely delivery of production inputs, lack of market outlets for agricultural produce, and lack of confidence in the already available improved dryland technology packages, these stated by Helland, J. (1997).

Accordingly, GTP-I (2010-2015) mainly focused on accerelated on growth of agricultural productivity for ensuring food security and alleviating poverty by applaying effective agricultural practice and improving the quality of extension services.

Similarly, under GTP II (2015/16 – 2019/2020),the same plan was adopted to mobilize all possible efforts to ensure adequate agricultural input supply and strengthen agricultural extension services to boost productivity and then commercialization. This indicates that agriculture continues to be a source of growth and poverty reduction.Under the new plan, commercialization of agriculture is given due to emphasis in the preparation of the path to manufacturing industry-led economic growth during the five (5) years' plan, which by SDGS.

1.9. Empirical literature review of the study

Ethiopia has relied on agriculture to agreater extent. According to Tesfaye et al. (2012) and the Ministry of Finance and Economic Development (2003), following the coming to power of the Ethiopian People's Revolutionary Democratic Front (EPRDF), since the 1990s, Agricultural Development-Led Industrialization (ADLI) has been in place as a national economic development policy that predominantly advocates smallholder agricultural development and transformation.

Many scholars argued that the use of agricultural technologies such as fertilizers, irrigation, improved seed, credit, and infrastructure has a positive impact on productivity. According to the above and other researchers' arguments more focused on technological inputs like by Gebremedhin et al. (2009), Abebaw and Haile (2013), Urgessa (2015), and formal credit markets. Hussien (2007), also indicated that Farm households are more likely to prefer the informal sector to the formal sector concerning flexibility in rescheduling loan repayments in times of unexpected income shocks. But they leftout one important issue of expertise agricultural extension contribution to ensuring such input plus additional innovation, effective management, practice, and train households how to farm effectively and efficiently by using available resources and fill constraints rural households. Without agricultural extension support or service using the above and other inputs efficiently and effectivelyuse is difficult to increase agricultural productivity.

Some of the African countries that conducted research like Kenyan, Muraya, and Ruigu (2017) claims that government expenditure in the form of investment in rural area including the provision of agriculture-related public goods is the main determinant of agricultural productivity in Kenya. Urgessa (2015) supports this idea by emphasizing the importance of investment in R & D, extension, and human capital in enhancing agricultural productivity.

Gender is one of the significant determinants of agricultural productivity since male-headed HH was found to have more capability and endurance in increasing agricultural productivity Ermias Haile (2014). The opposite is that female-headed HH is reluctant to adopt agricultural technologies Lugandu (2013). Abebaw and Haile (2013), pointed out that male-headed HH has more probability to become a member of farmers‟ cooperative and access inputs and training thus became more productive.

Hussien (2007), in his study also found out that the use of extension package, in effect, requires adequate labor supply, thus a positive effect of household labor on the choice of formal credit for the farm input. The choice of the formal sector increases with the number of productive members of the farm households. It was also indicated that the low level of education of the farm households may have contributed to the limited use of formal sector credit by farm households.

Gebremedhin et al. (2009) and Shumet's (2011) study shows thateducation plays an important role in the adoption of inputs and farm management practices. Educated farmers have a better

chance of adopting inputs and properly using them in their farms. They also have better access to agricultural information useful for decision-making. Chotigeat in Urgessa (2015), studied the relationship between the size of landholdings and agricultural productivity and found that there was no systematic relationship between the measures of productivity and land size. However, large capital infusion canceled out the negative effects of land and led to a positive relationship between land size and productivity. Lugandu (2013), from the input adoption viewpoint, small land size owners are obliged to adopt inputs and other land management practices to increase agricultural production. Adebiyi and Okunlola (2013), found that those with large farm sizes tend to adopt cocoa farm rehabilitation techniques. Di Falco et al. (2010) and Lugandu (2013) posited that large farmers diversify their crops and protect crop failures in times of erratic rainfall and use crop rotation and fallowing as a mechanism of soil fertility maintenance.

Concern about extension service by Dorosh and Rashid (2013) said agricultural extension services are what tie improved seed, chemical fertilizers, and credit. Since extension workers (EWs)and development agents (DAs)are nearer to the farmer they are key role players in instigating farmers to use agricultural inputs and disseminate the required information. In addition to improving productivity market access and marketing is critical concern for farmers and institutional support service such as extension are increasingly significant for this purpose. An important aspect of more market-oriented extension service is the role of the extension system in facilitating linkages between producers and market parties, Gebremedhin et al., (2006). Moreover, as a study by Gebremedhin et al. (2006); Gebreselassie(2006), Linkage with the credit supply service appears to be working well, especially about the HH package.

Also, the study of Urgessa (2015) shows that farm HH income has been found to have a strong relationship with farm productivity. Both land and labor productivity is credited to be the main determinants of farm HH income. Labor productivity has proven to be one of the significant variables for the change of rural HH per capita income improvement (Urgessa, 2015). In support of this, Blunck (2006) argued that a high standard of living could be sustained by improvements in agricultural productivity, either through achieving higher productivity in existing farms or through successful entry into higher productivity farms. Most of the literature suggests that rural HH income is increased through agricultural farmland and agricultural labor productivity. This could be because agricultural productivity has a positive impact on real rural HH incomes.This

idea confirms that agricultural productivity means the size of farmland and the number of labor force participated in productivity.

The gap of study:

The objectives of all the above studies shown a highlight the contribution and role of agricultural extension, increases to agricultural productivitybutnot shown detail how, where and to whom.The objectives of all the above studies shown a highlight the contribution and role of agricultural extension, increases to agricultural productivitybutnot shown detail how, where and to whom, the gap is not only these but also smallholder farmers in the rural area are not considered particularly in this study area. Those all researchs were shows general farm households, smallholders not concerned, there are so many factors hindered them to compete as other large and medium household farmers, such as illiteracy, less farm size compared with better-off farmers, financial constraints, lack of knowledge to use modern system and lack of information. Those and other faces them could not be met extension service effectively in a rural area and isolated them from agricultural extension services.

The gap of above and other conducted research stated by YishakGecho (2014); GezahegnAyele (2013);Tesfaye Lemma1(2012), and DawitAlemu (2014) case of wolaita zone studied that only highlighted on household generally and also studied on food security only, which studies not show the extreme problem because the household in study area all are not similar income, food availability, and their living status, not identified their wellbeing. Also, their study shows that the problem is associated only with land scarcity, population pressure, and drought. Those problemscausedby natural in any area or elsewhere and cannot put them the real solution to cop up the problems faces the study area households, the problem is not only these the major problems moreover, traditional farming and lack of knowledge about fertilizer, improved seed and animal breeding system, agricultural innovation and lack information of market and credit associated with illiteracy and backwardness or traditional practice. Furthermore, they left very important variables which can influence dependent variables such: as financial institutions and household labor force. The labor force is a very decisive factor especially in the least developing country like Ethiopia, particularly in the study area, and also technology adaptation in wolayta zone general, and sodozuriaworeda particularly not explained.

According to AlmazBalta; AyeleTessema; and Debebe's W/wolde (2015) studies, in this study area suffer from chronic food insecurity, as studies show that 72% of households are food insecurity in sodozuriaworeda. Also, their data collection or respondents' response more than 80% are facing food shortage 6 up to 8 months a year. As the above studies, associated problems are: less size of farmland died of livestock by drought, causes of dependency ratio, illiteracy of household head, and non-uses of agricultural inputs are significantly related to sources of food insecurity. The aim of theirresearch studiesexaminedonly on food security and its influential variables in this study area. But the problem of food insecurity causes low agricultural productivity due to the above factors explained and other important factors, also those problems could be solved by agricultural extension services not concerned, particularly in the study area. On these gaps and another study still have not solved the problem of food security and sustained agricultural productivity, even more declining agricultural productivity and suffer food insecurity, especially in the study area. Therefore this research more focus on how to solve the challenge faced by smallholder farmers not to access agricultural extension service programsto maximize agricultural productivity in study area.Because of, this is the important issue(expertise in agricultural extension services and smallholder agricultural households) is the main issues to cop-outfrom the vicious circled problem of those households and to achieve the real solution, particularly in the study area. Because of Ethiopia, southern state, and the wolaita zone agricultural activity, smallholders take a lion's share, thus agricultural transformation, modernization of the farming system, enhancing productivity as well as ensuring food security without enabling and sustaining smallholder farmers through by agricultural extension service even in national level very difficult. As a generally to fill the above gap and detail take study in this research area based on primary data collection to show recent output and also this research different from others' to show the result and study finding on challenges of smallholder farmers access to extension servicesand the role of agricultural extension on agricultural productivities and then its effect on poverty reduction and food security in this study area still yet not studied.

1.10. Conceptual frame workof the study

Smallholder farming in many developing counties is challenged by several factors. This can be classified into, socio-economic, institutional, demographic, and ecological factors. These challenges facing smallholder farmers limited their agricultural activity for economic growth and better living status. Furthermore limited to access extension services by those farmers, especially

in the study area the key limitation for their efficient and optimal agricultural productivity. Agricultural extension has long been one of the major conduits for agricultural development and transformation leading to rural poverty reduction and ensuring food security.

This study sought to establish the factors that affect small-scale farmers' access to public agricultural extension services in the case of around soddo districts. The aim of the study focused on improving agricultural productivity to reduce poverty and ensure food requirement at least in the household level of the study area, by effective accessing extension agent provided packages. Without household-level focused poverty reduction and food security, agricultural development and transformation cannot be achievable. So that, the study was guided by a conceptual framework; wants to limit the following factors which affect the probability of access to extension serviceseither positively or negatively in the study area. Even there was the availability of agricultural extension services in the study area the factors that influence particularly small-scale farm households, the direction in below conceptual framework shows that, the interrelation between the key variables of the study.

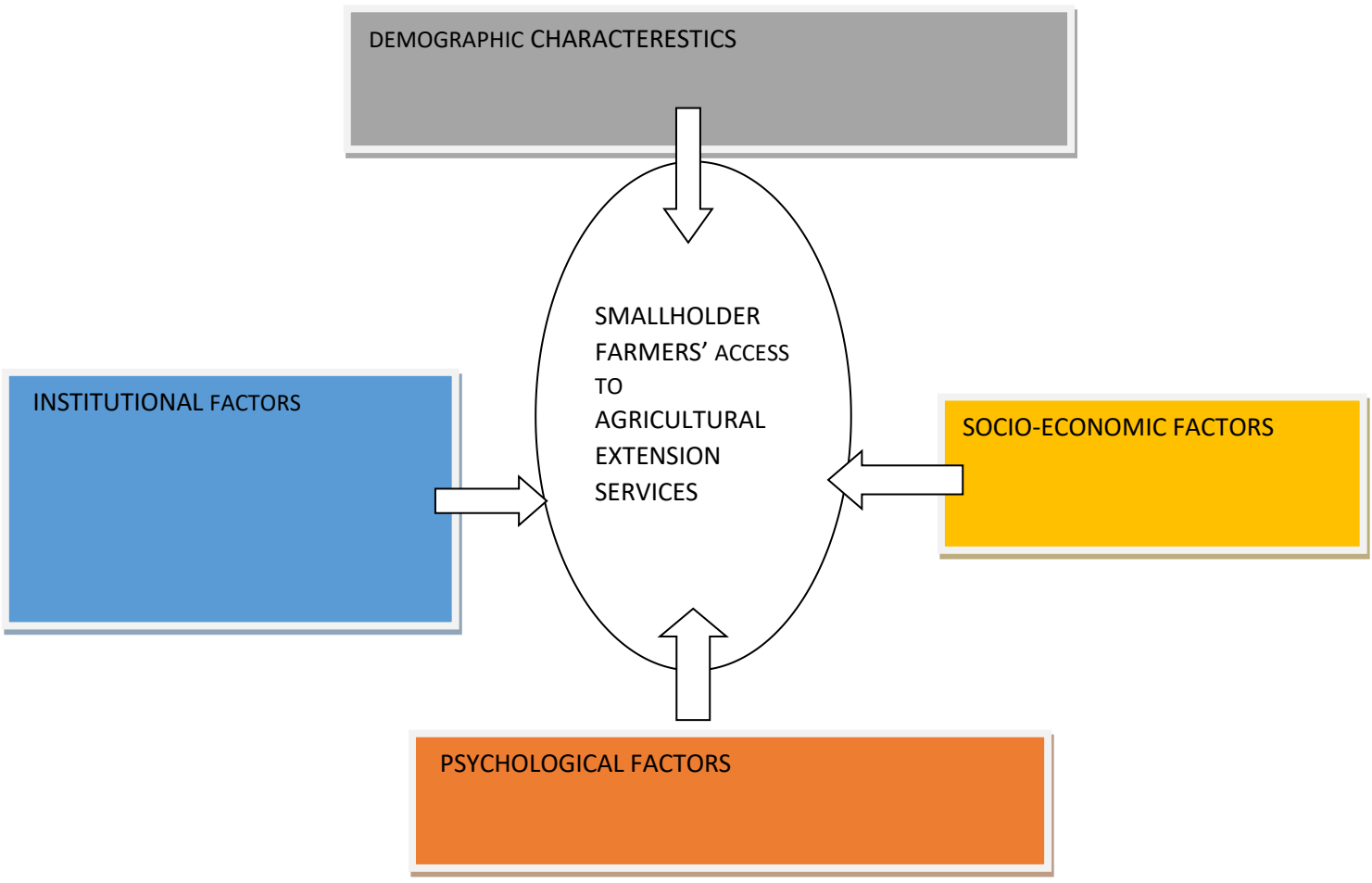


Figure 2.3.1 conceptual framework

1.11. Hypothesis of the study

Every hypotheses test requires analytical to state null hypotheses and alternative hypotheses. That if one is true; the other must be false and vice versa.

Formulating analytical plan: the analytical plan describes how to use sample data to accept or reject null hypotheses, it should be specified into significant levels (= 1%, 5%, and 10%)

Ho: smallholder farm household access to agricultural extension service has no significant correlation with explanatory variables (edu, fs, farm income, distance, land size……)

H1: smallholder farm household access to the agricultural extension has a significant correlation with explanatory variables. Or expected explanatory variables have significant influential factors on the dependent variable (smallholder farmers' access to agricultural extension service).

Also, it shows the relationship between variables which are dependent and independent variables, it also shows the direction to give a tentative answer, prediction between two or more variables, and it's useful for casual relationships. Some of these expected casual relationship between and so on.

CHAPTER THREE

METHODOLOGY OF THE STUDY

This chapter was presented the research methodology and statistical procedures that employed in conducting this research. Here the study area, sources of data and types of data, the target population, sampling technique, sample size, instruments for data collection and data analysis methods was discussed with the rationale for using each.

1.12. Description of study area

The study was conducted in Sodo zuria district, WolayitaZone, SNNP, Ethiopia. Wolayita zone has a total of 12 districts, but recently added additional district it became now 16 districts and Wolaita Zone is one of the most densely populated parts of the country with a crude population density of 385 people per square kilometer (ppkm^2). The highest population density was shown in Damot Gale, Sodozuria, and Humbo district of the zone; with 781 ppkm^2, 762ppkm^2, and 168 ppkm^2 respectively, , (CSA,2007).

Soddozuria district is one of the rural districtadministrations in Wolaitazone.The study district is located at a distance of 390 km from Addis Ababa. The Woreda has 30 rural Kebele administrative (26 rural and 4 local small towns). The total land coverage of the woreda is40,805 hectares, of which 12,269ha (35.75%) is allocated for crop production, 9,067 ha (19%) for fallow land while 12,019 ha (30.61%) for grazing land, and 7,450 ha (15.02%) for forest land(WLUM,2002). The agro-ecology of the districtis dominated by midland that covers about 87% of the total area, and the remaining 13% is highland with rugged mountains and slopes. Damota Mountain is the highest peak (over 2800 m.a.s.l) in the districtand it is considered the main water source to the surrounding communities(WFEDO,2005). Agriculture is the main

source of livelihood for more than 90% of the population in rural areas. About 93% of the wolaita including sodozuria district people are engaged in cropping activity in addition to livestock, its practice was still traditional and often characterized by low productivity. Mixed farming involving the production of cereals, root crops, Ensete, and coffee are practiced. Ensete is an essential element in the Wolayita's food economy in generally, and acts as a staple, or co-staple, food.Where land is very scarce and consequently where cereal harvests are low, high yielding, soenset offers some opportunity for food security, and it's also popular because of its drought-resistant properties.Major food crops include, in order of importance, maize, sweet potato, 'enset' (false banana), teff (Eragrostis teff), haricot bean, taro, sorghum, Irish potato, yam, and cassava. The main cash crop is coffee and "bahirzaf". Some farmers use chemical fertilizer, mainly diammonium phosphate, on food crops such as teff and maize.

The population density per square kilometer of the woreda is 470.83 which are very high. The altitude of the woreda falls in the range of 1500 to 3200ma.s.l. 6° 49' N latitude and 39° 47' E longitude and at an altitude of about 1900 m.

According to the annual statistical abstract of the region's bureau of finance and economic development(2009), the districthas a total population of 184,125 which is the second most populous district next to Humbo in the zone. Out of the total population, 90,336 are male and 93,789 are female and 80% of the total population size is rural dwellers. The total household size of the woreda has 37,005 of which 35,482 are male-headed households and 1,523 are female-headed households and the average family size is 4.8. In another word, the community of soddozuriaworeda depends mainly on rain-fed and traditional agriculture and livestock rearing for their means of livelihood(agricultural and rural development office of the wereda),Root crops play an important role in filling the gap in household food requirements, particularly during the lean season. The major livestock manages in the study area include cows, Oxen, sheep and goat, donkey, and poultry. Mule and horses were found in small numbers. Non-farm activities are the most important source of income for livelihood in the district(zuria woreda administrative bureau and WADB, 2012).

1.13. Justification for the Selection of Study Area

Wolayita Zone in general and the study area of Soddozuria, in particular, are considered the most densely populated area. This made the area be farm land-scarce, inactive participate on the agricultural supportive institution, like as agricultural extension service, high population pressure

mainly in the study area, lack of knowledge about the technical or modern farming system and, the problem of managing their limited agricultural input and crop rotation system, and others which forced especially smallholder farmers less farm output then less income leads to inefficient food availability and famine in the woreda. According to Dessalegn (2007), two-thirds of wolaita's households have landholding less than 0.5 hectares. This made the livelihood of the local household very difficult to attain better livelihood outcomes and efficient agricultural productivity. According to the Soddozuriaworeda agriculture and rural development office, the average landholding size of the woreda is 0.25 hectares (one-timed) which is very small as compared to the population size. On the other hand, a few types of research Adugna&Wegayehu (2012); Bereket (2010) were conducted in the wolaita zone. However, these researches exclusively focus on smallholder farmers' how could be accessed agricultural extension to scup up from those multiple problems and to come up with efficient agricultural productivity as well as the contribution of livelihood diversification toward alleviating poverty. However, access to agricultural extension programs for smallholder farmers is one challenge in rural livelihood. Soddozuria districtis one of the woredas in the wolaita zone that is near the major city in the zone and similar problem faces all woreda lack efficient access to institutional support on their agricultural activity addition to very limited farmland put them always under vicious circle of multiple problems.

Given these and other factors almost all rural dwellers in which agriculture is the mainstay of the people in the woreda are into account, selecting sodozuriaworeda as a study area is appropriate to show the impact of access to agricultural extension. This is the researcher's target by standing from unobserved or not given more attention part of the household to fill the gap and ensure all rural dwellers equally their economic activity.

1.14. Data source and data type

To achieve the desired objective the study that taken the place on primary and secondary data were collected to conduct this research. The primary data was gathered through the use of questionnaires, face to face intervieweeing the targeted participants, and direct observation techniques from the selected kebele households. The secondary data have been collected from various sources, such as documents, newspapers, journals, the internet, published research documents, and statistical reports from the zone, woreda, and kebele concerned office.

These surveys were designed to collect data on many dimensions of household agricultural activity, including income, from off-farm and on-farm, employment or labor farce engaged on agricultural activity, sizeof farm land, level of education, a distance far from their home or farm area to extension agent, access to the credit institution, experience to use input, dependence ratio, and other expected factors.

Both qualitative and quantitative information was gathered about smallholder farm households accessing agricultural extension services to improve their agricultural productivity in the study area to come up from multiple problems about efficient farm productivity. So, the information was gathered from a small, medium and large household member in the study area to identify and to investigate the problem that challengedthem access and visit to extension services in their farm productivity and then to show the direction how could they smallholder farmers' access and participate on extension and other institutional support. The information was gathered by a focus on taking a sample from the total number of household farmers from sodozuria district who engaged in agricultural productivity. Because the objective of the study targeted smallholder farmers, the survey take place including medium and large scale or better off farmers to compare and contrast their livelihood. But excluding another rural area that engaged in other types of economic activity (enterprise, trade, hunting ….). whereas, the qualitative data were collected by using a method like face to face interviews and direct conversation by open ended questionier and quantitative data were collected by using survey method on selected population and observation was one method of the data collection system in this research. This leads to a better conversance with the circumstances of a case and helps to assess the reactions of a face to face questions and issues raised in the course of the investigation. Face-to-face interview and questioner is explanatory method that enabled the investigator to ask and seek answers to the "how" and "why" questions associated with the research.

1.15. Sampling technique and sample size determination

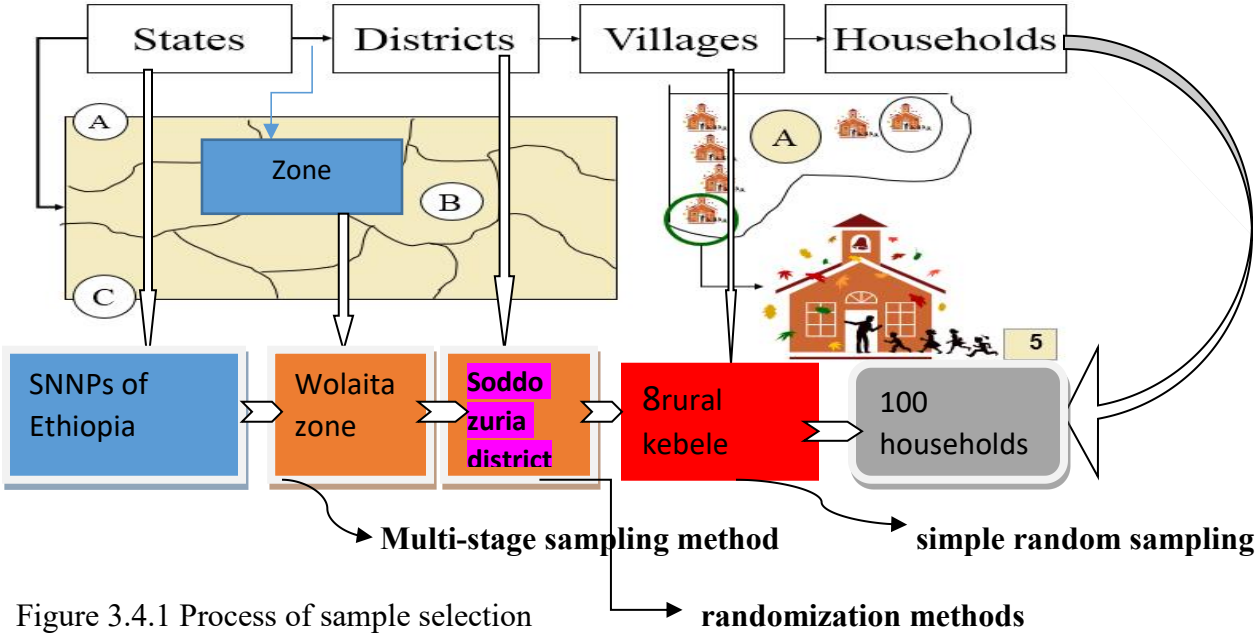


Figure 3.4.1 Process of sample selection

The research population is generally, a large collection of individual, objects, persons and other groups in the set of the population.

Target Population:- are a large group of rural population which have a common characterestics in the set of population, The total study populations of this research were the total householdswho engaged in agricultural activity in Soddo zuria woreda has 37,005 of which 35,482 are male-headed households and 1,523 are female-headed households(the data obtained from woreda ARDB).

The sampling frame is simply the sub set of the population and it have to be representative for that population from which it has drown (explorable.com 2009)

Sampling Techniques:-Soddozuria districthas a total of twenty-six (26) kebeles, excluding small town kebel. To address the objectives of the research, the sample respondents were rural household heads including male,(35,482) and female,(1,523) household farmers, (37,005) total households, and a total population of 184,125 in sodozuria district, out of the total population 90,336 are male and the majorty of remain are female. A **multi-stage sampling technique** was used to select the study sampling areaand the households level. In the first place from wolaita zone soddo zuria district was selected **random sampling method** based on their agricultural

activity, problems affect them on their farm productivity, access agricultural extension service, densely populated than other woreda and agro-ecological zone of the district. The woreda havethe total of 26 kebeles, out of these kebele, 8 rural kebelewere taken by **simple ramdom sampling methods**. Those selected kebeles were dalbowogene (1036), zalashasha (1350), mantegerera (1965), tome gerera (1470), shola koda (1137), warazalasho (1629), dalboatiwaro (1350), and qutosarfela (1747).Based on this, four kebeles fro dega and four kebeles from woynadega were selected. Then after, sample households were selected using simple random sampling method from eachselected sample kebeleto give every household an equal chance of inclusion in the sample.

