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CONTRIBUTION OF AGRICULTURAL MECHANIZATION FOR MAIZE PRODUCER WOMEN FARMERS IN BURIE ZURIA WOREDA, AMHARA NATIONAL REGIONAL

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THESIS ON

CONTRIBUTION OF AGRICULTURAL MECHANIZATION FOR MAIZE PRODUCER WOMEN FARMERS IN BURIE ZURIA WOREDA, AMHARA NATIONAL REGIONAL STATE

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Contribution of Agricultural Mechanization for Maize producer Women Farmers in Burie Zuria Woreda West Gojjam Zone, Amhara National Regional State

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Acronyms and Abbreviations

AM	Agricultural Mechanization
ARARI	Amhara Regional Agricultural Research Institute
ASAM	Appropriate scale Agricultural Mechanization
ASMC	Appropriate Scale Mechanization consortium
BiT	Bahir Dar university institution of Technology
BoFED	Bureau of Finance and Economic Development
CFW	Conceptual Framework
CGIAR	The Consultative Group on International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Center
DA	Development agent
FAO	Food Agricultural Organization
FAO	Food and Agriculture Organization
FDRE	Federal Democratic Republic of Ethiopia
FGD	Focus Group Discussion
IAT	Improved Agricultural Technology
KII	Key Informant Interviewee
NGO	Non-Governmental Organization
SAMA	Sustainable Agricultural Mechanization in Africa
SPSS	Statistical Package for Social Science
SSA	Sub-Saharan Africa
WF	Women Farmers

ABSTRACT

Women make significant contributions to the rural economy, yet they consistently have less access to resources and opportunities they need to be more productive. Increasing women's access to agricultural technology, extension service, and training would boost their productivity and generate gains in terms of agricultural production. As far as the researcher's knowledge, despite limited studies carried out to investigate how appropriate technology was employed in the agriculture sector, there are no tangible empirical findings regarding the contribution of agricultural mechanization from gender perspective. This study was, therefore, conducted to , to identify opportunities to use the technology, to analyze the determinant factors that influence maize production of women farmers, to assess the benefits of agricultural and to assess existing needs of women farmers in Burie Zuria Woreda by taking three sample kebeles namely: Wadra Gindiba, Alefa Basi and Zalima. The survey questionnaire was collected from 168 sampled maize producer women farmers selected using systematic random sampling technique from both women headed and men headed households. Accordingly, qualitative data were drawn from purposively selected samples; 23 FGD participants and 7 key informant interviewees. The research approach of this study was a mixed research approach with a concurrent parallel design for data collection and data analysis. Descriptive and inferential statistics were used to analyze the quantitative data. Multiple linear regression model was employed to determine the factors of agricultural mechanization for maize production of women farmers . The result of Multiple linear regression model showed that as marital status, availability of technology, utilization of technology, access to credit service and knowledge were significant predictors while age of women, education level of women, training access, access to technology, gender stereotype and access to market were insignificant predictor to agricultural mechanization for maize production of women farmers. There were agricultural technologies used in the study area, whereas its adequate availability and appropriateness to women are limited women farmers have needed to adopt technologies.Finally to increase maize production and productivity of women farmers, government, NGOs, higher education institutions and technology producers, and providers should work together in providing training, awareness raising and gender-sensitive or women-friendly technologies.

Keywords: Maize, women farmers, Agricultural mechanization, Maize Sheller, improved technology.

CHAPTER ONE

INTRODUCTION

1.1. Background of the study

As Clarke (1997) Cited in FAO (2011), clearly defined the term Agricultural mechanization generally refers to the application of tools, implements, and powered machinery as inputs to achieve agricultural production. Cognizant to the above another findings by Karim Houmy *et al.,* (2013) and (FAO, 2018) in similar manner describes agricultural mechanization as the term covers the manufacture, distribution, maintenance, repair, management, and utilization of agricultural tools, implements, and machines. It applies to agricultural land development, crop production, harvesting, and preparation for storage, on-farm processing and rural.