In these eight (8) kebele the number of households who depend on agricultural activity estimated 11,684.The sample sized of each sample kebele households were estimated as the following sampling formula.

Sample Size Determination:-There are several methods to determine the sample size of respondents from the finite population. Sample size formula based on Yamane (1967) and recently by Glenn (1992) as cited by Joas (2015) sampling formula below. Such method is the most appropriate way of sample size determination for finite population.

$$\boldsymbol{n = \frac{N}{1+N(\alpha)^2}}, \text{ ……..(1)}$$

Where **N** is the total household of eight kebele, **n** is the sample size which represented N, and **e** is the level of precision equals or error limited (0.1) with confedence interval of 90%.

n= 11684/1+11684*(0.1)^2 = 99.99 ≈ <u>100</u>

The total sample size for the study was 100 households which determined by above formula.

The sample survey taken place from each of eight kebele based as following **proportional** number of farm house holds (respondents).

- Dalbowegene 1036/11684*100 = 8.86 ≈ 9
- Zalashasha =1350/11684*100= 11.55 ≈11
- Mantegerera =1965/11684*100= 16.82 ≈17
- Tome gerera =1470/11684*100= 12.58 ≈13
- Shola koda =1137/11684*100= 9.73 ≈10

- WarazeLasho =1629/11684*100= 13.94 ≈14
- Dalboatiwaro = 1350/11684*100=11.55 ≈ 11
- Qutosarfela = 1747/11684*100 = 14.95≈ 15

Total sample size from each kebele = 9+11+17+13+10+14+11+15 = **100**. 11,684 total number of households in study conducted area, 100 estimated sample sizes.

3.4.2 Summary of sampling size determination

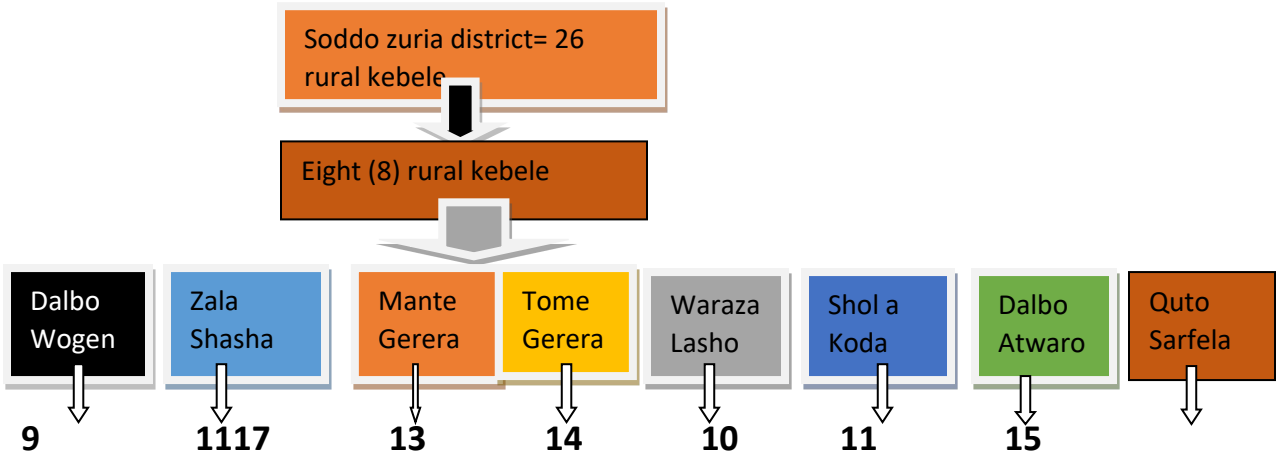


Table 3.4.2, household sampling proportion

The data collection was focused on households who engaged in agricultural activity in the study area all large, medium, and smallholder farmers to collect data in the field of farming and livestock breeding area and also home to home in a rural sample taken place area. Even though the target of this research is on smallholder households, to get full information, all households are relevantly assumed in this research.Lastly, arational number of respondents was taken from each kebele by using systematic sampling method from targeted household by estimating random sample proportion of each kebele into total household of sample kebele to determine random starting point or interval distance as the following estimation: Dalbowogene total hh=1036, sample proportion= 9, so the survey take place gap of house holds in this kebel stand from 1 up to 115, which means, (1036/9=115.11 per hh in the kebel;

- Zalashasha, total hh=1350 and sample proportion=11, so 1350/11=122.72~123
- Mantegerera, 1965/17=115.588
- Tome gerera, 1470/13= 113
- Shollakoda, 1137/10= 113.7~114

- Warazalasho, 1629/14= 116.351
- Dalboatwaro 1350/11= 122.72~123 and
- Qutosarfela, 1747/15= 116.467

Further, the distribution takes place in each kebele by asking targeted farm households (respondents) by interviewing face to face and to filling questioner who can fill and interested to give the right information in selected kebele and also direct observation was applied. It was anticipated that many farmers in the study area were unable to read and write. So the interview is most appropriate by the local language, with clarification of the instructions or questions more simple way without bias on the participants.

Also general information from different informants who have full information about farmers' and extension service and concerned institution such from woreda officials, each kebele official members, local elders and other concerned body (NGO, microfinance, agricultural college students and lecturers, agricultural material manufacture institutions, influential local members, development agents…).

1.16. Data collection methods

The data was collected using household servey, key informant interview and focus group discussion with semistructured questionnaire.Household survey questionnaire was used for gathering quantitative data to assess the socio-demographic, economic, and institutional factors that influence access to agricultural extension. Data collection was carried out familiar and simple to the geographic and socio-cultural characteristics of the study areas recruited and used one for each selected kebele. In addition, the qualitative data were collected through key informant interview and focus group discussion. Moreover, life history narratives and storytelling methods were also used to capture the possible experience about livelihood to validate the qualitative finding.

1.17. Data analysis method

The qualitative and quantitative data were obtained from the study area and secondary data or sources obtained from different statistics and other expected offices were analyzed by both descriptive statistics and econometrics analysis.The analysis was made general technique which can be fitted to all kinds of variables and interpretation, regression, describing function relationship between smallholder agricultural farmers and access to extension with explanatory variables which affect dependent variables. In addition describe by percentage, graphs, and other method computing

descriptive part of data analysis.On the other hand econometric analysis is based on three basic parts, such; specification of the models between dependent and independent variables, estimation and regression of the model, and evaluation and interpretation of the estimated model based on the regressionresults.

1.17.1. Model specification

Econometric model used to estimate and measure the relationship between dependent and independent variables. The dependent variable is a dichotomy or a binary. In this study binary logistic regression model was used. This is to distinguish or discriminate between those users or non-users of state-owned agricultural extension services.

$P_i = e^{z_i}/1+e^{z_i}$, and $1-P_i = [(e^{z_i}/1+e^{z_i}) \div 1-(e^{z_i}/1+e^{z_i})]$, $Z_i = \alpha + \sum^{n}_{i=1} \beta_i X_{ji} + \varepsilon_i$,: $P_i^* \equiv y* \equiv \begin{cases} 1 \text{ if } y* > 0, \\ 0 \ otherwise \end{cases}$

Analytical model factors influencing access to agricultural extension services can be estimated using the Probit or Logit models especially when the dichotomous nature of the dependent variable is taken into consideration. Logit and probit models translate the values of the independent variables (X), which may range from $-\infty$ to $+\infty$ into a probability for (Y) which ranges from "0" to "1" and compel the disturbance terms to be homoscedastic. This makes the selection between the two models very sticky as both models provide equally efficient parameters rather than interpretation of results. The forms of probability functions depend on the distribution of the difference between the error terms associated with a particular choice. The probit and logit models assume the existence of an underlying latent variable for which a dichotomous realization is observed as:

$$\mathbf{Y_i^* = \beta_o + \beta i \ldots . + e_i} \text{----------(4)}$$

Where $Yi*$ is a latent variable (not observable) and what is observed is a dummy variable Yi defined as: $\begin{cases} 1 \text{ if } y* > 0, \\ 0 \ otherwise \end{cases}$ ----------(5)

In order to estimate the probabilities of smallholder farmers' access to extension services or non-access in this study preferred to use a binary logistic model since the results are similar to probit. Despite to their comparative advantage, however Guajarati(2008) suggested that, BLRM is more appropriate, due to continuous independent variables expected to include, and its' meaningful interpretation of the **odds ratio**, it closed to approximation to a cumulative normal distribution,

and flexible from mathematical point of view rather than probit and tobit models. Therefore the Logistic **model** specified as:-

EXP(pi/1-pi) =$\alpha+\sum^{n}_{i=1}\beta iXji+\varepsilon i$ ----------(6)

The probability that a smallholder farmers' are access to agricultural extension service is denoted as P = P[Y = 1] and the probability that smallholder farmers' are not access to agricultural extension service is denoted as P = P[Y = 0]. Thus Pi represents conditional probability that smallholder farmers'have access to extension service while (1−pi) denotes conditional probability that smallholder farmers' have no access to extension service. Bi's a vector of coefficients to be estimated(slop); Xi's a vector of explanatory variables and εi's is the error term(disturvance).

Let say, Pi denotes the probability willing to access ext service =1, otherwise =0. (Zi) stand for function of Pi and explanatory variables (Xi), expressed as:

Zi = β0 + β1χ1 +β2χ2 + -------- + βnχn.----------(7)

Zi = β0 + β1χ1 + β2χ2+ β3χ3+ β4χ4+ β5χ5+ β6χ6+ β7χ7+β8χ8+ β9χ9+ β10χ10+ β11χ11+ β12χ12+ β13χ13+ β14χ14+ β15χ15+ β16χ16+ β17χ17Ui.OR

Following Green (2003) and Gujarati (1995) the logit model for the determinants of smallholder farmers' access to agricultural extension service can be specified as below.

However, the independent variables were both continuous and dummy variables as described above. According to Pindyck and Rubinfeld(1981) the cumulative logistic probability function is specified as;

Pi= f(Zi)= f(Bo+ $\sum_{n=1}^{m} BiXi + ei$)= 1/1+$\mathbf{e}$-(Bo+$\sum_{n=1}^{m} BiXi + ei$)----------(8)

Where: pi represents the probability of that ith small house holds would made a certain decision (in this case households access or not, and that a certain household heads have role in decision of their agricultural productivity or not given explanatory variables (Xi); e= represents the base of natural logarithms,

mi = represents the number of explanatory variables, i = 1, 2, 3 …, m, and Bo &Bi represent to be estimated.

The coefficient interpretation is understandable if the logistic model once written in terms of the odds and log of odds (Hosmer and Lemeshow, 1989). The **odds ratio**is simply the ratio of the probability of being access extension service (**pi**), otherwise (**1-pi**).

pi is non-linear not only in Xi but also in B_o&B_i which creates an estimation problem. Therefore, the log transformation is the most popular among the different types of transformations used to transform applicable data to approximately conform to normality.

The procedure to estimate the parameters.

$pi= e^{Bo+\Sigma Bi+ei}/1+e^{Bo+\Sigma Bi+ei}$ ----------(9)

$1-pi=(e^{Bo+\Sigma Bi+ei}/1+e^{Bo+\Sigma Bi+ei}/1-[\ e^{Bo+\Sigma Bi+ei}/1+e^{Bo+\Sigma Bi+ei}])$ ----------10

Therefore the odds ratio becomes:

$Ln(p/1-p), = fLn(\alpha+\sum^{m}_{i=1} \beta ixi+\varepsilon i)$ ----------11

{ Pi= {1 if Pi>0}

{0, otherwise}

$(P/1-P)= (e^{\alpha+ \beta iXi+\varepsilon i}/1+e^{\alpha+\beta iXi+\varepsilon i}/1-[e^{\alpha+ \beta iXi+}\varepsilon i/1+e^{\alpha+\beta iXi+\varepsilon i}]$), ***where as Pi= $e^{zi}/1+e^{zi}$***

logit transformation process is;

$log(e^{\alpha+\beta iXi+\varepsilon i}/1+e^{\alpha+\beta iXi+\varepsilon i}/1-e^{\alpha+\beta iXi+\varepsilon i}/1+e^{\alpha+\beta iXi+\varepsilon i})=$ $Ln(e^{\alpha+\beta iXi+\varepsilon i/}1+e^{\alpha+\beta iXi+\varepsilon i}/1-[e^{\alpha+\beta iXi+\varepsilon i/}1+e^{\alpha+\beta iXi+\varepsilon i}])$

= (p/1-p)*= ln(p/1-p)=►Zi= α+βiXi+εi=0 =►odds Ratio (log odds). The relation ship between the probability to access Ln(p) or oddis ratio and predictor variables (xi) is assumed to be alinear and its fit to appropriate log oddis interpretation due to its both continous and categorical explanatory variables.

Dependent variable =Small holder farmers access to agriculturalextension service (SHFACCEXT).

Independent variables= age, gend, family siz, edu., farm siz, time spent on farm, exprie to use fertilizer, distance to extension cent, num of oxen held, num of labor force, num of dependency, knowl of use phone, annual income from off-farm, livestock owned, and accto cr. were included in the study model.

Explanatory variables of the study were identified through review of the empirical literature on factors influencing smallholder farmers' access to extension service, past research findings, and the author's only knowledge of the extension service schemes of the study area were used to establish working hypotheses and were that not included important variables on the model. Also, many factors, have been related to smallholder farmers' access to agricultural extension service, not worked in this study area, and no more detail included the following demographic, socio-economic, and institutional factors were hypothesized to explain which are expected to influence the dependent variable.

SHFACC= f(age, gen, family siz, edu., farm siz, time spent on farm, exprie to use fertilizer, distance to extension cent, num of oxen hold, num of labor force, num of dependency, know of use cellphon, livestock own, exp. use of crd., farm-off inc.)were expected to affect dependent variable.

$Y = f(Xi)$ --(2)

$Y = f(\beta_0+\beta iXi+Ui)$ ---(3)

$Y = f(\beta_0 + \beta 1\chi 1 + \beta 2\chi 2+ \beta 3\chi 3+ \beta 4\chi 4+ \beta 5\chi 5+ \beta 6\chi 6+ \beta 7\chi 7+\beta 8\chi 8+ \beta 9\chi 9+ \beta 10\chi 10+ \beta 11\chi 11+ \beta 12\chi 12+ \beta 13\chi 13+ \beta 14\chi 14+ \beta 15\chi 15+ \beta 16\chi 16+ \beta 17\chi 17+Ui)$(actual population),

$\bar{Y} = f(\beta o+\beta 1\chi 1 + \beta 2\chi 2+ \beta 3\chi 3+ \beta 4\chi 4+ \beta 5\chi 5+ \beta 6\chi 6+ \beta 7\chi 7+\beta 8\chi 8+ \beta 9\chi 9+ \beta 10\chi 10+ \beta 11\chi 11+ \beta 12\chi 12+ \beta 13\chi 13+ \beta 14\chi 14+ \beta 15\chi 15+\acute{\varepsilon})$ (expected or sample population)

Where Y is response or true variable, β0 is constant parameter or intercept, even iff Xi= 0, Y=β0, βi is parameter to be estimated; Xi is independent variable which affect explained variable and Ui is disturbance or unexplained in the model.

$Pr(yiEj)= pr(\beta o+\beta 1\chi 1 \ldots\ldots + \beta 15\chi 15+\acute{\varepsilon})$

$\bar{Y}= pr(\beta o+\beta 1age + \beta 2gender+ \beta 3educ+ \beta 4dep.ratio+ \beta 5labfr+ \beta 6livst+ \beta 7sfl+\beta 8oxen+ \beta 9soilchr+ \beta 10know.\ fertzr+ \beta 11accrd+ \beta 12pragr.inp+ \beta 13willg+ \beta 14offinc+ \beta 15distext+\acute{\varepsilon})$

1.17.2. Definition of variables

As discussed above binary logistics model has been employed to examine the determinant of smallholder farmers' access to extension service to coping from problem facedthem not to be access effectively extension services to producing efficient farm output leads to ensure their food efficiencyand eradicate poverty in the study area. The following are the dependent and

independent variables described by binary logistic model examination of smallholder farmers' access to extension service to improve their agricultural productivity.

Dependent variables: smallholder farmers' access to agricultural extension service. It is dummy or dichotomy variable that can be explained access or not access toagricultural extension service. It represents by 1 and 0 respectively.

Independent variables: independent variables which would have tested through regression method where: Socio-demographic characterestics, socio-economic and institutional factor of variables which are confirmed by different literatures in influencing smallholder farmers' access to extension service and their farming activity. These are:

Gender of household head (SEXHH): In most research female found to be less access institutional support, less productive and food unsecured due to different social and economic reasons. On the other hand male-headed households have higher probability than female household head in easily accessing extension service than that of female headed house hold (T. Urgessa, 2015; cited by Daniel Temesgen, 2021). This study, like as other researcher by taking gender of the household head as a dummy variable that expressed, butassumed1 for female and 0 otherwise, and hypothesized that if 1 could have negativeinfluence on access extension service.

Age of household head (AGHH): it is discrete, described in numbers, measured in years, the probability of older or increasing the age of smallholders expected to positive on more experienced by accessing institutional package and solve problem faces on farming activity, by using input and adaptation of risk associated with exprience to access and farming practice (N. Assan, 2014; Abebaw and Haile 2013; and Bernard et al., 2013).

Level of education household (EDHH): is a dummy variable measured in level of schooling achieved by the household. It categorized by four levels as researcher believe: 1 if illiterate, 2 if read and write 3 if primary and secondary, 4 if higher education level. Household heads that are literate are expected to have a better knowledge of how to make a living. Educated household heads are very ambitious to get information and access. This variable also guided by Verhofstadt and Maertens (2014); Mojo et al. (2015) confirmed that it's positively influence the acess to extension services. Not only this but also education is very important in any economic activity

that level of education increase also get more advantage and skill in risk management, high opportunity to use modern technology, and other decision making and so on.

Family size (HHFS) - Family size of household is assumed to represent the labor input to the agricultural activity and on other hand dependencies in the household members who live and take food from the same dish and live under one roof. Therefore it affects dependent variable either positive or negative and expected to significantly influential factor. It is a continuous variable measured by the number and by changing the number of members in a household in to adult equivalent(Abebaw and Haile, 2013).

Dependency Ratio (DRHH): is continuous variable measured based on the number of dependency that household head were responsible to feed and govern.it considered affect to dependent variable negatively ((Nwaru, 2011).

Distance to extension center (DSEC): distance of the farming area to the near or far to center of extension visit effect households farming activity and accessing extension services. Distance to extension center area is categorized by interval of kilometer that was measured in terms of kilometer farmers to extension center.It's expected sign is either –ve or +ve (Maertens, 2014).

Farm size of HH (FSHH): It is continuous stay by the household potential effect on their level of land access to agricultural activity. Therefore, it was positively or directly related with response variable that was measured in terms of hectare crop and grazing covered (Francesconi and Heerink 2011; cited by Hiwot Mekonnen Mesfin, 2017;Maonga et al., 2015)

Credit received (CREDRE): credit is an important source of financial and other form of capital for the small household with poor resource base. Therefore, It is dummy variable denoted if household receive credit over the last production season or did not receives. According to Norton et al. (1970), and Deribe Kaske Kacharo (2007), credit helps farmers purchase inputs such as improved seeds, fertilizers and pesticides and so on.

Total livestock endowed by the household (LIVST): it is the total number of livestock endowed by the smallholder households in study area. It is continuous variable expresses in total live stock will be counted, or measured with Tropical Livestock Unit (TLU). It also appositive anddirectly related with extension service receipt (Kiros Habtu Ferede, 2012).

Time spent on the farming activity (TISP) – it is important in any business activity to increase amount of output, income or other benefit. So smallholder farmers' time spent on their farming activity an important variable and also advantage for the participant member in extension service. Therefore, it is catagorical variable expressed by hour or minute spent on farm activity and visit extension(Chilemba, J. and Maganga, A.M., 2017).

Knowledge use of ICT or mobile phone (KNUSEMPH): it is one of important factors in access and participate to extension service about technical input, information of agricultural input and output market price, access credit to fill the constrain in the agriculture, food price, fertilizer, and other. It measure by mobile phone get information from extension and other institutional package. It is a dummy variable, which takes 1 if the farm household has knowledge to use it and receive information and 0 otherwise. The farmers who has more information through by mobile/cell/ phone, radio, and other media, that the farmers have the advantage of getting information about new technology, input and price by contacting with experts or extension agents. The farm household that owns either radio or mobile or both is expected to have high probability to participate in agric. extension service, due to this the agricultural productivity also high(Nhundu et al., 2010).

HH income from non-farm (HHINC)- house hold income one factor affecting agricultural activity positively/negatively/ to influence of access to extension service. It measures by money received from non-agricultural commodity selling, by USD(Deribe kaske kacharo, 2007).

Number of oxen (NUOX)- continues number and most important input to plough. If the farmers have more number of oxen, those farmers produce and boost high output, which leads them more likely to access extension service. So it considered positively effect on access to extension service.

Soil chxcs (SOCHX)- It is a dummy variable which takes value 1 if the land is fertile and 0 otherwise. Here soil chaxcs is determined based on the response of the survey of households were taken place. Fertility of land has direct relationship with productivity. If the farm land is fertile the household can produce more and my not or might be need experts service package, if the land is infertile or somehow moderate, it considered less output and affect farmers' access to extension service positively, because these farm house hold my need some of important farm inputs i.e. fertilizer, improved seed, and others. Thus, it is expected that households with fertile

land have more income than households with infertile land indicating a positive relationship with household income and access to extension service.

Labor force participate on farming activity(LFPAR)- most of other developing countries, as well as in study area labor is most extensively used inputs of agricultural productivity. Adoption of new technology demands additional labor force for different farming operations. A small holder household with large labor force can access extension service more likely than a household with small number of labor force. Furthermore, Households with large family size will have more number of agricultural labors and hence, will have more agricultural productivity (output),so it is a direct relationship with access to extension(D. Haile, S. Gizaw, and K. Kefelegn, 2015).

Table 3.6.2: Description of Explanatory Variables and their expected sign that affect smallholder

Factors	Explanatory variables	Measurment(unit)	Variable Descriptions	Nature of variable and (expected effect)
Demographic factors	**AG**	Year	**Age of household head**	**Continuous var. (+)**
	Gender	Sex of HH	**Sex of household**	**Dummy variable by coding 1, if female (-)**
	FASZ	Number	**Family size of HH heads**	**Continuous variab. (+)**
	DEPRAT	Number	**Dependence ratio**	**Continuous variable, (--)**
	LABFPAR	Number	**Labor force participate in farming activity**	**Continuous var. (+)**
	LEV EDU	By level	**Level of education**	**discrete, (illiteracy=0, (+)**
socio-economic factors	**HH INCFAR**	Birr/$/	**HH income from farm**	**Continuous var USD (+)**
	LIVST	Umber	livestock owned	**Continuous (+)**
	NUOX	Number	Number of oxen held	**,, ,, (+)**
	OFFINC	Birr/$	**annual off-farmincome**	**Continuous, by USD (--)**
	SOiCHX	Nutrient	Soil character	**discrete 1, if fertile (+/--)**
	TISP	Minute/day	Time spent on the farming activity	**discrete, 1, maximum (+)**
	CREDRE	Amount by birr	**Credit service received by households**	**Dummy 1, if non-receive ETB (--)**

institutional factors	**DISEXTCEN**	km	Distance to extension center	**discreteif 1=far km from hh to ext. (-)**
	PRCFRINPT	**birr**	**Price of agricultural inputs**	**Dummy, I if high (-)**
	WILLGNSS	**Preference**	**Willingness to access extension services**	**Dummy, if 1 have no willingness (-)**
	EXPUSFERT	**KG/QOU/**	**Experience to use fertlizer**	**Dummy, 1, if no experience (-)**

Table 3.6.2, own expected sign and nature of variables (2022)

1.17.3. Hypothesis testes

Smallholder Farmers in the rural parts of Ethiopia particularly in the study area are characterized by heterogeneity in various aspects of livelihoods like differences in resource endowments, knowledge of farming practices, the ability of scarce resource utilization and their management, and other socio-economic factors which could lead to differences in their access to agricultural extension services and agricultural productivity. The null hypothesis is rejected if the calculated chi-square or Z value is over than the critical chi-square, (Z) with degrees of freedom equal to the number of restrictions at null hypothesis at 1%, 5%, and 10% level of significance i.e. LR>χc2. If the sample size is large the test statistic λ follows the chi-square (χ2) distribution with degrees of freedom equal to the number of restrictions imposed by the null hypothesis. We can formulate the following null hypotheses:

The hypothesis that chooses the appropriate functional form for binary logit model that can adequately represent the data was tested. In fact the choice of functional form has insignificant effect on the overall results and limited effect on empirical efficiency measurement in particular. H0: $\beta1 = \beta2 = \ldots = \beta15 = 0$. The coefficients of the predictor variables are simultaneously zero against H1. H1: coefficients of explanatory variables in binary logit model are statistically significantly different from zero meaning that the explanatory variables are important in the model. H1: $\beta1 = \beta2 = \ldots = \beta15 \neq 0$, the researcher would like to check it by cross tabulation statistical tests and other important tests would be checked.