There is no doubt that agricultural mechanization for the multitude of smallholder farmers in sub-Saharan Africa (SSA), has been a neglected issue for too long. Farm power applied to appropriate tools implements and machines. Farm mechanization is an essential agricultural input and has the potential to transform rural families' economies by facilitating increased output of higher value products whilst at the same time eliminating the drudgery associated with human muscle powered agricultural production. Such an improved situation for smallholder farmers can enable access to input supply chains and integration in downstream value chains and thus provide for more income, renewed business opportunities, and further value addition. Moreover, agricultural mechanization in its broadest sense can contribute significantly to the development of value chains as it has the potential to render postharvest, processing and marketing activities and functions more efficient, effective and environmentally friendly (Economic Commission for Africa, 2015).

As it has been pointed out by FACASI (2014), Agricultural Mechanization is an important link in the achievement of effective growth in production and it needs to be addressed in a larger context. Despite the big potential of agriculture in Ethiopia, the low level of engineering technology input in agriculture has been one of the main constraints hindering the modernization of the country's agriculture and food production systems. One of the major causes for the disappointing performance and low contribution of agricultural mechanization to agricultural development has been the fragmented approach to mechanization issues.

As Dagninet & Wolelaw (2016) pointed that the rural Ethiopia is expected to transform itself in many ways including but not limited to demography, farm power, intensification, employment reduction, diversification of livelihoods and most importantly increased productivity. In this aspect, the contribution of appropriate agricultural mechanization cannot be relegated given the research and actual evidences from within and other developing countries. Hence, utilization of appropriate agricultural mechanization is expected to enhance the transformation of rural Ethiopia and lead to a middle-income country by 2025.

FAO (2011) pointed out women make significant contributions to the rural economy, yet they consistently have less access than men to the resources and opportunities they need to be more productive. Increasing women's access to land, livestock, education, financial services, extension, technology, and rural employment would boost their productivity and generate gains in terms of agricultural production, food security, economic growth and social welfare of the rural folk.

According to AgroBIG (2016) maize a cereal crop, a member of the grass family, is grown widely throughout the world in a range of agro-ecological environments. Ethiopia is the top in East Africa and the fourth largest maize producer country in Africa. Maize is Ethiopia's leading cereal in terms of production with 6.4million tons. Amhara region is one of the major producing regions in Ethiopia contributing about 25% of the national production. West Gojam is among the top zones in the country with a production of 7.8 million quintals per annum which is half of Amhara region production. The national per capita consumption of maize has substantially increased during the last decade.

According to the report by Burie zuria Woreda Agriculture office (2018), the dominant crops grown in the district are Maize, *Teff*, barley, wheat, bean, and root and tuber crops like potato and sweet potato. Maize is the first cereal crop and covers 40.08% production in the woreda. There are 14,935 male headed and 2,152 female-headed maize producer households in the woreda. The report further explains the maize production potential of sampled kebeles. The report also revealed that there are 1084 male headed and 160 female-headed in Zalima kebele, 776 male headed and 120 female-headed in Alefa kebele, 689 male headed and 113 female-headed in Wadra kebele maize producer households. From these producers, agricultural technology adopters are Zalima 350, Alepha 249 and Wadra 340 households.

Women accounted for 48% of agricultural labor in Ethiopia and were responsible for 60-80% of household food production as (Dagninet, 2017) pointed. In line with this the other study carried out by AgroBIG (2016), stipulated that except plowing women engage in almost all maize production activities from planting to harvesting and post-harvest handling. Women involvement is relatively high in post-harvest activities (shelling, packing, and sorting). In times when the men are busy in field activities women also occupied by food preparation, home management, taking care of children and other agricultural activities. Although part of the grain harvest is used for home consumption and sold to cover input costs and household expenditures, men have a dominant role in controlling over the benefits of the harvest. Involving women in appropriate technology development and training provision is limited. It needs attention to reduce the burden in women and family members by looking at improved technologies.

1.2. Statement of the problem

Agricultural Mechanization is the economic application of engineering technology to enhance the effectiveness of human labor, including land preparation, planting, harvesting, on-farm processing, storage and marketing of products. In Ethiopia, Agricultural Mechanization has been afforded greater focus to address both small and large-scale farmers where each type of machine can effectively and economically work for small farmers especialiy (AMFE, 2018).

As it can be obviously understood, Agriculture is the main sector of the Ethiopian economy. ASAM has great contribution to increase agricultural productivity. Despite the crucial role of the improved agricultural technology for agriculture, studies on gender aspects of agricultural mechanization are relatively scared as far as the researcher knowledge. As the study carried out by UN women Ethiopia (2018), Female and male farmers in Ethiopia do not face the same production conditions and do not always make the same production choices. The gender gap in agriculture differently affects how women and men access, participate, adopt and benefit from climate-smart agriculture. Female managed farm plot is still less productive than male managed farm plot in Ethiopia this is due to women lacks using of improved technologies for their farm.

In this regard, different investigations and published research works have been so far conducted across different parts of the world. For instance, Jagvir Dixit, *et al.,* (2017) carried out research on “Maize mechanization for hill Agriculture to enhance productivity and profitability”. The

authors tried to investigate technological contribution for maize production in hilly topography and even tried to show optional technologies for it. But they overlooked gender issues although women contribute more labor for maize production including meal preparation for laborers. They also conducted their study by using samples from maize producer farmers simply. However, the study did not incorporate women's participation in maize production and their challenges specifically.

The research carried out by Hussien M.O (2016), on the title of "Gender Differential in Maize Productivity in Southern Ethiopia: Implications for Household Efficiency". His study figures out no difference in the average productivity of the sampled households of male and female smallholder farmers if female farmers can access easily the factors of production as their counterparts. But the study failed to identify challenges of WFs to use, benefits and exiting need of agricultural mechanization for women farmers.

"Agricultural Mechanization and Women Entrepreneurs in The Agricultural Sector In Rural Areas" is the study done by Lyly (2016) and her finding of the study shows that the influences of agricultural mechanization on women entrepreneurs in the agricultural sector in rural areas. The author also revealed that women have the least access to agricultural related assets and inputs to make women entrepreneur in the agricultural sector. The study overlooked to identify the exiting challenges, opportunities, and needs of WFs in detail for agriculture productivity. Rather the study focuses only challenges of women entrepreneur in agriculture.

Another author Tamrat (2016) took out the research on the title of "Prospects and Challenges of Agricultural Mechanization in Oromia Regional State-Ethiopia, Policy Perspectives". The study described mechanization status and enumerate the factors that affect the use of the agricultural mechanization technologies by smallholders from the policy perspectives of the region and the way forward for better utilization or intensification of agriculture. Although the study is identified major challenges to use technology, the study failed to investigate opportunities and existing needs of WFs to use technology and benefits of agricultural technology for maize producer farmers especially WFs. In addition the author samples were both men and women, it cascades in Oromia region more specifically and it discounted women issues.

Dagninet and Wolelaw (2016) in their study, on "Agricultural Mechanization: Assessment of Mechanization Impact Experiences on the Rural Population and the Implications for Ethiopian Smallholders", revealed that contribution of AM for farmers at all. Yet, the study did not provide information on the gender context of AM benefit, particularly maize producer women farmers. The study overlooked gender dimension, why I said this is because women and men farmer is experiencing benefit and challenged from technology in a different way. With support this idea (UN Women Ethiopia (2018), explains that Female and male farmers in Ethiopia do not face the same production conditions and do not always make the same production choices.

The other author Dagninet (2017) in his counterpart carried out the study on the title "Evaluation and Demonstration of Maize Sheller for Small-Scale Farmers**"**. The study explores the benefits of maize sheller like saving labor, drudgery in detail by comparing traditional shelling operation. He also tried to suggest appropriate types of maize sheller for farmers. But what he lacks that identifying challenges of women to use it. In addition to this, his samples were both men and women farmers. But women and men farmers hadn't face the same challenge in using agricultural technologies.

Dereje Dereso *et al.,* (2016) and his friends also cascaded the study on the title of "Determinants of the utilization of agricultural inputs and transfer of agricultural technologies". They investigate and clearly discussed on major determinant factors of farmers in using agricultural mechanization. What their study's limitation the researcher founds was that both the assessment of such remarkable benefits and opportunities of WFs in using ASAM had not given due attention.

Maize is also an important cash crop in many contexts; however, with a few exceptions, the literature on maize production and agricultural mechanization has paid limited attention to gender perspectives as far as the researcher's knowledge. In addition, it has often failed to identify the differences in constraints faced by women and men as producers and as knowledge seekers and buyers of inputs and services. Women and men are mostly different to access and to use agricultural mechanization due to different reasons or factors.