1.17.4. Diagnostics Tests

3.6.4.1 Multicollinearity Test

Checking the multicollinearity of explanatory variables before the estimation of the model parameters is important to take necessary remedies. Detecting multicollinearity by using diagnostic tools could be viewed as an attempt to distinguish a bad model from bad data. A serious failure of assumptions of the model, not on the data, happened when the two variables are perfectly correlated, and that leads to infinite variance. But, the more common case is one in which the variables are highly correlated. In this case, although a potentially severe statistical problem happens, the regression model retains all its assumed properties. Small changes in the data produce wide swings in the parameter estimates, coefficients may have high standard errors and low significance levels even though they are jointly significant and the R^2 for the regression is quite high, coefficients may have the "wrong" sign or implausible magnitudes are problems faced by applied researchers when regressions are highly correlated.

A variance inflation factor (VIF) = $1/(1- Rk^2)$ for each coefficients in a regression as a diagnostic statistic (Greene, 2012). As a rule of thumb, the variable is said to be highly collinear when the VIF is greater than 10 which will occur if $Rk^2 > 0.90$(David et al., 1988).

This mean ***VIF****is between* ***1&, (1<VIF<∞).***

If ***VIF >=10 sivermulticolli,*** *if* ***VIF<10 no multicolliniarity***.

Other measure computed the correlation tests, interdependence between predictor variables, to show the validity and consistency of the variables which entered in this model.

Also chi - square tests run to check its association.

3.6.4.2 Hetroscedasticity

Test Disturbance is heteroscedastic when they have different variances (V (εi) = $\sigma i2$)). It means that the error terms are mutually uncorrelated, while the variance of εimay varies over the observations. Heteroscedasticity may occur due to the high value of the explanatory variables, measurement error, subpopulation difference or other interaction effects, and other model misspecification. If all assumptions are satisfied heteroscedasticity, it does not result in biased parametric estimates. There are many tests for detecting heteroscedasticity. While here theinterdependence correlation test is designed to detect any linear form of heteroscedasticity

which tests the null hypothesis that the error variance is equal versus the alternative that the error variances are multiplicative functions of one or more variables. In this study also chi-square was applied, it indicates whether heteroscedasticity is present or not by chi-square value and significance level. The value of **chi-square** should be greater than 5 and the probability level should be less than 10%. This means if it became accepted null hypothesis there is homoscedasticity, if it can be rejected it can be heteroscedasticity.

CHAPTER FOUR

Results and discussion

Thischapter is designed for data presentation and analyses which were gathered from the sample selected household heads based on the basic research questions of the study. The analysis shows the determinants of smallholder farmers' access to public agricultural extension services to improve agricultural productivity leads to aliviate poverty and ensure food securty in Sodo zuria woreda. This can be achieving by full and effective participation of smallholder farmers in each extension and other institutional programs.

The first section of the result discussed the descriptive statistics part of socio-demographic, economic and institutional factors of the respondents. The findings are presented in the form of tablesand graphs. The collected data were also assessed for consistency, validity, and reliability using chi-square and other correlation methods.The second section presentedthe econometrical part of analysis used binary logisticregression model using SPSS and STATA software.

The sample size of the study is 100. All expected respondents completed questionnaires. This represented a response rate of 100%, which adequately represented the households and made it possible to make inferences. As evidence of the data, 81% of the respondents are considered smallholders. The remaining19% aremiddle and large-scale farmers', (Table 4.1.1, and 4.1.2). In addition, the data acquired from woreda of ARDO and FEDO file also shows that the total number of safety net beneficiaries, those households safe from famine or food insufficient either constantly or some of them support during food shortage season, such 3748hh or 14994 population get safety net twice a year and 412 household or 1650 total population gets safety net continuously through all the month (direct support) of in the woreda level. This means as data of woreda show that, 17% of households level and 11.24% of total population level in the woreda

needs constantly safety net support or under famine situation., Smallholder farming system can easily be understood and identified by the problem faced by them, their wealth and management capacity on technology disseminate, farming status, their wealth potential and capacity to use or access input, level of education & use of technicalfarming and knowledge to information system to communicate and search of information rather than these large and middle scale farmers'. So this shows that almost all farmers considered small-scale farmers in the study conducted area.

Therefore this chapter is designed to identify the rooted problems faced by those farmers and to explore the direction by measuring the determinant of access to extension services and this leads to improving agricultural productivity of all farm households equally (female, small-scale, and minor farmers' or who are economically disabled households) closed to with large and medium farmers by applying different method.

Characteristics of Background Variables

1.17.5. Demographic characteristics of the respondents

This section describes the analysis of the demographic characteristics of the sample respondents who participated in the study area. These demographic characteristics include gender, age of household, family size, education level, labor available, and dependency ratio.

Table 4.1.1 shows the frequency and percentage of background variables of participants who participated in study area.The gender distribution of the sample participants is presented in the table shows that about 78.0% (n = 78) of the participants are male headed farming households and 22% are female-headed farming households. This indicates that the majority of farm operation is managed by male-headed households in the study area. The reason for this majority of having a large number of male participants might be due to the culture of Ethiopia agricultural tasks, where most of the households are headed by a male compared to female-headed. As indicated in the cross-tabulation below shows that the probability of male households' access to extension is more likely than that of female heads (73.1%. n=57 and 68.2%, n=15 respectively), and the rest 26.9% of male and 31.8% of females are no access to agricultural extension services respectively. The information obtained from key informants and focus group discussion participants showed that women work either on their own farms or work as laborers on their

farms. In addition, the majority of women engage in non-farm sectors and salary jobs as their main occupation, and more of them reported domestic work as their main occupation.

Table 4.1.1 Demographic characterstics and association of different background variables regarding agricultural extension

Background variable	**Group**	**Access**	**Not access**	**Frequency**	**Percent**
Gender	Male	57	21	78	78.0
		79.17%with73.1%	75%with 26.9%	78.0%	100.0
	Female	15	7	22	22.0
		20.83%with 68.2%	25%with 31.8%	22.0%	100.0
	Total	72	28	100.0%	100.0
	X^2 and P-value=	.204a&.419 respectively			
Age	<= 38	32	13	45	45.0
		44.4% with 71.1%	46.4% with 28.9%	45.0%	100.%
	39 – 50	23	10	33	33.0
		31.9%with 69.7%	35.7% with 30.3%	33.0%	100%
	51+	17	5	22	22.0
		23.6% with 77.3%	17.9% with 22.7%	22.0%	
	Total	72	28	100.0%	100.0
	X^2 and P-value =		.408[a]&.816		
	Maximum, minimum		65 and 23		
Educational Level	Illiterate	22	7	29	29.0
		30.6% with 75.9%	25.0% with 24.1%	29.0%	100
	write and read	22	14	36	36.0
		30.6% with 61.1%	50.0% with 38.9%	36.0%	100
	Primary &	22	6	28	28.0
	secondary	30.6% with 78.6%	21.4% with21.4%	28.0%	100
	College & higher	6	1	7	7.0
		8.3% with 85.7%	3.6% with 14.3%	7.0%	100.0
	The value of X^2 and P-value = 3.585a .310 respectively				
	Maximum, minimum = 4 &1				
family size		Access	Non accessed	Frequen	%tage
	1-3	9	7	16	16.0
		12.5% with56.25%	25% with 43.75%	16%	100.0
	4-6	44	12	56	56.0
		61.1% with78.57%	43% with 21.43%	56%	100.0
	7-9	14	7	21	21.0
		19.44%&66.67%	25% with 33.33%	21%	100.0

	>9	5	2	7	7.0
		6.94% with71.43%	7.14%with28.57%	7%	100.0
	X^2 and P- value = 17.368[a] and .097 respectively Minimum and Maximum = 1 up to 13				
dependence ratio	0-1	31	12	43	43.0
		43% with 72.1%	43% with 27.90%	43%	100
	2-3	31	12	43	43.0
		43% with 72.1%	43% with 27.90%	43%	100.0
	>3	10	4	14	14.0
		13.9%with71.43%	14%with28.57%	14%	100.0
	X^2 value and P-value = 8.533[a] and.202 Maximum- minimum = 6 and 0				
labour force	0-2	48	23	71	71.0
		66.67%&67.60%	82.14%with32.4%	71%	
	3-4	22	5	27	27.0
		30.56%with81.5%	17.9% with 18.5%	27%	
	>4	2	0	2	2.0
		2.78% with 100%	0, 0%	2%	
	X^2 and P-value = 8.844[a and] .014 Maximum—minimum = 8 and 0 respectively				

Source, own survey (2021/22)

Regarding to the age of participants, relatively the majority of participants (45.0% and 33%) were in the age range from less or equal to 38 and in the age group of 39-50 years old respectively. whereas the age of +50 years old is only 22% of the information of participants in the study area. Age is also one of the decisive factors in the probability to access extension services to improve agricultural productivity. Since agriculture is labor-intensive and age can be related to experience, as a result, the older farmers are more accessible to and participate in extension services (77.3%) than that the younger and age of households between 39-50, compared to the age group in the above table 4.1.1. Therefore, as age increases to experience and knows the importance of extension service received by farmers, and then input adoption and productivity increase up to a certain age limit.

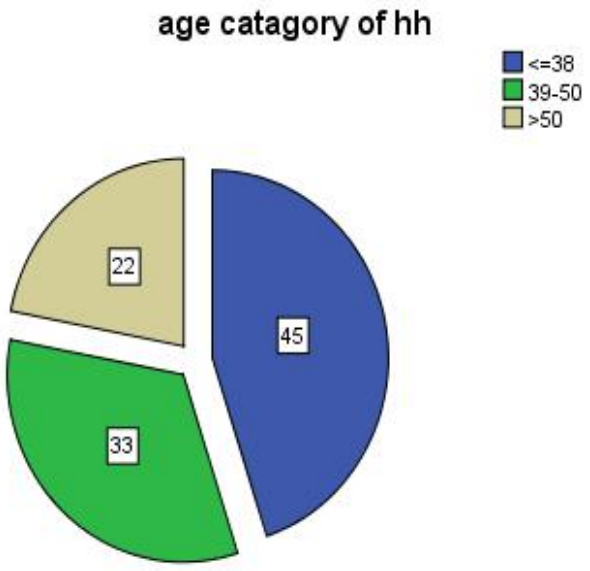
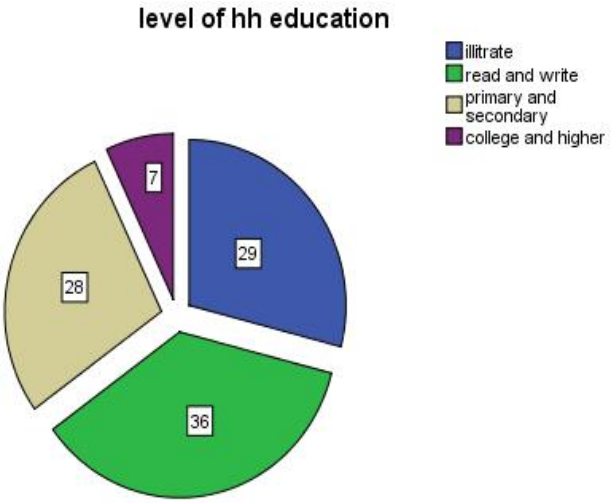


Figure 4.1.1a Age distribution of sample respondents

As a result of the statistical test reveals in the above table, 44.4% out of the age of <=38, 31.9% age of 39-50 and 23.6% of age range above 50 have access to extension service within the term of accessed household heads respectively.On the other hand, 71.7%out of age <=38, 69.1%out of age 39-50, and 77.3%out of age above50 are accessed in term of comparing with its age group respectively. Whereas, the remaining household heads had not accessed.The minimum and the maximum age range is taken from the study area is 23 and 65 years respectively, with mean and standard deviation being 1.77 and .79, respectively. The statistical test result showed that there was no association between age and agricultural extension.

As far as education plays an important role in bringing high opportunities and skills in receiving and participating in extension agent service to attaining better households' well-being. Table 4.1.1 indicates that out of the total sample respondents, (29.0%, n=29) of the respondents had not attended any level of education. The largest number of respondents replied that 36% (n= 36) can read and write which of them, n=14(38.9%) had no access to extension service. On the other hand, 28% (n=28) were attended primary and secondary education levels. Only 7% (n =7) had reached a higher level of education, (either technical, certificate, preparatory, or college, and university level). When farmers attend education higher and higher are more effective in technology usage. Farmers with basic education are more likely to access extension services, this leads them to adopt new technologyand information.Most smallholder farmers in the rural area of Ethiopia are less literate, and even cannot read and write, which shows the evidence of the study conducted in the area.



On the other hand, the result reveals that 78.6% primary and secondary, 75.9% illiterate, 22(61.1%), read and

write, and 85.77% college and higher were accessed extension service within the term of each level of educational background. The minimum and maximum levels of this variable are considered from 1 up to 4 levels of categories, the average is 2.13 with a standard deviation of about .917.

Figure 4.1.1b Educational distributions of sample respondents

The distribution of family size regarding access to agricultural extension (Table4.1.1), a family size with 1-3 members accounts for about 16 percent of the respondents,and out of them 56.25 %(n=9) were accessed extension services. While 56%of respondent reported that4-6 number of families accounts the largest share of numbers in the study area.Out of them 78.57%(n=44) were accessed and contacted with extensions and other respondents also respond that 21%7-9 number of households, of them 66.67%were received extension services.The remaining 7%have more than 9 number of familiesand out of them 71.42%have been accessed to extension services.The largest family size receive extension packages more than that of less number of families, which means a large number of families available households more benefited either accessing extension service leads them producing high output than that of less family size, which is associated with a large number of labor contribution. The minimum and maximum numbers are considered from 1 up to 13. The graph of the family size below shows positively skewed and normal carves.

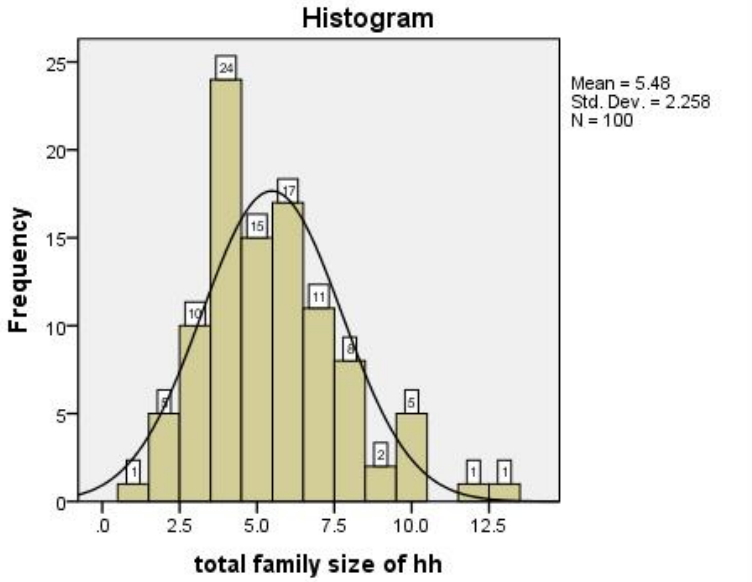


Figure 4.1.1cThe distribution of sample respondents regarding family size

The effect of labor force and dependency ratio

Table 4.1.1 presented the distribution of labour force interms of agricultural extension. The result revealed that about 71% (n=71) of respondents have a number of labor 0, 1, and 2and about27 %(n=27) of respondents report 3 up to 4 number of labor.The remaining 2% of households have more than 4 numbers of labors. The contribution of labor to agricultural activity and the probability of participation in the extension package program are important factors that increase productivity more. The key informants and focus group discussion participants stated that the level of labour force is low and the dependency ration is high compared to other areas because of that active age group flew to the local town and other towns to search off-farm works.In addition, informants also said that there is a very small piece of farmland which only a few numbers of labor would work and other go to search other jobs to generate additional income in order to cover food problem and other social constraints.However, farmers who have the largest number of labor force have anadvantage to engage on farming more which leads them to want to search extension service and participate on extension agent supportive package.

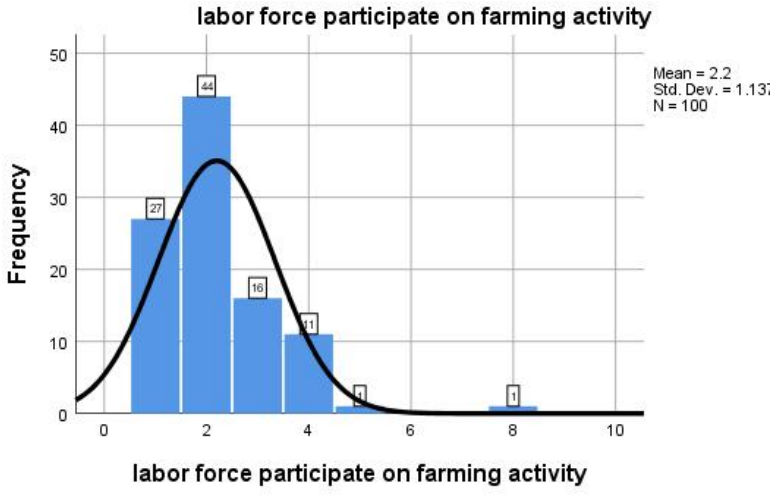


Figure 4.1.1d The distribution of sample respondents regarding family size

On the other hand, the dependence ratio affects households negatively regarding their willingness to access. As information of above table 4.1.1, dependent families 0-1, and 2-3 accounted 43%each and >3 number of dependency held household about 16% (n=16).The real dependence ratio takes the proportion number of inactive or non-working force to the age boundary. This dependence refers to the number of children under age 15 and age over 65. So, it

affect negatively, dispite to receiving to effective and efficient extension services. This is because of a high number of dependencethat household has high dependence burden. The minimum and maximum number of dependency ratio is 0 and 6 as well as the mean family size of sample households is 5.48 with a standard deviation of 2.26.

1.17.6. Socio-economic and institutional factors

This section presents the socio-economic and institutional factors such as size of farmandgrazing land, livestock owned, oxen held, income, access of input for agricultural purpose, access to credit, distance to extension, and other related factors discussed as follow.

Size of farming and grazing land of respondents

The cultivable land in the study area is the scarcest resource, which limits smallholder farmers' output and income earned from farm sources. The key informants and focus group discussion participants point out that the study area is characterized by very small and highly fragmented landholding due to the high density of population and expansion of the small town. So,size of farm land is continuously decreases both qualities and quantities. Inaddition to this loss of soil nutrients is depelate by erosion. Moreover, the the result showed in table 4.1.2 revealed that about60%(60) of farmers have less than 1.0 hectares of farm and grazing land including none farm land households. On the other hand, about32% of sample farmers have 1 up to 3-hectares and only 8% of householdsheldmore than 3 to 5-hectaressize of farmland. This data shows that the constraints of the size of farmland were a serious problem in the study area.

In spite of the extension services intervention, a very large number of the farmers' farm on a small piecesof land (67%) and this might be the reason why subsistence farming dominates in this study area with farm income low and poverty high, as well as less willingness of farmers' access to agricultural extension service.As the result below (Table 4.1.2) reveals that who have farmland 0.25 hectare, are 22 out of 29(75.9%) reported that, they had accessed.On the other hand, 0.5 hectare holders out of27 households among18(66.7%) have been accessed. Wheras, 0.8 hac held households only 2, out of then 50%(1) household have been accessed. 1hectare and 1.5 hectare held households are 7 and 8 respectively out of them 85.7%(6) and 62.5(5) have been accessed respectively. The remaining 2.0hac, 2.5hac,2.8hac, 3.0hac, 3.5hac, 4.0hac, 4.5hac and

5.0hectare held households, about 3/3(100%), 6/8(75%), 1/1(100%), 3/5(60%), 1/1(100), 1/1(100), 2/3(66.7) and 3/3(100%), have been accessed extension services either their farm field or extension center within the term of farm size respectively.respectively.

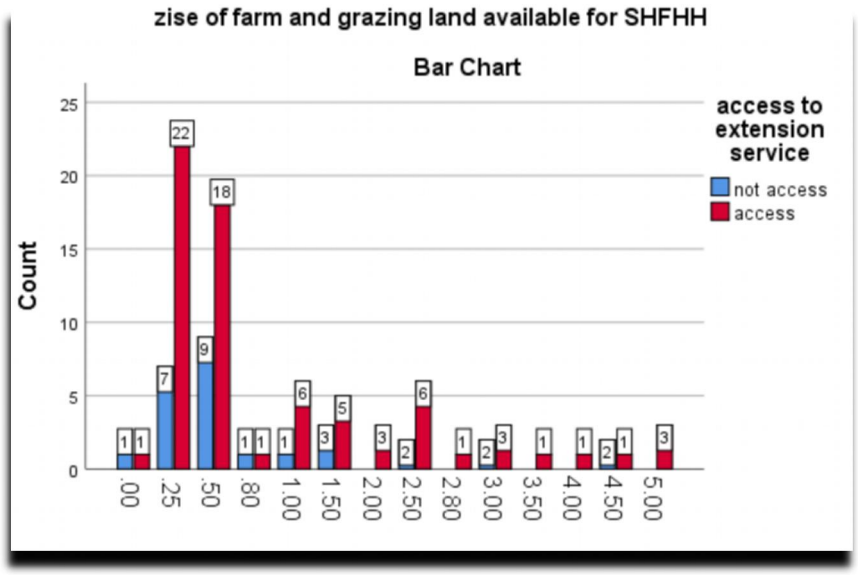


Figure 4.1.2a Distribution of farm and grazing land regarding agricultural extension

Africa or other least developing country accounts for over 60% of the available arable land on Earth. Nevertheless, smallholder farmers in the study area unable to secure sufficient and suitable land to grow their crops and keep livestock. Tenure security affects agricultural productivity through the choice of crop to grow, limited investment in land, and adoption of unsustainable agricultural practices. This problem is tackled by small farm households' access to experts and extension agent who provides service constantly. This issue may need to government effective land policy and equitable administrative policy. While, the aim of this research focused on, even if there are very limited arable farmland in the study area, its' possible to produce in which a limited farmland high amount of output by effective and efficient access of agricultural extension services,i.e. fertilizer, improved seed, new farming system, crop rotating to protect soil nutrient and reduce erosion, and other important factors which provided by extension agent with technical training and field demonstration. As data reveals in table, the minimum and maximum of farmland is 0 up to 5 hectares, which is based on the study area's average land size.

Agricultural inputs and land preparation accomplishment

Oxen is one of the important and the main input to plough accomplishment and produce high farm output.As survey data shows below, most of the farmers, (about 18%) of respondents have no oxen to cultivate(Table 4.1.2). Those farmers also have very less farmland or less than 0.5 hectares and they are smallholder farmers and may use relative oxen or hire oxen.Farmers who have no oxen (18%), 38.9% or 7/18 out of sample respondents are contacted with extension and remain a large number of 61.1%are not accessed.Whereas about 78.7% out of 47 who have only 1 number of ox households are accessed and remaining 21.3% of them are not accessed. On the other hand,84%(21/25), and 57.1%(4/7) of participants are who held only 2 and 3number of oxen were accessed, respectively and the remaining are not accessed respectively. Remain 3number of households who have more than 4 number of oxen were all of 3 respondents are accessed and participated on extension packages. The maximum and minimum number oxen were4 and 0 respectively, and the mean difference between this predictor and access to extension service is 1.3 oxen with a standard deviation of .948.

In addition to this, the result shows that 34.0% traditional practice, 49.0% subsistence, 2.0% mechanized, and 15.0% reported. As this information tells us wolaita zone sodo zuria woreda most of the farmers practice traditional and subsistence farming.As this results in low farming productivity and are vulnerable to food shortage and famine. So, agricultural extension service system was the mill stone to address farmers' problems in the study area and to ensure food problems by facilitating important agricultural-based inputs, equipment, managingskills and training toaccelerate the modernization of farming system to improve agricultural productivity and alleviate poverty through by increasing agricultural quality and quantity output. Even if there is less land size and limited or no plowing oxen, using the modern farming system and managing and efficient allocation of product based on quality production can achieve food security at least home and reduce poverty in study area.