However, as far as the researcher's experience concerned, there is quite a little information regarding the contribution of agricultural mechanization for maize producer women farmers in Burie Zuria Woreda, Amhara Regional State. Moreover, challenges of ASAM for maize

producer women and opportunities of women to use it have not been investigated. Even though it is a known fact that the agricultural mechanization is very essential for the increment of agricultural production, accurate information is not available which can express its benefit. Problems women farmers encounter in using agricultural mechanization though take many forms, they are not well known. As a whole, to the knowledge of the researcher, the study has not been undertaken concerning the contribution of ASAM for maize producer women farmers. The main purpose of this study was therefore to contribute knowledge on the benefits of ASAM to women farmers for the development of the agricultural sector, and it also to help policymakers to formulate enhanced policies and strategies in AM.

1.3. The objective of the study

1.3.1. General objective

The general objective of the study was to assess the contribution of agricultural mechanization for maize producing women in the case of Burie Zuria Woreda, Amhara National Regional State.

1.3.2. Specific objectives

By standing from the general objective, the specific objectives of this study were the following.

- To identify the opportunities of women to use appropriate scale agricultural mechanization for maize production.
- To identify factors that determine agricultural mechanization for maize production of women farmers.
- To examine the potential benefits of appropriate scale agricultural mechanization for maize producing women.
- To identify the existing needs of women in adopting technologies for maize production.

1.4. Research Questions

After analyzing the data, the following research questions were answered.

- What were the opportunities of maize producing women to use agricultural mechanization in the study area?
- What were factors that determine agricultural mechanization for maize production of women farmers.?

- What were the potential benefits of agricultural mechanization for maize producing women?
- What were the exiting needs of maize producing women in using agricultural mechanization?

1.5. Significance of the Study

The study by Karim Houmy *et al.,* (2013) showed that increased agricultural production and improved rural livelihoods cannot be achieved without the adoption and use of increased levels of farm power and mechanization. Here again, UN Women Ethiopia (2018) also indicated that Women play vital roles and are engaged in different activities across the maize production, from production to consumption including post-harvest management. However, it is often misconstrued to mean they are beneficial from agricultural mechanization.

The aim of the study was to contribute knowledge on how women farmers should be involved in using appropriate scale agricultural mechanization. It will have a contribution for Burie Zuria Woreda agriculture office to demonstrate and identifying exiting needs of women farmers regarding agricultural mechanization and to deliver essential support to them. The study also will provide information for agricultural technology producers, importers, research centers and higher education institutions and even service providers to deliver or provide gender-sensitive or women-friendly agricultural technologies and services.

The successful accomplishment of the study will have practical significance for policymakers in their effort to formulate policy, programs, and activities that will accelerate women benefits by using appropriate scale agricultural mechanization. The study will also serve as a point of reference for further gender-focused research undertakings in the area of ASAM.

1.6. Scope of the Study

This study was limited only to assess the contribution of agricultural mechanization for maize producing women in Burie Zuria Woreda, Amhara National Regional State. The study was also focused only on women farmers engaged in maize production in both male headed and female-headed households. In addition, this research was delimited only within the following four general factors that determine women farmers in using improved agricultural technologies. These were demographic factors, institutional factors, technological factors, and socio-cultural factors. In addition to these, challenges of WFs faced in and opportunities to using IAT benefits WFs

obtained from using IAT and exiting AM needs of WFs were the scope of the content. Finally, the study was conducted only in three kebeles of Bure Zuria woreda, namely Wadra Gindiba, Alefa Basi and Zalima.

In fact, there are different agricultural mechanization for agriculture production improvement. But for the sake of managing this research profoundly, this study will limit merely to examine the contribution of ASAM for maize production.

1.7. Limitation of the study

As far as a researcher understanding, this research has limitations that the other or future researchers need to address. Firstly, samples for this study were only maize producer women farmers; but there are women farmers who are engaged in growing other crops and those needs IAT in the study area. More importantly, other improved agricultural inputs like seed, fertilizer, water pumping technology and other many were not studied in this research. However, the above-mentioned technologies and the others also need further investigation to improve women farmers production in all angle. So, researchers will address these in the future.

Then again, the contribution of AM for men and women farmers engaged in maize production did not compare in this study. Rather, the study dealt with the contribution of AM for WFs only because addressing large sample was difficult when the case of men was added for this study. Hence, studies can be done by assessing the contribution of AM for all farmers together and by comparing the benefits and challenges of AM for men and women farmers in the future. It is worth to note that, this study also did not address all rural *Kebeles*, those are found in Burie Zuria *Woreda* regarding the contribution of AM for women farmers engaged in maize production rather than concentrated on three *Kebeles only* due to the scarcity of time and resources. Nevertheless, to compensate for this limitation, the researcher took medium (168 WFs) sample size and used mixed research approach to a comprehensive analysis of the problem.

1.8. The operational definition of terms

For this research context, the researcher used the following word and tapped the operation definition for them.

Appropriate Scale Agricultural Mechanization: - Improved and suitable technologies used to farm in maize production activities.

Gotta:- Traditional maize storage made from mud locally

Maize - is the most important staple food in sub-Saharan Africa and the leading cereal crop of Ethiopia, especially in Burie zuria Woreda.

Pics Bag: - Improved sack/quintal helps to store maize without chemical application and it prevents the crop from insects.

Women farmers: Women who have a livelihood in agricultural farms and maize producer and included from both men and women headed household.

Kebele: is the smallest administrative unit in the current administrative arrangement of the Federal Democratic Republic of Ethiopia

Gender Role: - assigning by the community to do is women or men.

Woreda: is an administrative unit comparable to a district, which covers a number of kebeles and less than Zone.

Sheller: - an agricultural technology which helps for harvesting maize or which can separate maize grain from its cob.

Tractor: - Improved technology to plowing the land for maize production.

Planter: - Helps sowing/ planting maize seed.

Storage: - An improved technology helps to store maize grain in a safe manner to avoid any drudgery.

Technology: - Improved agricultural technology for maize production from sowing to storage period.

Appropriate: - Being friendly or easy to use for women farmers for maize production.

Access: - The availability or potential for use of a mechanical resource at the individual, household, or community level. Access implies the right or ability to use a resource or input, but not the actual utilization by women maize producers.

Availability: - Presence of technology nearby for maize producer women farmers.

BiT ASMC project:- Bahir Dar university institute of technology; Appropriate scale mechanization consortium project, the project provided IAT and services freely, training and experience sharing for farmers.

1.9. Organization of the study

The research is organized into five chapters. The first chapter is an introduction part that contains background, statement of the problem, objectives of the study, significance of the study, research questions, scope of the study, limitation of the study, operational definition of terms and organization of the study.

The second chapter deal with a review of the literature and presentation of the conceptual and theoretical framework. Issues addressed in the chapter include concepts of AM, gender and AM, the contribution of AM for women farmers, challenges of women farmer to us AM and opportunities to use.

The third chapter addresses the description of the study area and the research methodology. It discusses the physical, demographic and socio-economic conditions of BurieZuria woreda including the three selected kebeles, namely Wadra Gindiba, Alefa Basi and Zalima. The research methodology constitutes a research approach, research design, data sources and data collection instruments and analysis techniques. It also presents the issue of reliability and validity of the research outcome as well as ethical considerations in the entire process of the research work.

Chapter four presents the main findings of the research using descriptive statistics and discussions. Thus, the demographic characteristics of respondents, technological factors, institutional factors, and socio-cultural factors were discussed in this chapter. It also presents information sources and training about technologies, technology ownership, opportunities and benefits that women had and the existing need of them to produce maize. Chapter five contains a summary of the findings/results which provides major conclusions and recommendations derived from the research findings.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1. Definition and concepts of Agricultural Mechanization

The concept of agricultural mechanization is defined in many ways by different authors. As stipulated by Karim Houmy *et al.,* (2013) agricultural mechanization is often associated solely with tractors and sophisticated agricultural machinery so-called tractorization. Particularly in developing countries, the term covers all levels of technology from the simplest and most basic (hand tools) to the most sophisticated and powerful. What is very important is that the technology involved meets the real needs of farmers and can be used efficiently and effectively and is financially viable.

As Dagninet & Wolelaw (2016) stated that most people declare mechanization only refers to tractor and combine harvester. However, mechanization includes the different small and medium agricultural implements used in the production, processing and transporting of agricultural produces.