Table 4.1.2 Association of agricultural input and land preparation with agricultural extension service

Background variable	**Group**	**Access**	**Not accessed**	**Frequency**	**Percent**
Size of farm	Nofarm land	1	1	2	2.0

land	(0.00)	1.4%with50.0%	3.6% with 50.0%	2.0	100.0
	.25hac	22	7	29	29.0
		30.6% with 75.9%	25.0%with24.1%	29.0	100.0
	0.5hac	18	9	27	27.0
		25% with 66.7%	32.1% &33.3%	27.0	100.0
	0.8hac	1	1	2	2.0
		1.4% with 50%	3.6% with 50%	2.0	100.0
	1.0hac	6	1	7	7.0
		8.3% with 85.7%	3.6% with 14.3%	7.0	100.0
	1.5hac	5	3	8	8.0
		6.9% with 62.5%	10.7% with 37.5%	8.0	100.0
	2.0hac	3	0	3	3.0
		4.2% with100%	0% with0%	3.0	100.0
	2.5hac	6	2	8	8.0
		8.3% with 75.0%	7.1% with 25%	8.0	100.0
	2.8hac	1	0	1	1.0
		1.4% with 100%	0.0% with 0.0%	1.0	100.0
	3.0hac	3	2	5	5.0
		4.2% with 60%	7.1% with 40%	5.0	100.0
	3.5hac	1	0	1	1.0
		1.4% with 100%	0.0% with 0.0%	1.0	100.0
	4.0hac	1	0	1	1.0
		1.4% with 100%	0.0% and 0.0%	1.0	100.0
	4.5hac	2	1	3	3.0
		7.1% with 66.7%	1.4% with 33.3%	3.0	100.0
	5.0hectare	3	0	3	3.0
		4.2% with 100%	0.0% with 0.0%	3.0	100.0
	Total	72	28	100	100.0
	X^2 and P –value = 8.685[a and] .63 Minimum vs Maximum =0 up to 5				
No of oxen	0	7	11	18	18.0

held		9.7% with 38.9%	39.3% with61.1%	18.0	100.0
	1	37	10	47	47.0
		51.4% with78.7%	35.71% with 21.3%	47.0	100.0
	2	21	4	25	25.0
		29.2% with84.0%	14.3% with 16%	25.0	100.0
	3	4	3	7	7.0
		5.6% with 57.1%	10.71% with 42.9%	7.0	100.0
	4	3	0	3	3.0
		4.2% with 100%	0.0%	3.0	100.0
	Total			100	100.0
	X^2 and Sing value = 14.561[a] and.006 Minima and maxima = 0 up to 4				
Soil chxcs	0	1	1	2	2.0
		1.4%& 50.0%	3.6% & 50.0%	2.0	100.0
	Fertile	49	16	65	65.0
		68.1/75.4%	57.1%/24.6%	65.0	100.0
	Moderate	15	5	20	20.0
		20.8%/75.0%	17.9%/25.0%	20.0	100.0
	not fertile	7	6	13	13.0
		9.7%/53.8%	21.4%/46.2%	13.0	100.0
	Total	72	28	100	100
	X^2 value with P-value = 1.038 and .213 Maximum vs minimum = 4 and 0				
Experience to use fertilizer	No	17	17	34	34.0
		23.61%/ 50.0%	60.71%/ 50.0%	34.0	100.0
	Yes	55	11	66	66.0
		76.39%/ 83.33%	39.28%/ 16.67%	66.0	100.0
	Total	72	28	100	100.0
	X^2 value with P-value = 11.983and .001				
On-farm income	0	2	5	7	7.0
		2.78%/28.57%	17.86%/71.43%	7.0	100.0
	<$150	19	17	36	36.0
		26.4%/52.8%	60.7%/47.2%	36.0	100.0
	$151-$550	20	3	23	23.0
		27.8%/87.0%	10.7% and 13.0%	23.0	100.0
	$551-$950	11	1	12	12.0
		15.3%/91.7%	3.6% and 8.3%	12.0	100.0
	$951-$1350	9	0	9	9.0
		12.5%/100.0%	0.0%/0.0%	9.0	100.0
	$1351-$1750	4	2	6	6.0
		5.6%/66.7%	7.1%/33.3%	6.0	100.0
	>$1750	7	0	7	7.0
		9.7%/100.0%	0.0%/0.0%	7.0	100.0
	Total	72	28	100	100.0
	X^2& p-value =28.085and .000 Minima and Maxima = 0 up to 1800				
Off-farm	0	39	9	48	48.0

income		54.2%/81.3%	32.1%/18.8%	48.0	100.0
	<$200	7	6	13	13.0
		9.7%/53.8%	21.4%/46.2%	13.0	100.0
	$201-$600	5	1	6	6.0
		6.9%/83.3%	3.6%/16.7%	6.0	100.0
	$601-$1000	10	1	11	11.0
		13.9%/90.9%	3.6% and 9.1%	11.0	100.0
	$1001-$1400	3	3	6	6.0
		4.2%/50.0%	10.7%/50.0%	6.0	100.0
	$1401-$1800	5	3	8	8.0
		6.9%/62.5%	10.7%/37.5%	8.0	100.0
	>$1800	3	5	8	8.0
		4.2%/37.5%	17.9%/62.5%	8.0	100.0
	Total	72	28	100	100.0
	X^2 and P-value = 12.722 and .029 Minima and maxim =0 up to $1800				
Access credit	No	40	24	64	64.0
		55.56%/62.5%	85.71%/37.5%	64.0	100.0
	Yes	32	4	36	36.0
		44.44%/ 88.89%	14.28%/11.11%	36.0	100.0
	Total	72	28	100	100.0
	X^2value and P-value = 8.795 and .004 respectively				100.0
Livestock category	<3	14	11	25	25.0
		19.4%with56%	39.3%with44%	25.0	100.0
	3-6	41	16	57	57.0
		56.9%with71.9%	57.14%with28%	57.0	100.0
	7-10	13	1	14	14.0
		18.1% & 92.9%	3.6% and 7.1%	14.0	100.0
	>10	4	0	4	4.0
		5.6% with 100%	0.0% with 0.0%	4.0	100.0
	Total	72	28	100	100.0
	X^2 value and Sign = 9.417 and .006 Maximum minimum = 12 and 1				
Time spent on farming practice	0	0	1	1	1.0
		0.0%/ 0.0%	3.6/100.0%	1.0	100.0
	Maximum	39	2	41	41.0
		54.2%/ 95.1%	7.1%/ 4.9%	41.0	100.0
	Medium	21	11	32	32.0
		29.2%/ 65.6%	39.3%/34.4%	32.0	100.0
	not always fixed	5	8	13	13.0
		6.9%/38.5%	28.6%/61.5%	13.0	100.0

	do not know	7	6	13	13.0
		9.7%/53.8%	21.4%/46.2%	13.0	100.0
	Total	72	28	100	100.0
	X^2- value and P-value =26.157 and .000 Maximum vs Minimum = 5 and 0				
Distance from farm area to extension centre	<1km	18	3	21	21.0
		25.0%/85.7%	10.7%/14.3%	21.0	100.0
	1-3km	33	8	41	41.0
		45.8%/ 80.5%	28.6%/19.5%	41.0	100.0
	4-6km	10	7	17	17.0
		13.9%/58.8%	25.0%/41.2%	17.0	100.0
	7-9km	4	3	7	7.0
		5.6%/57.1%	10.7%/42.9%	7.0	100.0
	10-12km	4	4	8	8.0
		5.6%/50.0%	14.3%/50.0%	8.0	100.0
	>12km	3	3	6	6.0
		4.2%/50.0	10.7%/50.0%	6.0	100.0
	Total	72	28	100	100.0
	X2 value and P-value =9.016a and .005 Minima vs maxima = 1 up to 15km				
Knowledge use mobile phone	No	33	16	49	49.0
		45.8% and 67.3%	57.1%and32.7%	49.0	100.0
	Yes	39	12	51	51.0
		54.2% &76.5%	42.9% &23.5%	51.0	100.0
	Total	72	28	100	100.0
	X2 and Sing = 1.03 and .2144				
Willingness to access extension service	No	2	12	14	14.0
		2.8% and 14.3%	42.9%and85.7%	14.0	100.0
	Yes	70	16	86	86.0
		97.2% and 81.4%	57.1%and18.6%	86.0	100.0
	Total	72	28	100	100.0
	X2 and Sing value = 8.795 and .004				
Experience to use improved seed	No	19	17	36	36.0
		52.8%	47.2%	36.0	100.0
	Yes	53	11	64	64.0
		82.8%	17.2%	64.0	100.0
	Total	72	28	100	100.0
	X^2 and P-value		6.227 and .012		

Source, field survey, (2021/22)

Type of livestock owned by households

Cows, oxen, goats, and sheep were the most common livestocktypes kept by most participants, and very few farmers keptanimals such asequine, and chickens in the study area. The result shows that about 48%, 24%, 10% and 16% of participantshave cattle, dairy farm, beef production and equines, respectively.The focus group discussion partiipants and key informants stated that cattle was the most commonly keptanimal than other kinds of animals in the study area, while as near to zonal town and other local towns around the woreda, dairy production and equine animal concerned the most important to gain income by using transportation of equine animals.And selling dairy product so it's animportant sources of income.

Table 4.1.2 shows that 25% of respondents reported they have kept <3 number of livestock including those who have no livestock (3 had no any of livestock owned), out of those 14(56%) were accessed extension services and the remaining are not. Whereas 57%(n=57) of respondents reported 4-6 number of livestock owned, this shares the highest proportion(71.9%)among them willing and able to access, while remaining are not. Thus, more than 82% of households owned livestock less than 6 numbers, this shows that, most of the study area farmers have limited resources and small scale farm households. Other 14% and 4.0% are owned 7-10 and more than 10 numbers of livestock,respectively.,The finding shows that households who have large number of livestock get accessto agricultural extension services than that of less number owned households.

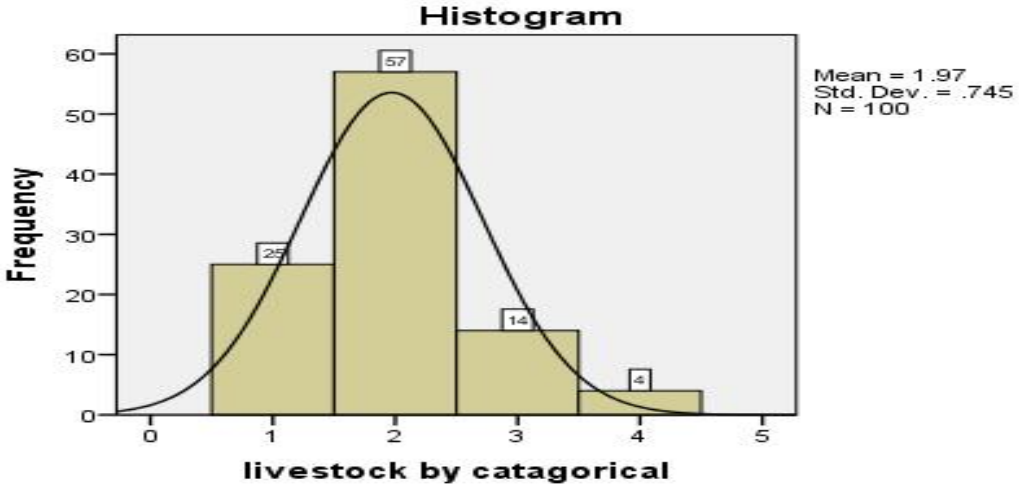


Figure 4.1.2b. The livestock holding of sample households

The maximum and minimum numbers of livestock are 0 up to 10, including all kinds of livestock owned by sample households, and the mean size of livestock is 1.97 with a standard deviation of .745(figure 4.7)

Soil type and its characteristics

Out of the total respondents 65.0%, 20.0%, and 13.0% of participants reported that their soil characterstics is fertile, moderate, and non-fertile respectively. While remain 2.0% have no significant farmland and they reported that they have no idea about soil nutrients. About 65.0% of households who have fertile soil, 75.4% of them have access to extension service and the rest 24.6% of households not accessed within soil characteristics. For moderate and not fertile soil 75% and 53.8% of respondents reported that they accessed extension service and the remaining participants said not. Fertile soil-held households were the highest share than moderate and non-fertile. This shows that generally in the wolaita zone particularly in a study conducted woreda, the soil is more suitable and has no high factor influence on-farm productivity. is the key informants also stated that no more challenges for farm households because extension workers can simply resolve this related to soil infertility by treating the soil in lime and training farmers rotate crop-to solve soil acidity, using urea and DUP, or compost, and so on.

Household source of income

There area major sources of income in different employment either payment or gain profit. The farmers' sources of income include on-farm, off-farm (non-farm) income. In the study area, both on-farm income and out-of-farm income are discussed detail as below information. Most of the poor countries like Ethiopian households work are variedfrom season to season, including the study area but they cannot satisfy their basic need even work here and there. The result shows that about 93% of sample respondents weregeneratedincome from different types of agricultural output, and the remaining 7% of households have no source of income from agriculture due to less farming and grazing land and unable to benefit from modern and technical inputs to improve production. However, out of 93% who have earned income 30% respondents obtained their income from fruit and vegetables, which is common and most important farm productivity in recent time. Fogus group participants also point out that there was increasing fruit income from

time to time in the study area among the last two decades. This is associated with a narrow land size; because of high population pressure in this area is popular at the regional level even at the country level. The remaining 15% participants also mentioned that income was generated from animal products such as milk, butter, egg, and others. The rest 12% obtained from selling of livestockand 10% of them from the root and “inset” product.The remaining 12%of respondents gained from othersources such as poultry, tree crop, beekeeping and so on.

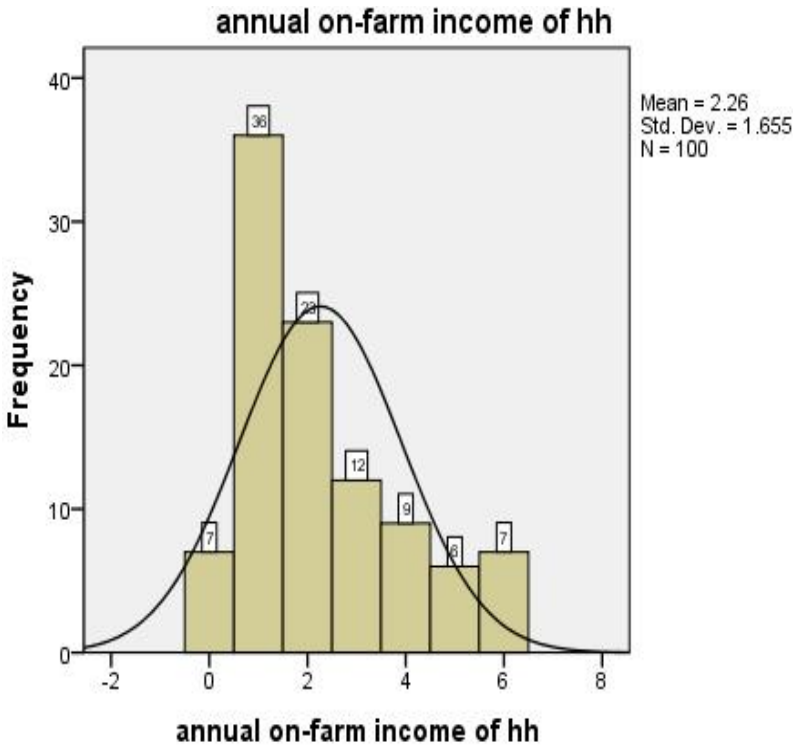


Figure 4.1.2c The distribution of annual on-farm income of households

Table 4.3 shows that about 36% of households gained less than $150 annual income and 23% gained from agricultural outputs.The remaining 12%, 9%, 6% and 7% of respondents gained about $551-$950 , $951-$1350,$1351-$1750, and morethan $1800, respectively.This finding shows that about 59% of households gained about $550 Annually. The result also revealed that, there isvery less number of farmers who have gained more than $1800 of income from on-farm. As a result,farmers who gained less farm income or nothing earned were forced to search for another non-farm income employs to fill their social and economic unrest needs. Thus, these factors obstacle the performance of development agents' services provision into those farmers are intended. The statistical result claimed that out of 36 households who generate income below

$150, 52.8%of respondents have access to extension service and remain 20 out of 23 who generating $151-$550 income have no access to extension services. The 12 among 11 who gotincome $551-$950 are accessed extension service and remainingare not accessed. The mean difference between this predictor variable with access to extension service is 2.26 with a standard deviation of1.655.However, the minimum amount of annual on-farm income is 0, and the maximum amount is $1800.

According to key informants'information, the agricultural practice in the study area is not only expected agricultural outputs, but also so many cultural and unknown products which use for food requirements and other benefits such as root or ground grains to generatecash by selling it for the local member who has experience about that product. In addition, sweet potato, ground potato, and "inset" are the most important grains usually uses for food purposes and also the way of income sources especially those smallholders, including women and other minor farmers.

Off-farm income is also one of important income source in the study area presented in figure 4.1.2Smallholders produce food and non-food products on small pieces of land with limited external inputs. But they are not always engaged full-time on-farm activities, in fact, most poor families earn their incomes in multiple ways, and productivity on farms should be viewed in the overall context of total family income.The result shows that50% of SHFs' received additional non-agricultural income sources in the study area. As key informants stated agricultural activity subsistence and depend on the seasonal rainfall, there for agricultural activity was supplemented by off-farm income, such as selling agricultural output, local alcoholic drink processing, and others. One possible explanation for diversified non-farm employment was due to inefficient agricultural productivity and poor farming output. As the result, most smallholder farmers' engaged in off-farm occupations and receive a higher income than those engaged in on-farm farmers. Because of this on-farm component practice with so many challenges regarding to natural hazards and epidemic crop and animal disease, general in country-level of small-hold farmers.

Among 48 respondents not engaged in off-farm activity, about 39 (81.3%) have access to extension service and the remaining18.8 %(n=9) have not accessed extension service. This shows that most of the farmers' who have not engaged any kind of non-farm income more likely to access and contact with extension, rather than that of more time engaged on non-farm

income.Whereas out of 13 respondents, about 54%(n=7) have earned<$200 and the remain 46% have notextensionaccess.The result confirms that, some of the farmers partly engaged in another occupation to either generate income or to cover their home consumption. Out of 50 respondents, about 26% engaged in selling of agricultural outputs, 18% on petty trade, 26% on daily labourer, 6% on beverage and waving. The remaining 10% gained from house building and 8% from other occupations.

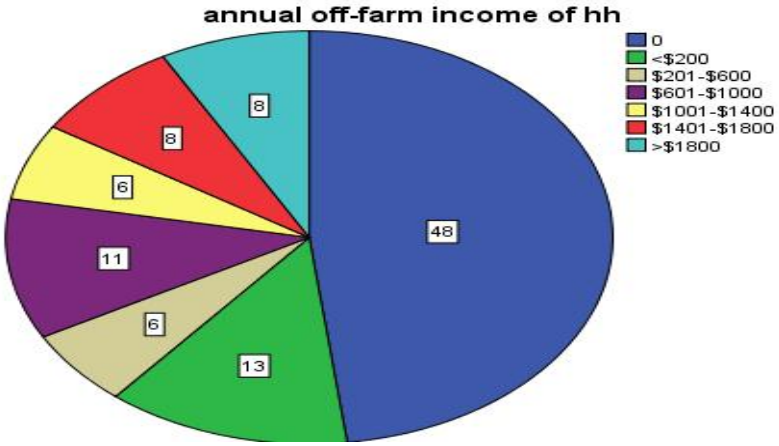


Figure 4.1.2dDistribution of non-farm income sources

Access to Agricultural Finance for Smallholder Farmers

Financial institutions often cite lack of unable collateral, high transaction costs due to remoteness of clients, dispersed demand for financial services, the lag between investment needs and expected revenues. In addition lack of motivation for irrigation, pests, and diseases, the small size of farmland, and individual transactions, underdeveloped communication, and transportation infrastructure, as well as high covariate risks due to variable rainfall and price risks were reasons why farmersdo not get money from lenders. The result shown in table 4.2, only 36% of respondents could have accessed credit loansand out of them, 88.9% reported that they access extension services and remain not accessed. However, table4.2 indicates that credit is the main kind of source of finance but 64%were not accessed and out of them 62.5% are received experts services. According to the result, a large number of households (SHFs) cannot be able to use credit to cover their financial problem for agricultural-based purposes.

Focus group discussion participants and key informants stated that smallholder farmers often have constrained due to lack of liquidity of finance of the agricultural inputs typically needed to improve agricultural productivity.However, credit is not easily accessible to poor farmers that means all farmers' have no equal access. Even if it is a positive effect on access to extension by covering the cost of service and search information to improve small holds farm productivity, but most farmers' missed and doesnot receive the credit due to fear to pay back the loan., as well as associated to animal and crop disease, drought and other constraints.

Effect of Fertilizer in the study area

Table 4.1.2 shows that out of 100 respondents, 66% respondents were experienced using fertilizerand the remaining 34% respondents have no experience using it. Even if more than half of farmers have experience they supposed to get inputssuch as fertilizer and improved seeds according to their plot size.But extension, agents decide how much input a farmer is going to take per his plots but not on the needs of the farmers as information is taken from interview conducted area. Each kebele key informants stated that, farmers were forced to take input. Those farmers who did not participated in the package were almost segregated from administrative services by local extension and kebele officials. And also some of the farmers don't need to receive fertilizer or other such kinds of inputs rather they take by force per their farmland size. Farmers who take their initiative are a very small number of the total household, even the provision of fertilizer by credit.

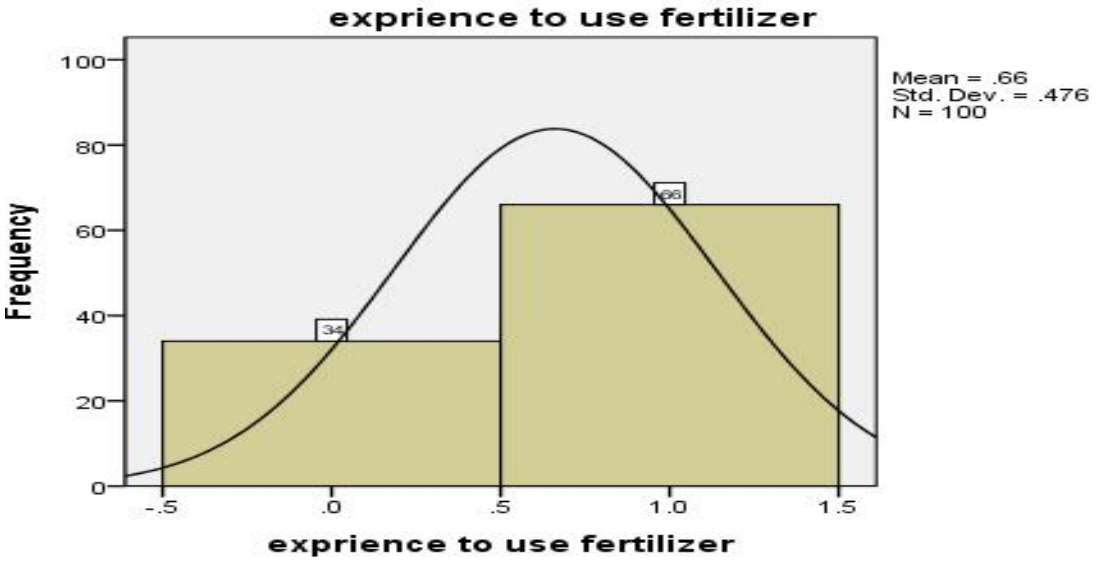


Figure 4.1.2e Experience of farmers using fertilizer

The kind of fertilizer available in the study area is manure and compost which practiced more.According to key informants, manure and composts are the most common organic fertilizers used by many farmers in the study area. Thus the probability of access to extension service, such as training on-farm field, demonstration, visiting, and other related packages.. While the number of smallholder farmers' did not aware and were not trained about the importance of fertilizer on their productivity in the study area.

As Evidence by Donovan and Casey, (1998) studied in Tanzania a show that about 25% of crop production is lost each year without the application of nitrogen fertilizer by the 10^{th} year as well as 60% is lost nonetheless and the average consumption of inorganic fertilizers is very low.Similarly, around 16 kg/ha of nutrients—ranging from less than 1 kg/ha in Niger and Gambia to about 89 kg/ha in South Africa.This shows that uses of either chemical or inorganic fertilizer input should be based on the content of kg/hectare, by acting of development experts.

The effect of using improved seed on farmers' agricultural productivity

that the result shown in table 4.2, most of the farmers (38.7%) replied improved seed improves their farm output, while (24.3%) and (5%) explained that constant or no change and decline or negative effect on their farming output respectively,while32% reported that unknown about its effect,.This is supported by key informants interviewed in the study area. The result indicates that the highest share (39%) of respondents replied thatthe use of improved seed able them to get a high output Out of 64 respondents that used seed, 9% didn't know its effect and 16%claimed no effect, and the remaining 3% replied even decline. If there is no change and unknown its effect means there is some problem either ordering or propagation of seed varieties as well as lack of knowledge of how to invest it to boost more output. So, extension sector would be made vital for those farmers. Generally, table 4.2 shows that only 66% of respondents have experience to use fertilizer and 64% have exprience to adopt improved seeds respectively, whereas, only 36 were received credit loans in the study area.

Distance far from a household farming area to extension center

The result revealed that about 72% of respondents have access to extension center and the remaining 28% are not accessed even they did not know what is agricultural extensionin the study area. Key informants alsostated thatall farmers did not actively participate and received extension packages in the study area. These services are offered by Government (public) extension institutions. Out of 100 sample households, 21(21%) respondents replied that 1km near distance from their farm area, while 41 (41%) revealed that the distance between farm area up to extension station is 1-3km And also other 17(17%) participants stated that about 4-6km and 7(7%) of respondentstraveled 7-9km.The remaining 8 (8%) and 5 (5%) reported that 10-12 and more than12km far respectively. As the above information shows that more than 7km far from households' home to extension station is difficult to get extension service due to time constraints, cost of transportation, and farmers' fatigue made less likely to meet extension. So, it affects the probability of accessing experts' services and receiving their service inversely. The distance near to extension center expected more benefit and easily can access extension service than that of too far distance.