Agricultural mechanization is broadly defined to include the application of tools, implements and powered machinery and equipment to achieve agricultural production, comprising both crop and livestock production as well as aquaculture and apiculture (FAO, 2018). The study also noted that the term agricultural mechanization covers the manufacture, distribution, repair and maintenance, utilization and management of agricultural tools, implements, equipment, and machines in agricultural production – for land development, crop, and livestock production, harvesting, and storage, in addition to on-farm processing and rural transportation.

To go further FAO (2018) indicated that Agricultural mechanization embraces the manufacture, distribution, and operation of all types of tools, implements, machines, and equipment for agricultural land development and farm products as well as for harvesting and primary processing of agricultural produce. In line with the above statements the other outers Xinshen Diao *et al.,* (2016) in their counterpart indicated that essentially agricultural mechanization represents technological change through the adoption of non-human sources of power to undertake agricultural operations

Agricultural productivity can be improved either through the development and adoption of new technologies or through the efficient use of the existing technologies without damaging the natural resource base. The mechanization of farm operations is a very important step toward increasing production efficiency (Bhasin, 2002).

In similar with the above author Karim Houmy *et al*., (2013) briefly stated farm production can be substantially increased through the use of mechanical technologies which are both labor saving and directly increase yields and production. Inputs of hard labor by farmers and their families can be substantially reduced if they have access to a carefully selected use of tools, machines, and equipment. The labor released can be used for other productive activities. The use of improved mechanical technologies can also have a direct impact on yields and area under production. Such technological interventions are commonly referred to as agricultural mechanization. In a rural context, the term also extends to cover other closely related small scale activities such as the primary processing of agricultural products, on-farm storage, and the delivery of irrigation water.

2.2. Historical development of Agricultural Mechanization in Africa

Agricultural mechanization in Africa is still at the first stage of the mechanization process, referred to as power substitution (FAO, 2018). According to FAO (2011), currently many of smallholder farms have limited access to production inputs, especially mechanization, and so achieve low levels of productivity. They also have fewer opportunities to access markets to take advantage of the numerous values adding activities that more developed food systems can provide. At the same time the rural population is expected to decline as people, especially the young and fit, migrate to urban centers in search of a life of less drudgery that can be offered by agriculture; there is also an increasing feminization of smallholder agriculture, especially in SSA, as women increasingly are left in control of the farm.

As Karim Houmy *et al.*, (2013) stated that the history of agricultural mechanization in Africa can be divided into three distinct periods; before, during and after colonization. The first period was marked by the use of rudimentary tools and the main sources of power were manual and, in some cases, animal. The second was; the colonization of many countries led to the introduction of more sophisticated mechanization and the use of the internal combustion engine as a source of power. Engine powered tractors and their associated equipment were brought in mainly for use

on the farms and estates owned and operated by the colonialists. The third; on gaining independence, the situation in most countries remained relatively unchanged for a decade or so. This was largely due to the fact that many settler farmers and the dealer networks remained. The importation of agricultural machinery continued, and support services remained available. But in the late 1960s and 1970s, many SSA countries adopted policies of direct public sector involvement in development; policies in which the government played a central role not only as facilitators and regulators, but also took over the roles of producers, manufacturers, traders, and bankers.

The study by FAO (2018) also (ARARI, 2016) clearly stated the evolution of agricultural mechanization in Africa covers seven periods; broadly aligned with the four phases of the region's evolution of its mechanization programs. It includes the colonial period (pre-1960); the first quarter-century after independence (1960–1985); the second quarter century after independence (1985–2010); and the period from 2010 to the present.

2.2.1. Agricultural mechanization during the colonial period

The first period was prior to 1920 and may be called the hand-tool technology period. The second period occurred between 1920 and 1945 when DAT was introduced and disseminated in parts of Africa where cattle could be kept. Note that in Ethiopia and South Africa, draft animals had been used for several millennia (Ethiopia) and centuries (South Africa). The third period occurred between 1945 and 1960 when the colonial authorities established various mechanized commercial farming schemes in several parts of Africa (FAO (2018).

2.2.2. Agricultural mechanization after independence: 1960–1985

FAO (2018) pointed out the first quarter-century after independence (1960–1985) marks the first stage in the process of agricultural mechanization. At the time, governments in Africa, with technical support from major development agencies, implemented a number of projects to transform rural areas. But many of them failed and the machinery ended up abandoned in various locations across the continent.