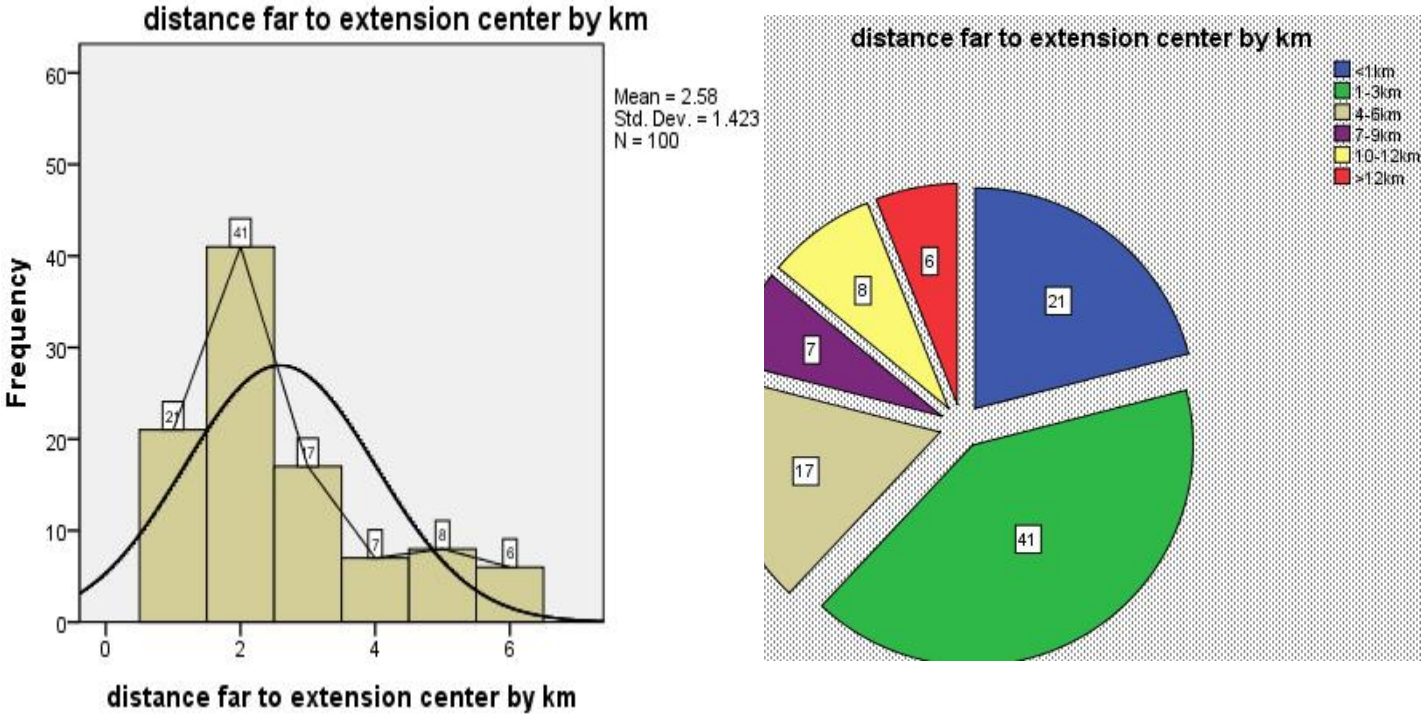


Figure 4.1.2f Distribution of distance to extension center

Thecross-tabulationresult of access to agricultural extension services by a distance of extension agent far from households' farm area (figure 4.1.2f).The majority (85.8%) of respondents have

access to extension at the distance of less than 1km followed by 1-3 km (80.5%),4-6km far (58.8%), 7-9km (57.1%), 10-12km (50.0%) and >12km distance (50%). The average distance to extension center was 2.58km with a standard deviation of 1.423km as well as aminimum distance is1km and the maximum distance is up to 12 km.

Mobile phone access and Households' willingness to access extension service

Regarding the mobile phone (cellphone), the survey result shows that 49% of respondents are unable to own mobile phone out of 100 respondents. Whereas 51%of households own mobile phones and they can get information by contacting with supportive institutions and stockholders. Farmers call to get information about crops and livestock production and marketing. Key informants and forcus group discussion participants stated that mobile used to farmers that make information symmetry and to be effective and efficient in their practice with confidence as well. Farmer to extension or other concerned institution and farmer to farmer to get easy any technology transformation and system of farming practice most appropriately. It is also a primary source of information in any activity. The crosstab result shows that out of 49 respondents who do not know to use a cell phone,33(67.3%) and 39(76.5%) respondents were accessed and also out of 51 respondents who have knowledge to use mobile are reported that they accessed extension service.The remaining 32.7% of respondents had not mobile and 23.5% held mobile phones are not accessed, respectively.

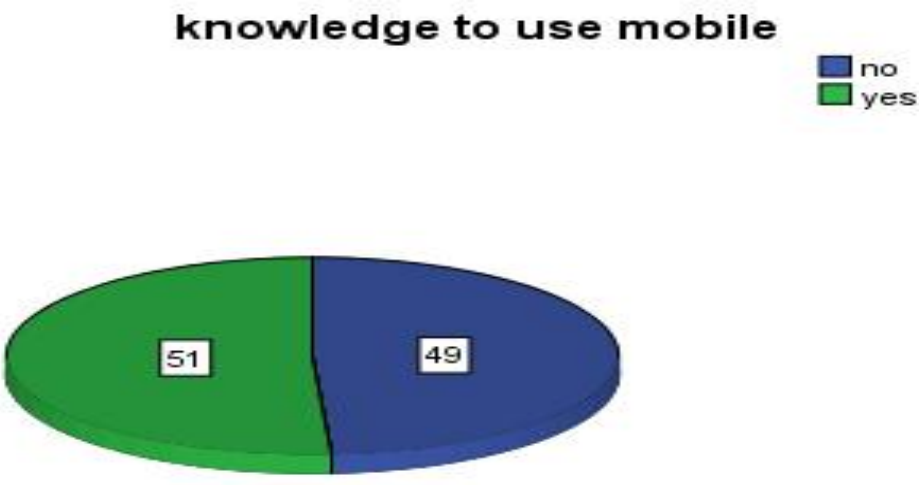


Figure 4.1.2g Kowledge of farmers about mobile use

The result showed that about 49% of respondents reported that, they do not know to get service by mobile phone yet, due to a lack of knowledge associated with illiteracy (24.5%), financial problem (40.8%), lack of accessibility (16.33%), and other constraints(18.35%) such fear to be stolen, lack of trust by information providers, cultural barriers, uncomfortable to handle, e.t.c..The result revealed that majority of the farmers had been willing to participating and access to extension services (table 4.1.2). About 86% (n=86) of respondents statedthat they havewillingness to access extension serviceswhile only 14% of respondents said they have no willingness to access for various reasons.

The weakness effect in many developing countries small householder farmers' access to extension services, due to unwillingness to get a package of extension such as fertilizer, improved seed, credit, irrigation, and othersBut about 34% of respondents have no experience to use fertilizer out of 100 sample respondents followed by improved seed(36%), and credit (64%). Also even out of those who accessed extension service, as sample household indicates that, frequency of contact with extension agent is less than 2 twice in the year is 27 out of 72 and 2-6 times per year=10 out of 72 or visited in a year less than 6 times, total= 37/72. The above estimated result including not accessed extension service with less than 2 times visited in the years shows that most of the study area smallholder farmers do not effectively participated in agricultural extension service. On the other hand, about28.0% also did not understand extension and its importance.

In addition to the above, tfocus group discussion participants and key informants stated that lack of awareness, lack of motivation to the towards training, communication gap among the scientist, farmers, and extension workers, lack of education, lack of interest to get modern techniques, poor social status, and small landholding of farmers are facing access of extension servives and willingness to access extension services. The result from household survey shows that willingness to access extension service is affect due to lack of knowledge(14.28%), cause of financial constraint (3.57%), difficulty to understand experts practical learning (14.28%), not interested to access extension package (10.71%), expected to less profitable receive extension service compared to traditional practice (7.14%), shortage of land size (29%), long-distance to extension center and lack of infrastructure (10.71%), and lack of information (10.71%) and other problem.

The chi-square and level of significance tests**:**The test statistics indicate in tables 4.1.2and 4.1.2 for distance to extension center, willingness to access extension agent, estimated time spent on the farming activity, livestock owned, access credit, on-farm income, experience to use fertilizer, No. of oxen held, No. of labor available, and experience to use seed are significantly influence dependent variable at <1% probability level and there was an association between those predictor variables and the probability to access extension service, on the other hand, size of farmland, dependence ratio, and off-farm income was also confirmed that there were statistically significant and association with extension service at <10% of significance level, but, age of household, level of education, gender of household head, knowledge to use a cell phone, and soil in above test statistics indicates that there was no statistical association between these predictor variables and smallholder farmers' access to extension service.

Table 4.1.2.2 Frequency and Percentage of Access to Agricultural Extension Service

Background variable	Group	Frequency	Percent
Access to extension service	No	28	28.0
	Yes	72	72.0
	Total	100	100.0

Table 4.1.2.2 shows the number and percentage of participants who had access and those who hadn't access to agricultural extension services. The majority of participants (72%) reported that they had access to agricultural extension services, while remaining 28% reported that they had no access to agricultural extension services.

1.17.7. Characteristics of smallholder households agricultural practice in the study areas

4.1.3 Charcarterstices of smallholder households' agricultural practices in the selected kebeles

Table 4.1.3. The association of agricultural practices with sample study areas

HHendowment onfarming prodactivity(20/21)	DWProp No=10	%	ZS Prop No=12	%	MG Prop No=13	%	TG Prop No=16	%	SK Prop No=10	%	WL Prop No=15	%	DA Prop No=12	%	QS Prop No=12	%	Total %
cerealcrop production	4	40	4	33.33	3	23	3	19	5	50	4	26.66	2	16.67	3	25%	28
Mixed prod.	5	50	8	66.66	10	77	11	69	4	40	11	73.33	10	83.33	5	41.67	64
Livestock	1	10	0	0	0	0	2	12	1	10	0	0	0	0	2	16.67	6
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	16.67	2
Total 10		100	12	100	13	100	16	100	10	100	15	100	12	100	12	100	100

Source: Field survey,(2021/22)

Table 4.1.3 shows that cereal production accounts 28.57% followed by mixed prod (64.32%), livestock only (6.1%), and other type of production (2%) such asgarden fruit, bee, forest tree, ginger and so on in eight samplekebeles.And also information of respondents and the profiles of the Districts, woreda office, and other formal and informal institutional data gathered indicated that mixed farming is dominant in this study conducted districts that major crops cultivated include food crops such as teff, maize, wheat, sorghum, cassava, sweet and normal potato, and tree crops; vegetables such as tomatoes, spinach and pepper,. Major animals raised include sheep, goat, cow/ox, and poultry. Most of the farmers cultivate on a very small acre of farmland, however, having more than 5-hectare farm size is very little. Mixed farming and cropping are the major farming practice by farmers with most of them engaged in traditional methods of agriculture such as the use of hoes and cutlass.

However farm productivity in the study area is generally low. The data obtained from key informants indicated that in the sodo zuria district production levels only increase with an increase in the acreage of land under cultivation. However, the District average crop yield per hectare for maize, and potatoes in the east and southeast part kebele higher than other parts of the local area. Even not explained in detail in this paper about "inset" is very essential and food secure during drought and famine season in the study area. Effective and to give more attention to smallholder farmers by extension workers is the critical and main important to improve productivity. Not only this but also, development experts play important role in learning by doing in a farm field with those households and solving small farm households' faced problems associated with the farming constraint.

1.17.8. Public agricultural Extension and Communication Methods

Table 4.1.4 Relationship between agricultural extension and communication

No	Contact method	DW Prop No= 10	ZS Prop No=12	MG Prop No= 13	TG Prop No= 16	SK Prop No= 10	WL Prop No= 15	DA Prop No= 12	QS Prop No= 12	Total	%
1	Face to face in farm field area	5	5	4	5	2	5	3	4	33	33
2	Face to face in extension center	2	3	4	2	4	2	3	2	22	22
3	Traditional information system	2	1	2	4	4	5	4	5	27	27
4	Modern communication	0	0	1	1	0	1	2	0	5	5
5	Others(foster. ..)	1	3	2	4	0	2	0	1	13	13
Total		10	12	13	16	10	15	12	12	100	
Percentage		10	12	13	16	10	15	12	12	100	100

Sources, own survey,(2021/22)

The result shows that about 33% farmers access to advisor service through face-toface in the field followed by face to face in extension site (22%), traditional information contact system (27%) and modern method by only (5%), while about 13% of them through other ways of communication.. The traditional method of contact is most dominant as data of above in sodo around the district, such method is sending local partners and model farmers, by letter to the village some educated farmers lead to share information or other farming system, poster and using kebele level meeting. On the other hand, modern communicating system (mass media) particularly applied some of kebele as data shows in table 4.5 that, out of the total kebele, TOME GERERA, MANT GERERA, WARAZA LASHO and DALBO ATIWARO kebel 1, 1. 1, 2 respondents answered respectively. Such methods like by wolaita radio station, television program, cellphone. Wireless telephone or mobile phone is commonly used in mass communication methods. However, the high illiteracy level, and farmers' extremely limited access to radio, telephone, and TV, the extension system has not benefited much from this communication method.

Mobile phones are most important in transferring, sharing, and sending information by message, telegram, Twitter to rural farmers, addition to calling., also hearing agricultural information on the radio helps encourage farmers to look for more detailed information by using cellphones to share their indigenous knowledge of agricultural production, that the use of cell phones in rural areas in wolaita generally has been increasingly associated with low price for mobile phone and availability of network coverage, this has been facilitated mainly price of input/output and extension advise about weather and decision their farming, but this type of communication is weak and unavailable in this study area, particularly to smallholder farmers. This communication method is particularly effective in delivering information and important agricultural input, as well as weather condition message in a very short time. As this result, agricultural technologies and knowledge of modern farming is low despite its enormous potential to bring the desired change agricultural-based development. There for AE play the vital role to address these for all farmers equally to improve efficient agricultural productivity particulary in study area.

1.17.9. Characteristics of household farming status in study area

Table 4.1.5 Kinds of farming status in the study area

What kind of farming status?	No of respondent	Percentage
Full time	67	67.0
Half time	25	25.0
Other	8	8.0
Total	100	100.0

Source, own survey, (2022)

The above table 4.1.5indicates that 67% (n=67) of sample householdsrespond they were engaged full time on on-farm activity, while about 25% (n=25) said half time and the remaining 8% (n=8)confirmedothers. As information of respondents that there were some of the farmers (33%, 25+8), participate in both on-farming and off-farming activity. As the data gathered is generally shown that farmers' in the study area generate income both farm output and non-farm income, and some households also more time spent on other kinds of works rather than agriculture. So that those farmers spent more time on out of farming activity rather than full time engaged on farming. So, it affects access to extension service negatively and more advancing to non-farm income as data confirmed.

1.17.10. Understanding and Awareness of Extension Services

As the studymentioned by the informants that, 30% (n=30) of the participants interviewed had no idea about the meaning of extension, whereas 57% (n=57) had some understanding of the meaning of extension and the remaining participants said 13%, (n=13) very understand the meaning of the term extension. Most of them were correct in their description. On the other hand, interviewed respondentspointed that, 77% (n = 77) indicated that they knew the extension agent for their respective area, and the remaining 23% (n = 23) of them answered that they didn't know the extension agent in their respective area.

Information taken from interviwee conducted area that,22 %(n = 22) had like to participate in farmer field school regard to solve their problem hindered on agricultural productivity. About 43% participants had like to training, problem-solving and individual visit in a farm field, such packages of services provided to smallholder farmers through by expertise local extension workers.This expected to improve the efficiency of production and innovative skills related to agricultural productivity. On the other hand, 20% of respondents reportedthat, farmer to farmer contact or by local cooperative program than other services. Only 13% (n = 13) of the farmers said other packages of service, they want to participate, such as NGO incentive package, local private organization and minor farmers' supportive partners eg (religion, 'wolaita mahiber'', and other private). Most of these groups (13%) respondents response were those like to such as the above-mentioned program in sodo zuria woreda farmers. extension agent office located in this study area were well-known farmers. All respondents who participated in this study area explained that they didn't have a specific timetable for attending the training programs, but they were at the beginning and the end of the crop season to access the package. The largest group of farmers interviewed 44%, n = 44) indicated that they like to received training and visit in their farm area by expertise extension workers/agents/ through meetings and apply (learning by doing).

1.17.11. Agricultural activity in wolaita sodo zuria woreda

Table 4.1.7 Types of agricultural activities in the sample woreda

Agricultural activity		**Frequency**	**Percent**
Traditional		34	34.0

Subsistence		49	49.0
Mechanized		2	2.0
Other		15	15.0
Total		100	100.0

Source, own survey, (2021/22)

The result showed thatabout34% of respondents stated there is traditional practice followed by subsistence(49.0%), mechanized (2.0%) and other type(15.0%). As this information tells us wolaita zone sodo zuria woreda most of the farmers practice traditional and subsistence farming as this results in low farming productivity and are vulnerable to food shortage and famine. So it needs agricultural extension service the millstone to address farmers' problem in the study area and to ensure food problems by facilitating important agricultural-based inputs equipment, manage and training. Even if there is less land size and limited or no ploughing inputs, using the modern farming system and managing and efficient allocation of product based on quality production can achieve food security at least home and reduce poverty in the study area.ጓ ሮ አ ት ክ ል ት ን ማምረ ት ና ለ ላ አ ማራ ጮች መጠቀ ም) as recently government doining.

1.17.12. Type of crop production in study area:

Among underdeveloped country smallholder farming systems the same information got from the study area, are characterized by a large off-farm income component presented in Table 4.1.8.The result shows that cereal production account 55%, fruit and vegetable about 15.0%, root and inset that important in local food about 11.0%, chat and coffee accounts 2% and 12,0%, respectively. Other types of crop production in study district about 5% (n=5) farming activities and source of household's income. Despite this situation, agriculture fulfills numerous important functions, including food security and risk insurance. Besides, agriculture has the potential to further contribute to income and employment generation. This can be ensured by effective and adequate extension-farmer linkage, particularly with smallholder agriculture practice across and within different areas. Promotion of this variability is important in the process of technology development, transmission, farmer training, and their experience and adoption.

Table 4.1.8 Crop productions in the study area

No	Type of crop yield	Frequency	Percent

1	Cereal and grain production	55	55.0
2	Fruit and vegetable	15	15.0
3	Pulses and oil seed	0	0.0
4	Root crop including 'inset'	11	11.0
5	Chat	2	2.0
6	Coffee	12	12.0
7	Other type of crops	5	5.0
	Total	100	100.0

Source; own survey (2021/22)

According to the above table 4.1.8information show that, growing cereal and rootcrop was the main food crop in the study area, such as maize, Bologna sorghum from cereal crop and potato, "godare" and other and fruit, coffee and chat the main source of the cash crop in this study area.

1.18. Econometrics part of data analysis

1.18.1. Diagnostic test

Befor testing binary logestic regression model, it's necessary to test multicolinierty problem and check the association among dependent and independent variables as well as interdependence r/n ships between explanatory variables about its' exixtence of strong r/n ship among them.

Table 4.2.1 Reliability test

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.596	.574	17

Source, survey data output, (2021/22)

The validity and reliability of the model were generated by different dialogistical tests. The correlation between each of the predictor variables were consistence and were not correlated highly (<.7), and the tests statistics of chi-square reveals that there is an association and statistically significant at <1% of probability level, (X^2>5 and sign <0.05), as reliability output of Cronbach's alpha shows shows in the above table that, there was no negativity and there is a validity of data and better result revealed in Cronbach's alpha (r=.588) and chi-square test.(evidence in APPENDIX 3,5,6 &7)

The assumption of chi-square and C. alpha, as well as correlation coefficiency satisfied as result revealed, so there is no multicollinearity and autocorrelation of the model, there for the hypothetical assumption is reject non-hypothesis and fit of the regression model.

i.e. Ho: B1=B2=B3=B4=B5=B6=B7 =B8=……B15≠0, which means there was at least one explanatory variable different from zero and have power on the effect of the dependent variable.

1.18.2. STATA part of regression results for marginal effect

The predicted margin (marginal effect) indicates the effect of unit change in each explanatory variable on the dependent variable, (p(y=1/x=x). which means in this study, marginal effect of the expected explanatory variables on the likelihood to influence smallholder farmers decision to access agricultural extension services expressed as:

Where, the probability to access extension services=Pr(y=i/x)=(ezi/1+ezi), zi= $(Bo+\sum_{n=1}^{m} BiXi + ei)$

$=e^{\beta o+ \beta iXi+\varepsilon i}/1+e^{\alpha+\beta iXi+\varepsilon i}$, then the marginal effects written as:

The dervativ of y w.r.t dy/dx =dE(pr(y=1/x))/dx= d$(e^{\beta o + \beta iXi+\varepsilon i}/1+e^{\alpha+\beta iXi+\varepsilon i})$/dx

$= \beta i*(e^{\beta o + \beta iXi+\varepsilon i}/1+e^{\alpha+\beta iXi+\varepsilon i})$-…..

There is statistically significant of important explanatory variables in this regression, such as; *size of farm and grazing land*, *number of oxen held by households*, livestock owned,*soil* chaxcs, knowledge to use *fertilize*r, , access to credit, price of agricultural inputs and *willingne*ss to access are statistical significant and founded to be influancial factors to the probability to acces extension service. As estimated result (table 4.2.2)reveals that,WILLDto access,SFLD,ACCRDD, LIVSTD, NOXN, and KNWFERDare stronglyeffect on dependent variable at <1% and 5% levele of significancy respectively.

Table 4.2.2 Marginal effect estimation using STATA

Variable	dy/dx	St.E	Z	p>(z)	[95% C.I. (interval)]X		
DEPR	**-.0288022**	.02769	-1.04	**.298**	-.083066	.025462	1.85
EDUD	**.0I51876**	**.07521**	**.20**	**.840**	**-.132229**	**.162604**	**.29**
SFLD	**-.114856**	**.04547**	**-2.53**	**.012****	**-.203969**	**-.025744**	**1.2115**
OFFFINC	**-.0000839**	**.00005**	**-1.56**	**.119**	**-.000189**	**000022**	**629.**
NOXN	**.132143**	**.05897**	**2.24**	**.025***	**.016559**	**.247727**	**1.3**
LIVSTD	**.1708497**	**.07329**	**2.33**	**.020***	**.02721**	**.31449**	**.18**
DISTD	**.033118**	**.0938**	**.35**	**.724**	**-.15072**	**.216957**	**.21**
SOILD	**.2757015**	**.14159**	**1.95**	**.052***	**-.001807**	**.55321**	**.65**
KNWFERD	**.3055754**	**.14728**	**2.07**	**.038***	**.016904**	**.594246**	**.66**
ACCRDD	**.174797**	**.174797**	**2.34**	**.019***	**.028513**	**.321081**	**.36**
KNMOBD	**-.0849781**	**.08075**	**-1.05**	**.293**	**-.243248**	**.073292**	**.51**
RPCAGRD	**.1253547**	**.07045**	**1.78**	**.075**	**-.012729**	**.263438**	**.34**
WILLD	**.6190713**	**.2095**	**2.96**	**0.003****	**.208464**	**1.02968**	**.86**

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Marginal effects after logistic

y = Pr(ACCEXTSERD) (predict)= .89478411

Log likelihood	***-28.864709***
No obser	***100***
LR chi2 (13)	***60.86***
Pro>chi2	***.0000***
adjR²	***.5132***

***source**, own data computed by STATA software, (2022)*

***Note,** ** and *Thestatistically significant at the 1% and5%, level of significance, respectively.*

The model result of above shows that, the **adjR²** value is 0.5132, and the **Pro>chi2**is 0.000. This implies that, about **51.32%** of variation in the dependent variable is explained the variation of these independent variables, this indicates all explanatory variable included in this model jointly are high influancial power and the regression is specified correctly and fit of the model.

So, the result confirmed that, the probability of accessing extension service decrease by a factor of 0.114856 (11.5%)when the **size of farm land** of households smaller by 1 hectare at 5% of probability level, remain other factors being unchanged. The negative sign of size of farm land indicates less farm size leads to less probability to access to extension services in the study area. Whereas **number of oxen** influence the probability to access extension services posetively and <5% probability level. This implays, when households held 1 additional number ox, the probability of access to extension service incrementby 13.2143%, other factors being constant.**Livestock** also one of influencial factor by (**0.1708497**) at 5% level of significance and

posetvely affect access to extension services considered in the study area, so this implays that, if farm household have more number of livestock, the predicted probability of smallholder hauseholds access to extension services higher by 17.1% compared to less number of livestock owned households, remain factors held constant in the model. Also **knowledge to use fertilizer** one of important explanatory variable that found significant and positive sign at 5% probability level over the dependent variable. The value is**0.3055754**, implays, a farm households have knowledge to use fertilizer, the probability of access to extension services more likely by 30.56%, other factors being constant. **Willing to access extension** also the strongest influencial power in this model as the result table 4.2.2 revealed that, the probability of smallhouseholds access to extension services higher by 61.91%, when the farm households have willngeness to receive extension services compared to that of unwillingness households at 1% level of significance, remaining held constant in the model, and so on.

1.18.3. SPSS part of regression results for odds ratio(log odd)

Binary logistic regression also applied by SPSS software to examine factor that affect response variable in the model. the dependet variable is desctete that the value is (1, 0) for all values of xi, so it's cumulative distribution function of logit model: E(y)=p= exp(β 0+ βixi+ui)/1+β 0+ βixi+ui), it can not be estimated with OLS, as this result its applicable to transforming in to odds ratio (log odds) to make coefficient interpretation is understandable written in terms of the odds and log of odds: pr= (p/1-p), log(p/1-p), =Ln(p/1-p)

Ln(Pi/1-Pi) =Ŷ== ṕ= **βo + βiXi+εi** →the relationship between Ln(p) and Xi is assumed to be linearly.So, the interpretation by log odds or odds ratio.

Note: marginal effect of STATA model results and odds ratio(log of odds) of SPSS model results are interchangeable in the model regression, but they are actually two different things of its' interpretation. Odds tario implays by loglikelihood of more/less likely or multiplicative effect, while marginal effect (mfx) by probability or its small change of one or more of independent variables over the dependent variable.

Table 4.2.3 Binary logit model estimation on factors affecting access to extension servives

Predictor variables		B	S.E.	Z-stats (Wald)	Df	Sig.	**Exp(B)**	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	agegroupD(1)	1.447	.978	2.188	1	.139	**4.251**	.625	28.918
	genderD(1)	-1.621	1.082	2.245	1	.134	**.198**	.024	1.648
	educD(1)	.428	1.006	.181	1	.671	**1.534**	.213	11.021
	Deprtio	-.627	.317	3.925	1	.048**	**.534**	.287	.993
	Labfrc	.543	.465	1.365	1	.243	**1.721**	.692	4.278
	livstD(1)	-4.523	2.073	4.758	1	.029**	**.011**	.000	.632
	SFLd	-1.417	.474	8.935	1	.003***	**.242**	.096	.614
	Noxen	1.438	.599	5.767	1	.016**	**4.212**	1.303	13.622
	soilD(1)	-3.113	1.180	6.960	1	.008***	**.044**	.004	.449
	knwuferzrD(1)	-2.658	1.032	6.630	1	.010***	**.070**	.009	.530
	accesscrdD(1)	-2.491	1.211	4.235	1	.040**	**.083**	.008	.888
	prcagrinpD(1)	-1.894	1.011	3.512	1	.061	**.150**	.021	1.091
	willtoaccD(1)	-3.729	1.313	8.064	1	.005***	**.024**	.002	.315
	offfarinc	-1.847	.942	3.847	1	.050**	**.158**	.025	.999
	distcD(1)	-.390	1.250	.098	1	.755	**.677**	.058	7.840
	Constant	12.321	4.165	8.749	1	.003	**224263.499**	--	---

Note, **** and **The statistically significant at the 1% 5%, and10% level of significance, respectively*

-2 Log likelihood ----------51.084[a]
Cox & Snell R Square ----------.491
Nagelkerke R Square ----------.707
Chi-square ----------67.507
Sig. value ----------.000
N ----------100

Source, survey data regression result, (2022)

Binary logistic regression was performed to assess the impact of a number of factors on the possibility that participants would report whether they had access to agricultural extension services or had no access to agricultural extension services. The model contained 15 independent variables (agehh, edulevel, labforc, dep. ratio, gender, pricagriinput, farmland, No.oxen, livst,disextctr, soilchx, knwusfer, offminc, acccrdt, willing to acc.). The result of binary logit model presented10 predictors was statistically significant with a Chi-square (67.507, N = 100) =

51.084, $p < 0.000$),indicating that the model was sufficiently fit and able to distinguish between participants who are access to agricultural extension services and those who are no access to agricultural extension services. The model as a whole explained between 49% (Cox & Snell R^2) and 71 %(Nagelkerke R^2) of the variance of those expected explanatory variables in access to agricultural extension services and remain 51% and 29% variation of by other factors, which are not included in this model respectively (e_i).

The regression result in Table 4.2.3 shows that out of 15 explanatory variables 3 continuous and 7 categorical predictor variables made a unique statistically significant contribution to the model at 1% and 5% level of significance. and can interpret its by odds ratio coefficient (Ɛβ), were a significant variables such are; dependency ratio 5% level of significance (Pv=0.048), livestock owned 5% LS (Pv=0.029), size of farm and grazing land 1% LS(pv=0.003), number of oxen held 5%LS (pv=0.016), soil chaxcs 1%LS (pv=0.008), experience to use fertilizer and access credit 1%LS (pv=0.01) and 5% of LS (pv=0.04) respectively. Remaining price of agri. input, willingness to access extension, and off-farm income are 10% level of sig (p=0.06), 1% level of sig (0.005), and 5% level of sig (0.05) respectively. Among those of predictors willingness to access extension, size of farmland, soil chaxcs, and experience to use fertilizer are 99% of CI., so its have very strongand positive relationship with response variable. Except for the price of agricultural input, other all explanatory variables are strong and less than 5% probability level.

While the age of household, level of education, labor force, gender, and distance to extension center is statistically insignificant and no association with dependent variables even if these variables have prior expectation would be an influancial powerover dependent variable in this study area. This means access to extension service is not diiferent interms of these predictor variables. But as the descriptive statistics in Table 4.1.1 and 4.1.2 indicated that participants at all educational levels and age average were positive perceptions of extension services and gender of household (female) and distance far farmland negatively influence access to extension service earlier results presented in the tables. The estimated Pseudo R-squared value is also high (49%), and adj pseudo R^2 (70%), and also the overall significance of the model is satisfactory, as reported by the Chi-square value. The P-value were significant at 1%, 5%, and 10% implying that all the variables jointly determine the dependent variable.

Interpretation of influential explanatory variables by odds ratio

Size of farming and grazing land;this is one of the strongest predictor variable reported in Table 4.2.3 which can be considered as a household's wealth in a rural area.It has a positive and statistically significant influence at<1% significance level. On average, every one additional hectare of land held householdspredicted to also increase in the case of access extension services. Both descriptive and econometrical part of the analysis result confirms that farm size is a key constraint input for rural household and landholding per capita is declining mainly because of a rapidly growing population and expansion of the city. The probability of access extension service decrease by **1.417unit**, when the farm size decreases by every one hectare, it implays that, if the sizes of farmland decrease by one (1) hectare, the odds ratio of access extension service decrease by 0.242 times other variables held constant.

Willingness to access extension service: It is strongly significant and positively affected access to extension service programs, if farm households have a willingness to access. Therefore it suggests that the odds ratio of access to extension service by **0.024** times less likely, when small farm households have no willingness to receive extension service packages than that of having the willingness to access households at 0.005 probability level, other things remains constant. This means without farmers' willingness to access, even if there was full and enough package of extension services such like; provision any important agricultural input, visiting and awareness, practical learning (training), and facilitated any additional subsidize. There is no efficient and effective agricultural productivity. Therefore constructing and being aware more of household attitudes is the first act to become significant change on agricultural development and rural household wellbeing trough by extension agents.

Soil fertility: Asoil is also one of the expected influential variables and strongly affects access to extension services in the study area. If the soil of household were suitable and more fertile, it assumed that farmers' might not want to receive extension service, such as farm input i.e. fertilizer, treating the soil with lime by extension service,.., because his/her soil is easily productive and favorable, so they less likely to access. So it was believed by the researcher and also the regression output shows that it negatively influenced response variables and 1% of probability level. This means, the odds ratio to access extension service is a factor of **0.044** times less likely, when the soil is fertile than that of unfertile soil chaxcs of households in thestudy area, other things held constant.

knowledge to use fertilizer: When farm household had no experience(knowledge) to use fertilizer on their crop production, the odds ratio of accessing extension service less likely by the factor of **0.070** times than that of experienced farm households, other factor remaining constant.

Credit service: Whereas, **credit service** is one of the important sources of financial contribution and it is one mechanism to reduce financial constraints and encourage economic activity through the whole livelihood. As this research measures in terms of whether at least one member of farm household has received credit or not during this research conducted, farmers who have access to credit may overcome their financial problems and cover financial constraints buy inputs, search information, and adopt new technology, because of farmers without cash very difficult attain their farming goals. It is a dummy variable so that 0 if accessed 1otherwise. It is expected that receiving credit was increase the probability of access to extension services and the odds ratio of **0.083**. This indicatsthat participants who were no access to credit a factor of.083 times less likely to report or (8.3%) less likely than those who were access to credit, controlling for all other factors in the model. So, access credit positively influential factor of the probability to access extension service.

Livestock owned by household: Livestock was a **positive** and significant influential factor on access extension service at <5% probability level. The –ve sign indicates that the probability to access extension service for less number of livestock owned farmers also less likely, which means, one additional number of livestock owned by households, more probability to receive extension services. The results of the odds ratio show that the odds of small-hold farmers' access to extension service by a factor of **0.011times**less likely when farm households owned less than 3 numbers of livestock compared to more than 3 numbers of livestock held households, other things remaining constant.

Number of oxen: Number of eoxen areone of the critical inputs in agricultural productivityin the study area, second to farmland. The availability of oxen makes farmer happy and boost crop production more to be meeting their food requirement and generate income, so the model result confirms that it's significant <5% probability level and affect access to agricultural extension service positively. So it interpreted as, the odds of access to extension service increase a factor of **4.212** times, as 1 additional number of oxen owned by farm household, keeping the influence of other factors constant.

Dependence ratio: It is a continuous variable and negatively affects the dependent variable, sig=**0.048** which is less than a 5% level of significance. Therefore, the odds ratio of access to extension service decreases by **.534**, when every one additional number of dependency family added(child borned or elder person who retired) as a result, other things held constant. This means the farm household who has a large number of age below 14 or 15(children) and age above 65 (elder) madethose households difficult to participate in any rural development package such as agricultural extension service and forces them less probability to access extension service, than that of less dependence held farmers. Forexample, one of female headed household has a child, its hard to her when she wanted to meed experts goe to their service center. If households who have more children, they have spent more time and money by serving their children rather than access and receive extension package due to the cost of their children.

Off-farm income: Regarding the determinants of smallholder access to extension service, the results showed that off-farm income (non-farm income) is influenced negatively with expected signs at5% probability level. It is also asumed a dummy variable in this model that codes 1 if more than $200, 0 if less than $200 of annual income. On average each 1 additional unit of USD non-farming income incrment, the probability to access extension service program decrease by the expected coefficient, or, the log- likelihood of access to extension by (**16%**) less likely, than that of earned more than $200 in a year. (The odds ratio to access extension service by **0.158** times less likely, when household earns more income from off-farm than that of earning lessthan $200), considered other factor held constant.Because of those household enjoys generating income from out of farming activity, so these households no willingness to access due to they time spent more time on out of farming activity and not participate in farming input provision.

Price of agricultural input: Agricultural input price is one of the important factors that influence the response variable. It's negatively influenced and statistically significant by a 0.061 probability level. The negative sign of coefficient anticipated that the price of farm input and other related price are very high, it influences farm households to access extension service due to the high cost to receive extension packages, so they are not interested in the high cost of receiving extension agent service. So, it implies that, the odds ratio access extension service by **0.15** times less likely for high agricultural input price than that of low and medium input price, keeping the influence of other variables constant.

Additional tests to fitness of the model

=$\boldsymbol{\Sigma\beta}$/$\boldsymbol{\Sigma}$SE, should be >pro, =$\boldsymbol{\Sigma\beta}$ of above model= -20.458 and,

= $\boldsymbol{\Sigma}$SE= 14.933, $\boldsymbol{\Sigma\beta}$/$\boldsymbol{\Sigma}$SE = -20.458/14.933= 1.3697,

1.3697>pro (0.00), so the assumption is proofed.

1/2$\boldsymbol{\Sigma\beta}$ should be <$\boldsymbol{\Sigma}$SE

½(20.458)= 10.229, 10.229<14.933

VIF, also should be <10,

VIF= (1/1-R2), 1/1-0.49 and 1/1-0.707

= 1.96 and 3.4,

1.96<10 and 3.4<10, in both case it satisfy the assumption

Compute to test statistics:-as above resilt, shows that test statistics > tabulated statistics, so reject null-hypothesis. The decision is, the explained explanatory variables have an influancial power on the probability of access to extension service by small house hold farmers'.

CHAPTER FIVE

Conclusion and Recommendation

1.19. Conclusion

The government of Ethiopia has tried to implement this technology-led extension program, particularly since the mid-1990s in a high-profile national program. But has this was not implemented, and there were so many unsolved obstacles. National strategy chimes with a widely held view that poverty reduction in Ethiopia is impossible without significant growth in crop yields for major staples, and this requires improving farmers' access to fertilizer, improved seeds, agricultural credit, and other inputs. However, this view is not new, and still; research has been conducting transformation plans, and sustainable development carried out.

Despite this even there was so much research conducted to improve agricultural productivity and ensure food sufficiency studied on credit accessibility, irrigation usage, technology adaptation, and infrastructure facilitation as well as a market chain with rural households (farmers). But there was no attention has been given to agricultural extension agents (development experts), improving the use of fertilizer, promoting improved seeds adoption, irrigation, and the use of modern farm machinery and other components of the modernization package, encouraging access and contact with credit market more challenged and inconsistency without extension system. Because of those small hold farmers' would not frequently use fertilizers and improved seeds. The results of this research revealed that most of the households (78%) participated in the extension service programs. But as the data implies, most of them were less likely to visit in the year among their farming area and other package provision in the center of extension, moreover accessing input and knowing the extension in their local where asked households were none despised number reported.

The problem of smallholder farmers generally in Ethiopia, particularly in the study area is strictly technical and resource-related problems, such as lack of knowledge and skill. Even there is a provision of input i.e. fertilizer, improved seed, irrigation pump, and others, due to inefficient use and waste time and economy without any change of farm outcome. On the other hand, the resource was one of the stranglehold challenges, such as the very limited size of farm and grazing land (land lessness), financial constraints to hold oxen; livestock; cost for input, and

other challenges hindered especially small-hold farmers in the study area context. The study conducted in the wolaita zone of sodozuria district to describe the current status of agricultural productivity and system of the farming status of smallholder farmers' by their limited resources explained above, indicated the weakness of accessing agricultural extension services in the study area was one of the hindered problems. The system is still dominated by one-way or linear agricultural knowledge-information and non-technology (traditional practice).

However, even smallholder farmers often struggle to produce enough for their consumption, and such a shift could be one threat to smallholder farmers, but effective agricultural extension agents can solve the tackled problems, by coordinating with other public and economic institutions.

The study was based on smallholder farmers' access to AES in the sodo zuria district, the aim of the study investigated to improve the productivity level by adopting agricultural technology packages and expert training and visiting at the household level to eradicate poverty and ensure food security. A binary logistic model was used to analyze the weather access or not of 100 farmers selected randomly. The estimated result in the binary logit model and descriptive statistics of the above result shows that; size of farmland, price of agriculture input, soil characteristics, knowledge to use fertilizer, access to credit, number of oxen, willingness to participate in extension program, livestock owned, and time spent on the farm were found to be statistically significant and influenced the probability of being smallholder farmers' access to extension services at1%, 5%, and 10% level of significance.size of Farmland and willingness to access extension service were strongly influenced and positively related to access to extension service. Whereas the (price, dep. Ratio and off-farm inc weakly related) to access in the study area. The variation of overall explained explanatory variables in the model are explained by 49.1% (Cox & Snell R^2) and 71%(Nagelkerke R^2) on the access to agricultural extension servicesand the remaining by other influencial factors that not included in the model(ei). The overall log-likelihood ratio and chi-square of the estimated variables are 67.507 and 51.084a respectively.

Lack of modern farming knowledge of farmers associated with a low level of education, limited farming land, lack of major farm input, low level of output related to soil characteristics, less perception and unwillingness to participate and receive extension service, not managed important

farm season and not work maximum hour during farm season one of the farmers' side problem. Limited labor force associated with migrating to local and other towns to search for other kinds of work, high dependence ratio, no experience use of modern agricultural input, the high price of agricultural input, and financial constraints also affect access to extension service. On the other hand, extension workers, agents, and rural development institution packages do not give high attention to those economically and psychologically minor farm households'.A field study and other gathered information show that provision of fertilizer, improved seed, and sometimes animal breeding by extension was not considered for those farmers.

Moreover, the result reveals, that most of the extension service programs focus on economically powerful farmers, (middle and large-income farmers). The main role of the AE agent is to empower farmers and enable them to identify and analyze their agricultural-based problems and to be able to make the right decision to the growth of rural development activities leads to the expansion of technology transfer, input supply, coordination, and credit delivery mainly responsible to development experts. Because of these, lack of information, financial constraints, lack of knowledge and unwillingness about technical improved input and credit, far distance to extension center, illiteracy, limited farm size, and lack of plughing oxen are factors that influence access to extension services.

1.20. Recommendations

As the finding of this research shows that the researcher suggested as following;-

- Every institutions coordinat and struggle to gather to come up of small-holder farmers' to be effective and equitable participation in any agricultural service package to improve agricultural productivity, to meet their food requirements, reduce purposive poverty and increase farm-based income. Because rural households especially small-holder farmers without efficient agricultural output, there is unthinkable to improve farmers' well-being and ensure food sufficiency in the household level.
- In particular, to increase production and productivity, Increase agricultural professional support; Improve integrated agriculture; Accelerate the supply of inputs: Collaborative efforts by extension agents and stakeholders are required in this research paper.
- To increase productivity and productivity, farmers need to be self-sufficient, especially in food crops; effectively access to agricultural service programs,
- The government and concerned institutions are recommended to play a key role in accelerating the supply of inputs, especially with the special support of smallholder farmers and the equitable distribution of resources, (arable land, credit, and ongoing education and training),natural conservation, resource utilization, climate change policy. Also when during any policy formation those farmers have to be minded.
- MoARDPolicy makers should give equal emphasis to incentives and affordability to small-scale farm households about modern inputs as their efforts. Even though, there was evidence of better co-ordination and synergy between service providers, experts (extension agents), and farmers', there appeared a little effect co-ordination on smallholder farmers' through government and other stakeholders should work towards developing a strong institutional framework that will guide and strength this mutually beneficial partnership to enhance agricultural productivity.
- Local, zonal, regional, and government policy also matters going to be given attention for equitable and sustainable rural livelihood to eradicate poverty, ensure food security and improve wellbeing in each household level. So, this study suggests that rural and agricultural-based policy formation is more focused on those factors. Such as developing

small and minor farm households' economic, social and psychological by forming universal and adult education, subsidizing minor farmers including agricultural package programs.

- Strengthening the capacity of financial and agricultural institutions to better serve those farmers, Financial institutions and NGO donors suggested as this study find problems. There was the limited provision of credit and inflexible due to shortage of due payment, not considering those economically minor farmers' interest payment, and complexity during credit loan. So, financial institution has to be recommended to be made flexible, and more small-hold farmers-focused credit provision is one of the important findings in this research. Also, the credit institution and credit worker should be meet farmers in the local area, advise, aware and follow them after receiving money for what purpose they used, encourage them and more indicate to constantly use credit, and also solve when problems hindered them rather than make them under risk and credit debtor.
- Extension agent and experts recommended that, not only facilitate input and farmers' training in the center as a whole but also give more attention to smallholder farmers' who has very limited farmland and non-holed plow oxen farmers. Because they were left out from any service programs and no one remembers them and, not given more attention from experts each of this research conducted area or kebele. The public agricultural extension should be working to strengthen to improve smallholder farmers' living status.

To achieve smallholder farmers, well-being and home food security require every to struggle to strengthen those farmers. All these important bodies coordinate together to achieve effective and equal participation of smallholder farmers on extension services and other agricultural-based institutional support. This will be achieved if, and only if, farmers have a positive perception and appreciate the significance of participation. Farmers' participation and farmers' side problem solving has been a concern for many projects about agricultural development and agricultural innovative system. On the other hand, extension agents should be more effective in helping to improve smallholder farmers' livelihoods.

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APPENDICS

Appendix, 1

CROSS TABULATION

1. Level of education

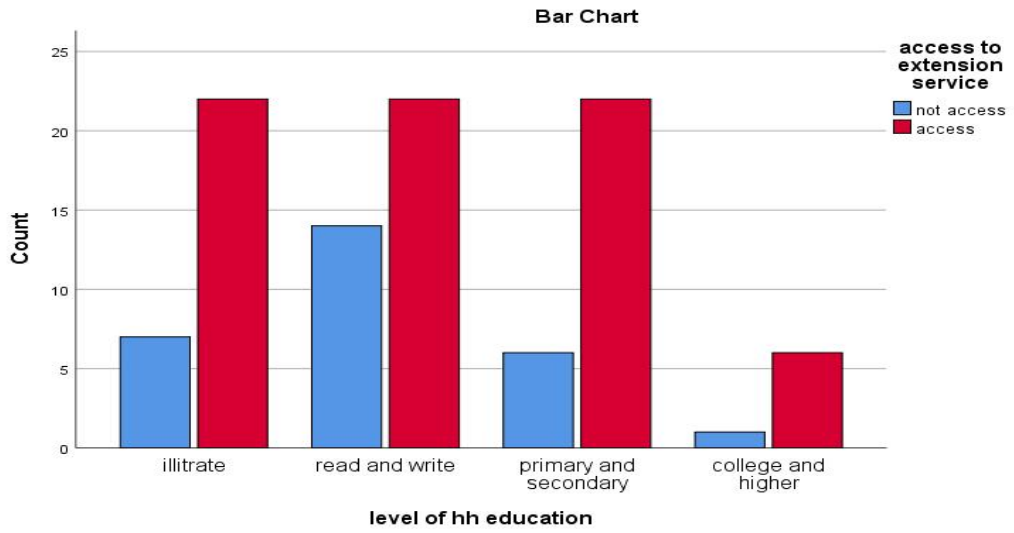
Crosstab

			access to extension service		
			not access	access	Total
level of hh education	Illiterate	Count	7	22	29
		Expected Count	8.1	20.9	29.0
		% within level of hh education	24.1%	75.9%	100.0%
		% within access to extension service	25.0%	30.6%	29.0%
		% of Total	7.0%	22.0%	29.0%
	read and write	Count	14	22	36
		Expected Count	10.1	25.9	36.0
		% within level of hh education	38.9%	61.1%	100.0%
		% within access to extension service	50.0%	30.6%	36.0%
		% of Total	14.0%	22.0%	36.0%
	primary and secondary	Count	6	22	28
		Expected Count	7.8	20.2	28.0
		% within level of hh education	21.4%	78.6%	100.0%
		% within access to extension service	21.4%	30.6%	28.0%
		% of Total	6.0%	22.0%	28.0%
	college and higher	Count	1	6	7
		Expected Count	2.0	5.0	7.0
		% within level of hh education	14.3%	85.7%	100.0%
		% within access to extension service	3.6%	8.3%	7.0%
		% of Total	1.0%	6.0%	7.0%
Total		Count	28	72	100
		Expected Count	28.0	72.0	100.0
		% within level of hh education	28.0%	72.0%	100.0%
		% within access to extension service	100.0%	100.0%	100.0%
		% of Total	28.0%	72.0%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.585[a]	3	.310
Likelihood Ratio	3.584	3	.310
Linear-by-Linear Association	.411	1	.522
N of Valid Cases	100		

a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 1.96.



2. size of farm and grazing land by hectare * access to extension service

Crosstab

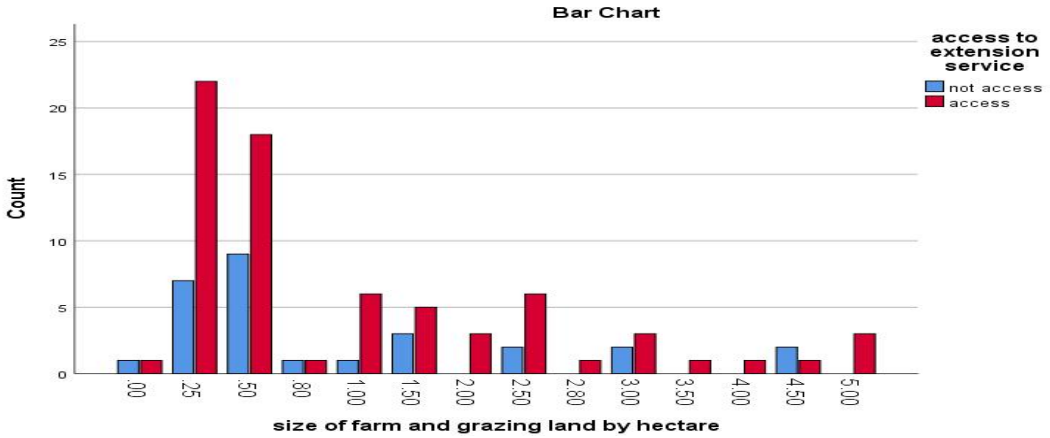
			access to extension service		Total
			not access	access	
size of farm and grazing land by hectare	.00	Count	1	1	2
		Expected Count	.6	1.4	2.0
		% within size of farm and grazing land by hectare	50.0%	50.0%	100.0%
		% within access to extension service	3.6%	1.4%	2.0%
		% of Total	1.0%	1.0%	2.0%
	.25	Count	7	22	29
		Expected Count	8.1	20.9	29.0
		% within size of farm and grazing land by hectare	24.1%	75.9%	100.0%
		% within access to extension service	25.0%	30.6%	29.0%
		% of Total	7.0%	22.0%	29.0%
	.50	Count	9	18	27
		Expected Count	7.6	19.4	27.0
		% within size of farm and grazing land by hectare	33.3%	66.7%	100.0%
		% within access to extension service	32.1%	25.0%	27.0%
		% of Total	9.0%	18.0%	27.0%
	.80	Count	1	1	2
		Expected Count	.6	1.4	2.0
		% within size of farm and grazing land by hectare	50.0%	50.0%	100.0%
		% within access to extension service	3.6%	1.4%	2.0%
		% of Total	1.0%	1.0%	2.0%
	1.00	Count	1	6	7
		Expected Count	2.0	5.0	7.0
		% within size of farm and grazing land by hectare	14.3%	85.7%	100.0%
		% within access to extension service	3.6%	8.3%	7.0%
		% of Total	1.0%	6.0%	7.0%
	1.50	Count	3	5	8
		Expected Count	2.2	5.8	8.0
		% within size of farm and grazing land by hectare	37.5%	62.5%	100.0%
		% within access to extension service	10.7%	6.9%	8.0%
		% of Total	3.0%	5.0%	8.0%

	2.00	Count	0	3	3
		Expected Count	.8	2.2	3.0
		% within size of farm and grazing land by hectare	0.0%	100.0%	100.0%
		% within access to extension service	0.0%	4.2%	3.0%
		% of Total	0.0%	3.0%	3.0%
	2.50	Count	2	6	8
		Expected Count	2.2	5.8	8.0
		% within size of farm and grazing land by hectare	25.0%	75.0%	100.0%
		% within access to extension service	7.1%	8.3%	8.0%
		% of Total	2.0%	6.0%	8.0%
	2.80	Count	0	1	1
		Expected Count	.3	.7	1.0
		% within size of farm and grazing land by hectare	0.0%	100.0%	100.0%
		% within access to extension service	0.0%	1.4%	1.0%
		% of Total	0.0%	1.0%	1.0%
	3.00	Count	2	3	5
		Expected Count	1.4	3.6	5.0
		% within size of farm and grazing land by hectare	40.0%	60.0%	100.0%
		% within access to extension service	7.1%	4.2%	5.0%
		% of Total	2.0%	3.0%	5.0%
	3.50	Count	0	1	1
		Expected Count	.3	.7	1.0
		% within size of farm and grazing land by hectare	0.0%	100.0%	100.0%
		% within access to extension service	0.0%	1.4%	1.0%
		% of Total	0.0%	1.0%	1.0%
	4.00	Count	0	1	1
		Expected Count	.3	.7	1.0
		% within size of farm and grazing land by hectare	0.0%	100.0%	100.0%
		% within access to extension service	0.0%	1.4%	1.0%
		% of Total	0.0%	1.0%	1.0%
	4.50	Count	2	1	3
		Expected Count	.8	2.2	3.0
		% within size of farm and grazing land by hectare	66.7%	33.3%	100.0%
		% within access to extension service	7.1%	1.4%	3.0%
		% of Total	2.0%	1.0%	3.0%
	5.00	Count	0	3	3
		Expected Count	.8	2.2	3.0
		% within size of farm and grazing land by hectare	0.0%	100.0%	100.0%
		% within access to extension service	0.0%	4.2%	3.0%
		% of Total	0.0%	3.0%	3.0%
Total		Count	28	72	100
		Expected Count	28.0	72.0	100.0
		% within size of farm and grazing land by hectare	28.0%	72.0%	100.0%
		% within access to extension service	100.0%	100.0%	100.0%
		% of Total	28.0%	72.0%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.685[a]	13	.796
Likelihood Ratio	10.746	13	.632
Linear-by-Linear Association	.055	1	.814
N of Valid Cases	100		

a. 21 cells (75.0%) have expected count less than 5. The minimum expected count is .28.



3. frequence of visit to extension workers in the year * access to extension service

Crosstab

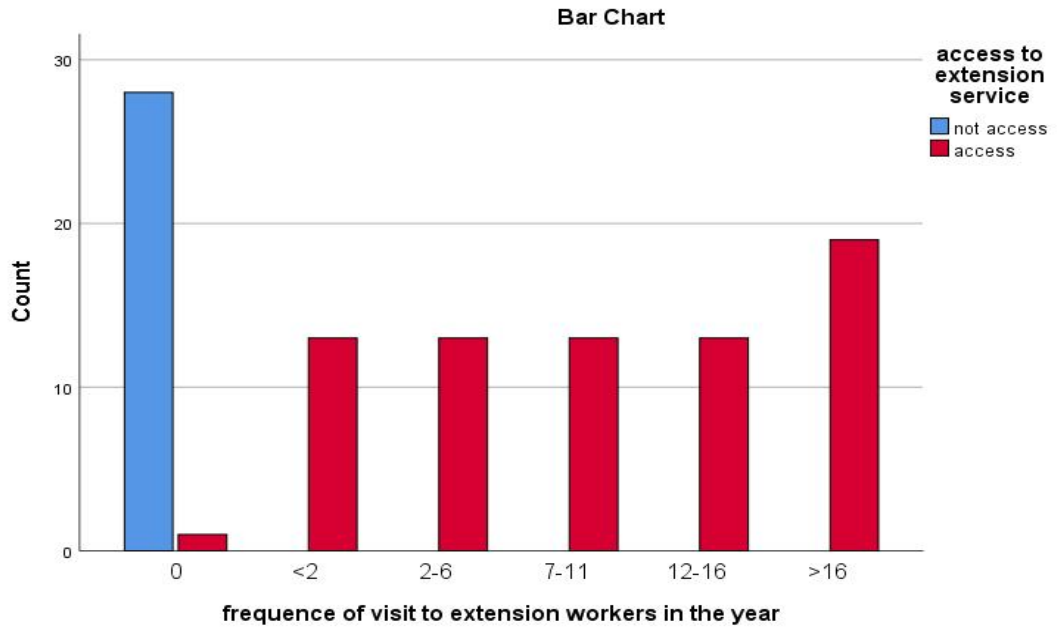
			access to extension service		
			not access	access	Total
frequence of visit to extension workers in the year	0	Count	28	1	29
		Expected Count	8.1	20.9	29.0
		% within frequence of visit to extension workers in the year	96.6%	3.4%	100.0%
		% within access to extension service	100.0%	1.4%	29.0%
		% of Total	28.0%	1.0%	29.0%
	<2	Count	0	13	13
		Expected Count	3.6	9.4	13.0
		% within frequence of visit to extension workers in the year	0.0%	100.0%	100.0%
		% within access to extension service	0.0%	18.1%	13.0%
		% of Total	0.0%	13.0%	13.0%
	2-6	Count	0	13	13
		Expected Count	3.6	9.4	13.0
		% within frequence of visit to extension workers in the year	0.0%	100.0%	100.0%
		% within access to extension service	0.0%	18.1%	13.0%
		% of Total	0.0%	13.0%	13.0%
	7-11	Count	0	13	13
		Expected Count	3.6	9.4	13.0
		% within frequence of visit to extension workers in the year	0.0%	100.0%	100.0%
		% within access to extension service	0.0%	18.1%	13.0%
		% of Total	0.0%	13.0%	13.0%
	12-16	Count	0	13	13
		Expected Count	3.6	9.4	13.0
		% within frequence of visit to extension workers in the year	0.0%	100.0%	100.0%
		% within access to extension service	0.0%	18.1%	13.0%
		% of Total	0.0%	13.0%	13.0%
	>16	Count	0	19	19
		Expected Count	5.3	13.7	19.0
		% within frequence of visit to extension workers in the year	0.0%	100.0%	100.0%

	% within access to extension service	0.0%	26.4%	19.0%
	% of Total	0.0%	19.0%	19.0%
Total	Count	28	72	100
	Expected Count	28.0	72.0	100.0
	% within frequence of visit to extension workers in the year	28.0%	72.0%	100.0%
	% within access to extension service	100.0%	100.0%	100.0%
	% of Total	28.0%	72.0%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	95.211[a]	5	.000
Likelihood Ratio	109.891	5	.000
Linear-by-Linear Association	54.329	1	.000
N of Valid Cases	100		

a. 4 cells (33.3%) have expected count less than 5. The minimum expected count is 3.64.



BINARY LOGISTIC MODEL ANALYSIS

APPENDIX 2

STATA REGRESION RESULTS

```
. logit ACCEXTSERD DEPR EDUD SFLD NOXN LIVSTD OFFFINC ACCRDD DISTD SOILD KNWUFERD KNWMOBD PRCAGRD WILLD

Iteration 0:   log likelihood = -59.295332
Iteration 1:   log likelihood = -32.597652
Iteration 2:   log likelihood = -29.437601
Iteration 3:   log likelihood = -28.871241
Iteration 4:   log likelihood = -28.864711
Iteration 5:   log likelihood = -28.864709

Logistic regression                             Number of obs     =        100
                                                LR chi2(13)       =      60.86
                                                Prob > chi2       =     0.0000
Log likelihood = -28.864709                     Pseudo R2         =     0.5132
```

ACCEXTSERD	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
DEPR	-.3059325	.2737014	-1.12	0.264	-.8423773	.2305123
EDUD	.1657483	.8492642	0.20	0.845	-1.498779	1.830276
SFLD	-1.219988	.4378021	-2.79	0.005	-2.078064	-.3619115
NOXN	1.403604	.5754545	2.44	0.015	.2757339	2.531474
LIVSTD	3.394763	1.86614	1.82	0.069	-.2628045	7.05233
OFFFINC	-.0008911	.0005355	-1.66	0.096	-.0019407	.0001586
ACCRDD	2.156122	1.070902	2.01	0.044	.0571927	4.255051
DISTD	.3833544	1.220577	0.31	0.753	-2.008934	2.775642
SOILD	2.186683	.9112351	2.40	0.016	.4006947	3.972671
KNWUFERD	2.344471	.8597509	2.73	0.006	.6593902	4.029552
KNWMOBD	-.8961026	.8563201	-1.05	0.295	-2.574459	.7822538
PRCAGRD	1.547538	.8815052	1.76	0.079	-.1801804	3.275256
WILLD	3.403774	1.072874	3.17	0.002	1.30098	5.506568
_cons	-4.560568	1.578139	-2.89	0.004	-7.653665	-1.467472

```
. logistic ACCEXTSERD DEPR EDUD SFLD NOXN LIVSTD OFFFINC ACCRDD DISTD SOILD KNWUFERD KNWMOBD PRCAGRD WILLD

Logistic regression                             Number of obs     =        100
                                                LR chi2(13)       =      60.86
                                                Prob > chi2       =     0.0000
Log likelihood = -28.864709                     Pseudo R2         =     0.5132
```

ACCEXTSERD	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
DEPR	.7364363	.2015636	-1.12	0.264	.4306854	1.259245
EDUD	1.180276	1.002366	0.20	0.845	.2234028	6.235605
SFLD	.2952338	.129254	-2.79	0.005	.1251723	.696344
NOXN	4.069841	2.342008	2.44	0.015	1.317497	12.57202
LIVSTD	29.80758	55.62511	1.82	0.069	.7688922	1155.548
OFFFINC	.9991093	.0005351	-1.66	0.096	.9980612	1.000159
ACCRDD	8.637576	9.249997	2.01	0.044	1.05886	70.46043
DISTD	1.467198	1.790829	0.31	0.753	.1341316	16.04893
SOILD	8.905622	8.115116	2.40	0.016	1.492861	53.12623
KNWUFERD	10.42776	8.965272	2.73	0.006	1.933613	56.23571
KNWMOBD	.4081573	.3495133	-1.05	0.295	.076195	2.186394
PRCAGRD	4.699885	4.142973	1.76	0.079	.8351195	26.45001
WILLD	30.0774	32.26926	3.17	0.002	3.672894	246.3044
_cons	.0104561	.0165012	-2.89	0.004	.0004743	.2305075

The marginal effect of the regression output

```
. mfx

Marginal effects after logistic
      y  = Pr(ACCEXTSERD) (predict)
         =  .89478411
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
DEPR	-.0288022	.02769	-1.04	0.298	-.083066	.025462	1.85
EDUD*	.0151876	.07521	0.20	0.840	-.132229	.162604	.29
SFLD	-.1148564	.04547	-2.53	0.012	-.203969	-.025744	1.2115
NOXN	.132143	.05897	2.24	0.025	.016559	.247727	1.3
LIVSTD*	.1708497	.07329	2.33	0.020	.02721	.31449	.18
OFFFINC	-.0000839	.00005	-1.56	0.119	-.000189	.000022	629.01
ACCRDD*	.174797	.07464	2.34	0.019	.028513	.321081	.36
DISTD*	.0331182	.0938	0.35	0.724	-.15072	.216957	.21
SOILD*	.2757015	.14159	1.95	0.052	-.001807	.55321	.65
KNWUFERD*	.3055754	.14728	2.07	0.038	.016904	.594246	.66
KNWMOBD*	-.0849781	.08075	-1.05	0.293	-.243248	.073292	.51
PRCAGRD*	.1253547	.07045	1.78	0.075	-.012729	.263438	.34
WILLD*	.6190713	.2095	2.96	0.003	.208464	1.02968	.86

(*) dy/dx is for discrete change of dummy variable from 0 to 1

APPENDIX 3

Diagonstical estimation of the result reliability, (app 2.1, interdependence of statistical tests)

```
. pwcorr SFLD FS OFFFINC DEPR LABR NOXN GEND EDUD TIMSPD DISTD SOILD KNWUFERD KNWMOBD ACCRDD PRCAGRD WILLD AGED
> LIVSTD, sig
```

	SFLD	FS	OFFFINC	DEPR	LABR	NOXN	GEND
SFLD	1.0000						
FS	0.1238	1.0000					
	0.2197						
OFFFINC	-0.0634	-0.0526	1.0000				
	0.5312	0.6033					
DEPR	0.0657	0.6696	0.0453	1.0000			
	0.5162	0.0000	0.6547				
LABR	0.2895	0.5680	-0.0271	0.1248	1.0000		
	0.0035	0.0000	0.7888	0.2162			
NOXN	0.5887	0.2340	-0.0897	0.1608	0.2623	1.0000	
	0.0000	0.0191	0.3747	0.1099	0.0084		
GEND	0.1038	0.0597	-0.0165	0.0971	-0.0555	0.1945	1.0000
	0.3043	0.5550	0.8703	0.3364	0.5835	0.0525	
EDUD	-0.0492	0.2263	0.1111	0.1921	0.2182	-0.0164	-0.0862
	0.6270	0.0235	0.2709	0.0555	0.0292	0.8717	0.3939
TIMSPD	0.3089	0.1386	-0.1200	0.0022	0.2480	0.3168	0.2464
	0.0018	0.1690	0.2343	0.9830	0.0129	0.0013	0.0135
DISTD	-0.0036	-0.0118	-0.1020	-0.1187	0.1476	0.1223	-0.1411
	0.9713	0.9072	0.3124	0.2395	0.1429	0.2254	0.1616
SOILD	0.0812	0.0914	-0.1112	0.0259	0.1112	-0.1222	0.0152
	0.4220	0.3656	0.2707	0.7982	0.2708	0.2257	0.8808
KNWUFERD	0.1420	0.1627	0.1245	0.0432	0.3135	0.2954	0.1284
	0.1587	0.1058	0.2171	0.6695	0.0015	0.0029	0.2029
KNWMOBD	-0.0540	-0.3515	-0.0793	-0.2732	-0.1980	-0.0488	0.1555
	0.5937	0.0003	0.4329	0.0060	0.0483	0.6299	0.1224
ACCRDD	0.0667	-0.1138	-0.0414	-0.1265	0.0331	0.0927	-0.1046
	0.5097	0.2594	0.6825	0.2100	0.7434	0.3587	0.3003
PRCAGRD	-0.0513	-0.0124	0.0379	0.2697	-0.1082	-0.0716	-0.0265
	0.6121	0.9025	0.7081	0.0067	0.2838	0.4790	0.7935
WILLD	0.1040	-0.0677	0.0685	-0.0631	0.1477	0.0672	-0.0751
	0.3033	0.5032	0.4984	0.5331	0.1424	0.5065	0.4575
AGED	-0.1123	-0.2111	0.0028	-0.1029	-0.2310	-0.2024	0.0437
	0.2660	0.0350	0.9778	0.3085	0.0208	0.0434	0.6662
LIVSTD	0.3524	0.0505	-0.0047	0.0312	0.0092	0.2373	0.0603
	0.0003	0.6178	0.9629	0.7577	0.9276	0.0175	0.5511

```
. spearman SFLD FS OFFFINC DEPR LABR NOXN GEND EDUD TIMSPD DISTD SOILD KNWUFERD KNWMOBD ACCRDD PRCAGRD WILLD AGED
>  LIVSTD, stats(rho p)
(obs=100)
```

Key
rho
Sig. level

	SFLD	FS	OFFFINC	DEPR	LABR	NOXN	GEND	EDUD	TIMSPD	DISTD
SFLD	1.0000									
FS	0.2149 0.0318	1.0000								
OFFFINC	-0.0491 0.6279	-0.0187 0.8539	1.0000							
DEPR	0.1171 0.2460	0.6559 0.0000	0.0461 0.6486	1.0000						
LABR	0.2700 0.0066	0.5940 0.0000	-0.0563 0.5778	0.1840 0.0669	1.0000					
NOXN	0.6102 0.0000	0.2354 0.0184	-0.0800 0.4291	0.1678 0.0952	0.2748 0.0057	1.0000				
GEND	0.1712 0.0885	0.0716 0.4792	-0.0322 0.7504	0.1503 0.1355	0.0474 0.6393	0.2348 0.0187	1.0000			
EDUD	-0.0864 0.3930	0.2470 0.0132	0.1129 0.2634	0.2006 0.0454	0.2764 0.0054	-0.0204 0.8403	-0.0862 0.3939	1.0000		
TIMSPD	0.2549 0.0105	0.1534 0.1276	-0.0875 0.3866	0.0220 0.8280	0.3293 0.0008	0.3197 0.0012	0.2464 0.0135	-0.0399 0.6936	1.0000	
DISTD	-0.1071 0.2890	-0.0095 0.9255	-0.1266 0.2093	-0.1359 0.1776	0.1628 0.1057	0.0814 0.4207	-0.1411 0.1616	-0.0049 0.9616	0.1193 0.2371	1.0000
SOILD	-0.0126 0.9007	0.0758 0.4537	-0.1119 0.2678	0.0603 0.5515	0.1155 0.2525	-0.1282 0.2038	0.0152 0.8808	0.0531 0.5996	0.0575 0.5696	0.0180 0.8588
KNWUFERD	0.2777 0.0051	0.1963 0.0503	0.1130 0.2629	0.0682 0.5004	0.3400 0.0005	0.3089 0.0018	0.1284 0.2029	0.1796 0.0738	0.2120 0.0342	-0.0446 0.6597
KNWMOBD	-0.1326 0.1883	-0.3551 0.0003	-0.0868 0.3904	-0.2963 0.0028	-0.2050 0.0408	-0.0660 0.5144	0.1555 0.1224	-0.2553 0.0104	0.0850 0.4004	0.0634 0.5312
ACCRDD	-0.0037 0.9709	-0.0914 0.3659	-0.0322 0.7502	-0.1471 0.1442	-0.0226 0.8236	0.0930 0.3574	-0.1046 0.3003	0.0716 0.4789	-0.0322 0.7505	-0.0286 0.7773
PRCAGRD	-0.0764 0.4502	0.0404 0.6901	0.0064 0.9497	0.2442 0.0144	-0.0457 0.6513	-0.0336 0.7398	-0.0265 0.7935	0.0530 0.6002	0.0455 0.6531	0.0964 0.3400
WILLD	0.0199 0.8440	-0.0303 0.7645	0.0359 0.7230	-0.0557 0.5818	0.1625 0.1063	0.0641 0.5266	-0.0751 0.4575	0.0038 0.9700	0.2777 0.0051	0.2080 0.0378
AGED	-0.1140 0.2586	-0.2518 0.0115	-0.0318 0.7533	-0.1202 0.2337	-0.2395 0.0164	-0.1839 0.0670	0.0437 0.6662	-0.2680 0.0070	-0.1410 0.1617	0.1258 0.2122
LIVSTD	0.2478 0.0129	0.0776 0.4427	0.0398 0.6941	0.0217 0.8303	0.0239 0.8134	0.1625 0.1063	0.0603 0.5511	-0.0700 0.4890	0.2974 0.0027	0.0780 0.4407

APPENDIX 4

SPSS REGRESION RESULTS

Omnibus Tests of Model Coefficients

		Chi-square	Df	Sig.
Step 1	Step	67.507	15	.000
	Block	67.507	15	.000
	Model	67.507	15	.000

Dependent Variable Encoding

Original Value	Internal Value
not access	0
Access	1

Table 4.3.1 c

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	51.084[a]	.491	.707

a. Estimation terminated at iteration number 8 because parameter estimates changed by less than .001.

Categorical Variables Coding's			
		Frequency	Parameter coding
			(1)
distance far from farm area to extension center	Other	79	1.000
	<1km	21	0.000
gender of hh	Female	22	1.000
	Male	78	0.000
level of education	Other	71	1.000
	Illiterate	29	0.000
livestock dummy	<3 and 3-6	82	1.000
	7-10 and>10	18	0.000
soil characterestics	Other	35	1.000
	Fertile	65	0.000
exprience to use fertilizer	No	34	1.000
	Yes	66	0.000
access to credit	No	64	1.000
	Yes	36	0.000
anual off-farm income	Other	64	1.000
	<$200	36	0.000
willingness to access extension service	No	14	1.000
	Yes	86	0.000
price of agricultural input	Other	66	1.000
	High	34	0.000
age catagory of hh	Other	55	1.000
	<=38	45	0.000

variable in equation

		B	S.E.	Wald	Df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	agegroupD(1)	**1.447**	.978	2.188	1	.139	4.251	.625	28.918
	genderD(1)	**-1.621**	1.082	2.245	1	.134	.198	.024	1.648
	educD(1)	**.428**	1.006	.181	1	.671	1.534	.213	11.021
	Deprtio	**-.627**	.317	3.925	1	.048	.534	.287	.993
	Labfrc	**.543**	.465	1.365	1	.243	1.721	.692	4.278
	livstD(1)	**-4.523**	2.073	4.758	1	.029	.011	.000	.632
	SFLD	**-1.417**	.474	8.935	1	.003	.242	.096	.614
	Noxen	**1.438**	.599	5.767	1	.016	4.212	1.303	13.622
	soilD(1)	**-3.113**	1.180	6.960	1	.008	.044	.004	.449
	expusferlzrD(1)	**-2.658**	1.032	6.630	1	.010	.070	.009	.530
	accesscrdD(1)	**-2.491**	1.211	4.235	1	.040	.083	.008	.888
	prcagrinpD(1)	**-1.894**	1.011	3.512	1	.061	.150	.021	1.091
	willtoaccD(1)	**-3.729**	1.313	8.064	1	.005	.024	.002	.315
	offfarincD(1)	**-1.847**	.942	3.847	1	.050	.158	.025	.999
	distcD(1)	**-.390**	1.250	.098	1	.755	.677	.058	7.840
	Constant	**12.321**	4.165	8.749	1	.003	224263.499	--	---

a. Variable(s) entered on step 1: agegroupD, genderD, educD, deprtio, labfrc, livstD, SFLD, noxen, soilD, expusferlzrD, accesscrdD, prcagrinpD, willtoaccD, offfarincD, distcD.

Variables in the Equation

		B	S.E.	Wald	Df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	agegroupD(1)	1.342	.994	1.821	1	.177	3.826	.545	26.853
	Labfrc	.389	.550	.500	1	.479	1.476	.502	4.341
	genderD(1)	-1.630	1.083	2.264	1	.132	.196	.023	1.637
	educD(1)	.362	1.017	.127	1	.722	1.437	.196	10.545
	Deprtio	-.826	.546	2.287	1	.130	.438	.150	1.277
	Famsiz	.147	.360	.167	1	.683	1.159	.572	2.346
	livstD(1)	-4.710	2.198	4.594	1	.032	.009	.000	.668
	Noxen	1.392	.602	5.350	1	.021	4.024	1.237	13.093
	soilD(1)	-3.128	1.217	6.600	1	.010	.044	.004	.476
	SFLD	-1.397	.481	8.432	1	.004	.247	.096	.635
	distcD(1)	-.512	1.278	.160	1	.689	.599	.049	7.342
	knwusmobD(1)	.306	.908	.114	1	.736	1.359	.229	8.046
	expusferlzrD(1)	-2.714	1.050	6.681	1	.010	.066	.008	.519
	accesscrdD(1)	-2.758	1.333	4.282	1	.039	.063	.005	.864
	willtoaccD(1)	-3.781	1.326	8.129	1	.004	.023	.002	.307
	offfarincD(1)	-1.901	.964	3.887	1	.049	.149	.023	.989
	prcagrinpD(1)	-2.050	1.086	3.561	1	.059	.129	.015	1.082
	Constant	12.866	4.424	8.459	1	.004	386991.716		

Variable(s) entered on step 1: agegroupD, labfrc, genderD, educD, deprtio, famsiz, livstD, noxen, soilD, SFLD, distcD, knwusmobD, expusferlzrD, accesscrdD, willtoaccD, offfarincD, prcagrinpD.[a]

Statistics

		level of hh education	total family size of hh	size of farm and grazing land by hectare	frequence of visit to extension workers in the year	time spent on farming	distance far to extension center by km	soil characterestics	annual on-farm income of hh	annual off-farm income of hh	dependence ratio	labor force participate on farming activity	number of oxen owned	gender of hh	access to extension service	exprience to use fertilizer	exprience to use improved seed	knowledge to use mobile	access to credit	willingness to access extension service	age catagory of hh	livestock by catagorical
N	Valid	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean		2.13	5.48	1.2115	2.25	1.96	2.58	1.44	2.26	1.70	1.85	2.20	1.30	0.78	0.72	0.66	0.64	0.51	0.36	0.86	1.77	1.97
Std. Deviation		0.917	2.258	1.29844	1.904	1.053	1.423	0.743	1.655	2.087	1.424	1.137	0.948	0.416	0.451	0.476	0.482	0.502	0.482	0.349	0.790	0.745
Minimum		1	1	0.00	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1
Maximum		4	13	5.00	5	4	12	3	6	6	6	8	4	1	1	1	1	1	1	1	3	4

Appendix 5

Correlation

Reliability

Case Processing Summary

		N	%
Cases	Valid	100	100.0
	Excluded[a]	0	.0
	Total	100	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.596	.525	17

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
total family size of hh	12.1115	15.975	.532	.724	.508
size of farm and grazing land by hectare	16.3800	24.723	.331	.483	.558
dependence ratio	15.7415	22.660	.443	.653	.528
labor force participate on farming activity	15.3915	23.985	.486	.590	.525
number of oxen owned	16.2915	25.659	.430	.511	.544
gender of hh	16.8115	30.054	.101	.186	.595

level of education	17.3015	29.640	.169	.197	.589
time spent on farming	17.1815	28.789	.312	.332	.577
distance far from farm area to extension center	17.3815	30.312	.046	.224	.599
soil characterestics	16.9415	30.203	.048	.224	.599
exprience to use fertilizer	16.9315	29.063	.272	.343	.581
access to credit	17.2315	30.587	-.025	.164	.605
price of agricultural input	17.2515	30.127	.064	.250	.598
willingness to access extension service	16.7315	30.082	.126	.299	.593
livestock dummy	17.4115	29.691	.201	.245	.588
age catagory of hh	17.1415	31.711	-.226	.279	.622
anual off-farm income	17.2315	30.509	-.010	.175	.604

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 50.0.

b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 49.0.

c. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 33.3.

d. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 49.5.

e. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 14.3.

f. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 16.7.

g. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.0.

Test Statistics

	size of farm and grazing land by hectare	dependence ratio	labor force participation farming activity	number of oxen owned	gender of hh	level of education	distance far from farm area to extension center	soil characteristics	experience to use fertilizer	experience to use improved seed	annual off-farm income	~~knowledge to use mobile~~	access to credit	price of agricultural input	willingness to access extension service	~~age category of hh~~	livestock dummy
Chi-Square	153.400[a]	44.480[b]	82.640[c]	60.800[d]	31.360[e]	17.640[e]	33.640[e]	9.000[e]	10.240[e]	19.360[e]	7.840[e]	~~.040~~[e]	7.840[e]	10.240[e]	51.840[e]	~~1.000~~[e]	40.960[e]
df	13	6	5	4	1	1	1	1	1	1	1	~~1~~	1	1	1	~~1~~	1
Asymp. Sig.	.000	.000	.000	.000	.000	.000	.000	.003	.001	.000	.005	~~.841~~	.005	.001	.000	~~.317~~	.000

Source: field survey data statistical output (2021/22)

Appendix 6

Statistics

		size of farm and grazing land by hectare	dependence ratio	labor force participate on farming activity	number of oxen owned	gender of hh	level of education	distance far from farm area to extension center	soil characteristics	exprience to use fertilizer	anual off-farm income	knowledge to use mobile	access to credit	price of agricultural input	age catagory of hh	willingness to access extension service	livestock dummy
N	Valid	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
	Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean		1.2115	1.85	2.20	1.30	.78	.29	.21	.65	.66	.36	.51	.36	.34	.45	.86	.18
Median		.5000	2.00	2.00	1.00	1.00	0.00	0.00	1.00	1.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
Mode		.25	2	2	1	1	0	0	1	1	0	1	0	0	0	1	0
Std. Deviation		1.29844	1.424	1.137	.948	.416	.456	.409	.479	.476	.482	.502	.482	.476	.500	.349	.386
Variance		1.686	2.028	1.293	.899	.173	.208	.168	.230	.227	.233	.252	.233	.227	.250	.122	.149
Skewness		1.486	.591	1.699	.740	1.373	.940	1.446	-.639	-.686	.592	-.041	.592	.686	.204	-2.107	1.691
Std. Error of Skewness		.241	.241	.241	.241	.241	.241	.241	.241	.241	.241	.241	.241	.241	.241	.241	.241
Kurtosis		1.338	.037	5.710	.568	.119	-1.140	.092	-1.625	-1.561	1.683	-2.040	1.683	-1.561	1.999	2.488	.878
Std. Error of Kurtosis		.478	.478	.478	.478	.478	.478	.478	.478	.478	.478	.478	.478	.478	.478	.478	.478
Minimum		0.00	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum		5.00	6	8	4	1	1	1	1	1	1	1	1	1	1	1	1

Appendix 7

Hotelling's T-Squared Test

Hotelling's T-Squared	F	df1	df2	Sig
856.687	53.157	14	86	.000

ANOVA with Friedman's Test

		Sum of Squares	df	Mean Square	Friedman's Chi-Square	Sig
Between People		74.736	99	.755		
Within People	Between Items	403.970[a]	15	26.931	622.813	.000
	Residual	568.963	1485	.383		
	Total	972.934	1500	.649		
Total		1047.670	1599	.655		

Grand Mean = .7013

a. Kendall's coefficient of concordance W = .386.

Coorelation between explanatory interdependence

	size of farm and grazing land by hectare	dependence ratio	labor force participate on farming activity	number of oxen owned	gender of hh	level of education	distance far from farm area to extension center	soil characterestics	exprience to use fertilizer	anual off-farm income	access to credit	price of agricultural input	willingness to access extension service	livestock dummy

size of farm and grazing land by hectare	Pearson Correlation	1	0.066	.290**	.589**	0.104	-0.049	-0.004	0.081	0.142	-0.032	0.067	-0.051	0.104	.352**
	Sig. (2-tailed)		0.516	0.003	0.000	0.304	0.627	0.971	0.422	0.159	0.748	0.510	0.612	0.303	0.000
	N	100	100	100	100	100	100	100	100	100	100	100	100	100	100
dependence ratio	Pearson Correlation	0.066	1	0.125	0.161	0.097	0.192	-0.119	0.026	0.043	.197*	-0.126	.270**	-0.063	0.031
	Sig. (2-tailed)	0.516		0.216	0.110	0.336	0.056	0.240	0.798	0.669	0.049	0.210	0.007	0.533	0.758
	N	100	100	100	100	100	100	100	100	100	100	100	100	100	100
labor force participate on farming activity	Pearson Correlation	.290**	0.125	1	.262**	-0.055	.218*	0.148	0.111	.313**	-0.151	0.033	-0.108	0.148	0.009
	Sig. (2-tailed)	0.003	0.216		0.008	0.584	0.029	0.143	0.271	0.001	0.134	0.743	0.284	0.142	0.928
	N	100	100	100	100	100	100	100	100	100	100	100	100	100	100
number of oxen owned	Pearson Correlation	.589**	0.161	.262**	1	0.194	-0.016	0.122	-0.122	.295**	-0.062	0.093	-0.072	0.067	.237*
	Sig. (2-tailed)	0.000	0.110	0.008		0.053	0.872	0.225	0.226	0.003	0.541	0.359	0.479	0.506	0.017
	N	100	100	100	100	100	100	100	100	100	100	100	100	100	100
gender of hh	Pearson Correlation	0.104	0.097	-0.055	0.194	1	-0.086	-0.141	0.015	0.128	-0.054	-0.105	-0.026	-0.075	0.060
	Sig. (2-tailed)	0.304	0.336	0.584	0.053		0.394	0.162	0.881	0.203	0.591	0.300	0.794	0.457	0.551
	N	100	100	100	100	100	100	100	100	100	100	100	100	100	100
level of education	Pearson Correlation	-0.049	0.192	.218*	-0.016	-0.086	1	-0.005	0.053	0.180	0.026	0.072	0.053	0.004	-0.070

	Sig. (2-tailed)	0.627	0.056	0.029	0.872	0.394		0.962	0.600	0.074	0.800	0.479	0.600	0.970	0.489
	N	100	100	100	100	100	100	100	100	100	100	100	100	100	100
time spent on farming	Pearson Correlation	.309**	0.002	.248*	.317**	.246*	-0.040	0.119	0.058	.212*	-0.075	-0.032	0.045	.278**	.297**
	Sig. (2-tailed)	0.002	0.983	0.013	0.001	0.013	0.694	0.237	0.570	0.034	0.461	0.751	0.653	0.005	0.003
	N	100	100	100	100	100	100	100	100	100	100	100	100	100	100
distance far from farm area to extension center	Pearson Correlation	-0.004	-0.119	0.148	0.122	-0.141	-0.005	1	0.018	-0.045	-0.029	-0.029	0.096	.208*	0.078
	Sig. (2-tailed)	0.971	0.240	0.143	0.225	0.162	0.962		0.859	0.660	0.777	0.777	0.340	0.038	0.441
	N	100	100	100	100	100	100	100	100	100	100	100	100	100	100
soil characterestics	Pearson Correlation	0.081	0.026	0.111	-0.122	0.015	0.053	0.018	1	-.261**	-0.192	-0.017	-0.049	0.066	0.016
	Sig. (2-tailed)	0.422	0.798	0.271	0.226	0.881	0.600	0.859		0.009	0.055	0.863	0.631	0.511	0.872
	N	100	100	100	100	100	100	100	100	100	100	100	100	100	100
exprience to use fertilizer	Pearson Correlation	0.142	0.043	.313**	.295**	0.128	0.180	-0.045	-.261**	1	-0.033	0.055	0.114	.197*	0.116
	Sig. (2-tailed)	0.159	0.669	0.001	0.003	0.203	0.074	0.660	0.009		0.741	0.590	0.258	0.049	0.248
	N	100	100	100	100	100	100	100	100	100	100	100	100	100	100
anual off-farm income	Pearson Correlation	-0.032	.197*	-0.151	-0.062	-0.054	0.026	-0.029	-0.192	-0.033	1	0.002	0.121	-0.118	0.159
	Sig. (2-tailed)	0.748	0.049	0.134	0.541	0.591	0.800	0.777	0.055	0.741		0.986	0.229	0.244	0.114
	N	100	100	100	100	100	100	100	100	100	100	100	100	100	100

access to credit	Pearson Correlation	0.067	-0.126	0.033	0.093	-0.105	0.072	-0.029	-0.017	0.055	0.002	1	0.077	.243*	-0.092
	Sig. (2-tailed)	0.510	0.210	0.743	0.359	0.300	0.479	0.777	0.863	0.590	0.986		0.444	0.015	0.362
	N	100	100	100	100	100	100	100	100	100	100	100	100	100	100
price of agricultural input	Pearson Correlation	-0.051	.270**	-0.108	-0.072	-0.026	0.053	0.096	-0.049	0.114	0.121	0.077	1	0.107	0.072
	Sig. (2-tailed)	0.612	0.007	0.284	0.479	0.794	0.600	0.340	0.631	0.258	0.229	0.444		0.289	0.476
	N	100	100	100	100	100	100	100	100	100	100	100	100	100	100
willingness to access extension service	Pearson Correlation	0.104	-0.063	0.148	0.067	-0.075	0.004	.208*	0.066	.197*	-0.118	.243*	0.107	1	0.133
	Sig. (2-tailed)	0.303	0.533	0.142	0.506	0.457	0.970	0.038	0.511	0.049	0.244	0.015	0.289		0.186
	N	100	100	100	100	100	100	100	100	100	100	100	100	100	100
age catagory of hh	Pearson Correlation	-0.112	-0.103	-.231*	-.202*	0.044	-.268**	0.126	0.116	-0.115	0.159	-0.092	0.072	0.133	1
	Sig. (2-tailed)	0.266	0.309	0.021	0.043	0.666	0.007	0.212	0.251	0.256	0.114	0.362	0.476	0.186	
	N	100	100	100	100	100	100	100	100	100	100	100	100	100	100
livestock dummy	Pearson Correlation	.352**	0.031	0.009	.237*	0.060	-0.070	0.078	0.016	0.116	-0.026	0.082	-0.062	0.189	-0.110
	Sig. (2-tailed)	0.000	0.758	0.928	0.017	0.551	0.489	0.441	0.872	0.248	0.797	0.415	0.543	0.060	0.277
	N	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Appendix 8

4.2.1 Measure of central tendency and despertion of variables

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
size of farm and grazing land by hectare	100	1.2115	1.29844	0.00	5.00
dependence ratio	100	1.85	1.424	0	6
labor force participate on farming activity	100	2.20	1.137	1	8
number of oxen owned	100	1.30	.948	0	4
gender of hh	100	.78	.416	0	1
level of education	100	.29	.456	1	4
distance far from farm area to extension center	100	.21	.409	1	12
soil characteristics	100	.65	.479	0	4
experience to use fertilizer	100	.66	.476	0	1
annual off-farm income	100	.36	.482	0	1800
knowledge to use mobile	100	.51	.502	0	1
access to credit	100	.36	.482	0	1
price of agricultural input	100	.34	.476	1	4
willingness to access extension service	100	.86	.349	0	1
age category of hh	100	.45	.500	23	65
livestock dummy	100	.18	.386	1	10

Source: field survey data statistical test, (2022)

BIBLOGRAPHY 1

Survey Questionnaire paper

ADDIS ABABA UNIVERSITY FACULITY OF BUSINESS AND ECONOMICS, SCHOOL OF COMMERCE GRADUATE OF ECONOMICS DEP.T thesis paper survey questioner

This paper designed to collect data for the study of the purposeful investigating the title of the FACTOR AFFECTING SMALLHOLDER FARMERS' ACCESS TO AGRICULTURAL EXTENSION SERVICE generalin countries particularly in case of wolaita sodo rural woreda. The objective of this questioner to gather relevant and important information regarding general instruction based on socioeconomic**,** demographic **and** institutional **factors. Therefore you have been selected based on questioner sample of targeted population to complete this question paper confidentially.**

Dear respondents, your response will help quality of research and to make appropriate measure of parameters' relationship. The question designed by multiple choices and some are blank space to be give open opinion. You requested simple circle the letter or number and fill blank space when you give the answer. Thank you for your time and cooperation!

1. **Sex of household head**_____ 1, Male 2, Female
2. The **education level**of household head _____1, illiterate, 2, write and read, 3, primary and secondary, 4, college and above.
3. Wealth categories of household head 1, rich 2, medium rich 3, poor 4, very poor
4. **Age of household**, Age and sex of total family size of household including permanently **employed laborer**and level of education write below table as provided. Here also considered **dependence ratio**(age of below 16 and above 60 year old).

Age of household	Age of family member	Sex M	sex F	Level of education	participate on farming	Non participate
	<16					
	16—25					
	26—35					
	36-- 45					
	46--55					
	56-65					
	>65					
	Total					

5. Are you a member of beneficiary of safety net programme? 1, yes 2, no
6. If you say yes above question, what kind of safety net benefited? 1, constantly 2, twice a year (per six month) 3, if other way _____
7. Do you have your own farm land? 1, yes 2, no

8. If yes above question, write size of your farm and grazing land by hectare? _____
9. Farming status 1, half time in a day, 2, full time, 3, other _____
10. What kind of agricultural practice have you engaged? 1, cereal production 2, animal raring (animal husbandry sector) 3, mixing 4, others _____
11. Do you know the extension agent in your area? 1. Yes 2. No
12. If you say yes, which extension approach do you like the most? 1. Farmer School center (FTC) or lecture 2. Training, problem solving, and visiting individual farmers' in the field of farming 3. Farmer to farmer 4. Contract farming 5. other----------
13. What is your understanding the term of agri. extension? 1. I have no idea what extension is. 2. I have some understanding about extension. 3. I understand very well what extension is.
14. Who would be play the crucial roles to solve your farming challenges?
    1, agricultural extension 2, mechanization service center 3, community 4, agricultural credit or microfinance institution 5, other institution 6, NGO
15. Do you have access to agricultural extension service? 1, yes 2, no
16. If you say yes, what type? 1 public /government/ 2, private 3 NGO 4 other
17. If you say no question 15, select one of that is most applicable to you from the given reason.

No	The reason not access (what difficulties and constraint)	If you have addition idea explain your own idea
1	Lack of knowledge about extension service	
2	difficulties associated with financial shortage	
3	hard to understand their practice	
4	no motivation to visit/ not interested/	
5	less probability of their contribution on my agricultural activity/no change of that traditional method of farming	
6	No enough land size	
7	Long distance to get access	
8	No information	
9	Other	

18. If you say yes quest. 15, by what source or mechanism have you contact? 1, face to face on farm field 2, face to face in extension center 3 traditional information system (writing letter, local messenger or runner, …) 4, TV, radio or other media 5, others_____
19. Question 15, how many times do you contact with extension workerwithin a year? 1, <2 2,-- 6 3, 7—11 4, 12----16 5, >16
20. How long distance take in kmfrom your home or your farm area to agri. extension center? 1, <1 km 2, 1----3km 3, 4---6km 4, 7---9km 5, 10---12km 6, >12km
21. If you get access of extension service effectively, what effect on your agricultural productivity? 1, less effect 2, medium 3, high effect 4, no effect
22. Did you participate in agricultural extension package program? 1. Yes 2.No
23. If yes, what type of the package you used? 1. Chemical fertilizer 2. Modern Improved seed 3.pests or weed control 4.small-scale irrigation 5. Credit
24. What do you expect the role of agricultural extension service in agricultural development? 1, it provide important agricultural input 2, facilitate new technology 3, training and practice new important farming activity 4, supply and transfer information about different agricultural activity 5, to examine research and development package to transform traditional agricultural practice in to

more modernization farming system 6, provision of credit. 7, if other _____

25. How much approximate estimated time do you spent on farmingactivity 1, medium minutes 2, Maximum minutes. 3, not always fixed 4, do not know
26. How do you rank most of your farmland soil fertility? 1. Fertile 2. Moderate 3. Non fertile
27. Have you experience to use fertilizer? 1, yes 2, no
28. If you say yes the above question, who provided and motivated you to use it? 1, agricultural extension 2, NGO package 3, your own knowledge 4, other governmental body
29. What do you think the effect of fertilizer on your farming activity? 1, improve productivity 2, keep agricultural productivity would not be declining 3, no effect 4, declining
30. If you say no question 27, why not use it? 1, because lack of access 2, no information about fertilizer importance 3, financial constraint 4, no motivation to use it 5, has fertile soil 6, as less farm land
31. Have you experience how to use improved seed 1, yes 2, no
32. If your answer is yes, who motivated you 1, agricultural extension 2, NGO package 3, your own knowledge 4, other governmental body 5, other _____
33. What effect of improved seed in your productivity? 1, improve (more output gain) 2, keep constant out-put 3, decrease 4, unknown
34. If you say no question 31, why not use it? 1, no access 2, less information about it 3, difficult to me how to use 4, financial constraint 5, no awareness
35. How many times do you produce within a year? 1, once a year 2, twice a year 3, other ____
36. Have you farm all your total land? 1, Yes 2, No
37. If your answer for question #36 is 'No' what is the reason? 1, less labor force 2, lack of oxen 3, lack of farming experience to cover all land size (lack of technical farming) 4, financial constraint 5, others specify _____
38. ploughing are accomplished by 1. Rented tractor 2. Rented oxen 3. Own oxen 4. Support from relatives 5. Rented and own oxen 6. Others specify _____
39. If you have your own oxen, what numberdo you have? _____
40. What is your agricultural activity? 1, traditional 2, subsistence 3, mechanized 4, other
41. Have you knowledge use ICT or mobile phone to contact with other local communities and other agricultural institution to get information? 1, yes 2, no
42. If no above question, why not? 1, lack of knowledge how to use 2, financial constraint 3, not get access to use it in local area 4, other _____
43. Have you ever used credit? 1. Yes 2, No
44. As answer 43, for what purpose do you use the credit? And tick blow use and not used

No	Adaptation System	Used	Not used
1	To cover food shortage from other (market)		
2	Diversifying from farm to non-farm		
3	Improved Crop/Livestock		
4	To Purchase farm input and livestock diversifying		
5	Crop diversification		
6	Others		

45. If your answer for question 43 no, why not use? 1, high interest rate 2, no provision 3, may fear unable to be pay back credit 4, short period of payment 5, no willingness 6, other
46. How long have you been in agricultural activity? 1, less than 3 years 2, 3—6 years 3, 7—11 4, 12—16 5, 17—21 6, 22—26 7, > 26
47. Do you have livestock? 1 Yes, 2, No
48. If you say yes, Write the number blow how many and what type of livestock have you?

No	Cattle	Beef type(fatten)	Dairy farm	Equine	Poultry(egg production)	Total
1						

49. Do you produce more than home consumption or supply market to generate income? 1, yes, 2, No
50. If you say yes # 49, what types of product do you supply? 1, cereal grain 2, fruit and vegetable 3, animal product (butter, skin, milk, egg,…..) 4, selling livestock 5, root product 6, if other ----------
51. If your answer to question # 49 is 'No', which of the following is the most important for you? 1, need to extension support for produce maximum farm output 2, need government package to get enough farm land for surplus production 3, need credit to cover financial constraint to buy farm input and livestock maximize 4, other government subsidy
52. If you say yes question 49, how much is your total **on-farm annual income**? 1, < $150 2, $151-$550 3, $551----$950 4, $951—$1350 5, $1351-$1750 6, >1800
53. Do you have any other occupation in addition to farming? 1, yes 2, no
54. If you say yes, ques. 53, what occupation do you engaged? 1, Local beverage 2, Waving 3, Selling local agri. output 4, Petty trading 5, House builder 6, Daily laborer

    If you has other specify_____

55. If you say yes #53, how much is your total **off-farm annual income**? 1, < $200 2, $201-$600 3, $601----$1000 4, $1001—$1400 5, $1401-1800 6, >1800
56. Which income more compared both? 1, on- farm 2, off farm 3, equal 4, not know
57. With regard to sex who is more access agricultural extension service package? 1, male 2, female 3, equal 4, not know (have no information)
58. Do you expect smallholder farmer and large-medium agricultural farmer get equal access to extension service? 1, yes 2, no
59. If you say no, who do you think better? 1, Smallholder 2, large-medium 3, (no significant difference)
60. Do you think access to agri. extension service farmers' equal agricultural (output) productivity with that of not accessed farmers'? 1, yes 2, no 3, no information
61. Do you expect smallholder farmers; who participated/accessed/ agricultural extension service program actively equal as other rural farmers to fill their farming gap? 1, yes 2. No
62. If you say no, what a fundamental problem hindered /constraint faced/ you (smallholder farmers') not actively participate? 1, lack of knowledge /illiteracy/ 2, infrastructure constrain and inadequate concerned institutions 3, less perception and unwillingness 4, financial problem 5, less farming and grazing land 6, unfertile soil 7. Lack of information 8. Inflexible and ineffective administrative and government policy 9. Traditional practice problem. **Possible to choose more than one answers**

63. What is your agricultural productivity trend year to year? 1, declining 2, increasing 3, no change 4, unknown
64. If you say declining, by what causes do you expect? 1, less land productivity 2, plant and animal epidemic disease 3, land degradation 4, shortage of rain or seasonal variation 5, high price of input 6, if other specify it_____
65. If you say increasing question #63 what effect do you think? 1, by getting extension supportive provision 2, by using ICT 3, good climate condition 4, by using improved agricultural inputs 5, other _____
66. put circle the number the effect of agricultural extension service on improve small holder farmers agricultural productivityin study area

No	Effect of agri. extension service on smallholder farmers' as well as countries improve agri. productivity	No	Effect of agri. extension service on whole rural household wellbeing efficiency of equal economic growth
1	Strongly believe	1	Strongly believe
2	Believe	2	Believe
3	Less believe	3	Less believe
4	No effect	4	No effect

67. Types of farming productivity, (crop production)

No	Types of crop (yield)	If you have write yes in each yield blow		Write no of covered area in hectare blow	If not write no
1	Grain production				
2	Fruit and vegetable				
3	Pulses and oil seed				
4	Root crops				
5	Chat				
6	Coffee				
7	If other types of crops,				

68. Generally how would you rate participating on your local extension service in helping to improve farmers' wellbeing through agricultural production? 1. Very effective 2. Effective 3. Fair 4. Less effective
69. Participating in agri. extension package program helps to increase my agricultural productivity. 1. Strongly agree 2. Agree 3. Don't know 4. Disagree E. Strongly disagree
70. What remedy do you expect to solve the problem of SHFs; can be access to extension service effectively and to ensure efficient productivity and sustained wellbeing. **You can choose more than one answer**. 1, infrastructure 2, extensional center 3, financial support 4, strong government administration (political situation) 5, awarening and educating house holders
71. What is your alternative solution to achieve and buildup effective small holder farmers' participation on extension service or package? _____
72. What do you feel about the responsibility of between agricultural extension service and smallholder farmers participation? , who become first to solve problem about meet each other? 1, extension workers to farmers 2, farmers to extension service 3, other _____
73. What factors hinder SHFs' communicating with extension agents in your area? 1. Difficult to find in the office 2. Lives out of the village 3. Has many appointments to make 4. I

don't have phone to call 5. Doesn't visit their area regularly 6. SHFs never tried to find them in person 7. Other----------

74. What is your recommendation for agricultural supportive institutions about transforming modern agricultural activity to rural household farmers generally and small household farmers particularly in study area as well as in Ethiopia? **You can give more than one answer**. 1, facilitate infrastructure 2, constant training and practical learning 3, should provide information through by fast technology (media or TV, mobile, radio….) 4, provision of credit and other incentive through by development experts or extension agent to minor farmers' 5, if other specify _____
75. What is your suggestion on the criteria of small holder farmers' active participation? _____
76. If you have any other which related with these survey topic suggestion, explain in your own idea_____