2.2.3. Agricultural mechanization after independence: 1985–2010

In this period, interest in mechanization based on mechanical technologies waned among the major development agencies. Although government tractor hire projects attracted much attention,

the reality in many countries was that the tractors in the schemes were only a fraction of the total number in the national fleet (FAO (2018).

2.2.4. Agricultural mechanization after independence: from 2010

FAO (2018) investigates that most countries have become more open to investments and look to local and foreign entrepreneurs to invest also in agricultural development. Early investments were directed at the export sector (e.g. horticulture), but there is a growing interest in medium-scale farms that produce food for the local market or for export to neighboring countries. Agro-processing and other value-adding enterprises are increasingly attractive to investors, and they require mechanization inputs. Complementary investments in irrigation and other rural infrastructures, including roads and storage facilities, create an enabling environment for investment in agricultural mechanization in some parts of Africa. It may be concluded that there is now a lot of interest in transforming African agriculture: new opportunities are being created and new players are entering the sector.

In fact, in many instances, agricultural mechanization still continues to receive "special" treatment. Governments are still intervening not only as facilitators and managers of regulation but also being directly involved in manufacturing, importing and distribution and sales of farm machinery as Karim Houmy *et al.*, (2013) stipulated.

Thus, developing appropriate mechanization technology will improve production and productivity, reduce the huge production losses and it has a great contribution to food security. Moreover, it is only when the environment is made conducive through proper use of appropriate energy and improved implements, will there be an improvement in the working conditions and performance of jobs that would otherwise be difficult to accomplish in the traditional way (FACASI, 2014).

Increased agricultural production and improved rural livelihoods cannot be achieved without the adoption and use of increased levels of farm power and mechanization. However, agricultural mechanization is not quite as straightforward an input (Karim Houmy *et al.*, (2013). In line with the above statement FFTC (2005) labels that farm mechanization plays a significant role in every nation's economy. However, it is often misconstrued to mean modernization, beneficial only to

industrialized countries with highly mechanized agriculture. Developing countries often have to rely on a variety of imported farm machines, which are seldom appropriate for small farms

As described by Karim Houmy *et al.*, (2013) briefly, crop yields in SSA are very low when compared with other regions in the world. Losses in both quantity and quality are common. Several factors contribute to these low levels of production. Some of the reasons are technical (low fertilizer use, poor seed, poor crop husbandry, low levels of irrigation, poor storage, etc.); other reasons relate to the prevailing physical and socio-economic environment. Sub-Saharan Africa remains the region in the world with the lowest power usage (manual, animal and mechanical) and the lowest level of farm mechanization.

2.3. Agricultural Mechanization in Ethiopia

As clearly indicated by FACASI (2014) despite the long history of agriculture in Ethiopia and the start of using some sort of mechanization, still, the country's agriculture is characterized by the use of traditional farming implements and practices with very low energy inputs. The entire field operations at small scale agriculture are performed with very simple farm tools with mainly human and animal power sources. Animal traction is the main farming technology of the smallholder farmers who, in terms of total arable land, dominate crop production in Ethiopia.

In a study conducted in Kenya and Ethiopia by van Eerdewijk, A. & Danielsen, K. (2015) describes the labor burden for women was concentrated in weeding, tillage and land preparation; postharvest management and transport of agricultural produce; and chopping and collecting fodder, fetching water and child care. Advocating for a reduced work burden for women does not fall within social norms, and women themselves do not have time available to access resources and information that might lead to the reduction of the work burden via investment in mechanization. In fact, it is often men who conduct commercial transactions at the farm level and consequently men who make decisions and control the resources required to invest in mechanization (especially capital). Moreover, with the ongoing trend of male migration to urban areas, coupled with the advancement of climate change, women have an increasingly central role in agricultural production and commercialization; nevertheless, they still have little access to mechanization.

According to Dagninet &Wolelaw (2016) a row planter (a simple animal drawn semi-automatic row planter) was gave 30% more grain yield compared to manual placement of two seeds. The study also revealed as farmers reporting a 20 to 100% increase in yield by using moldboard plow, low level mechanization as it uses the traditional implement system. Post-harvest management is the handling, processing and preservation of crop produce at the time and after harvesting. The average post-harvest losses of food crops such as Teff, Sorghum, Wheat and Maize are 12-9%, 14.8%, 13.6% and 10.9% respectively.

The finding of ARARI (2016) explains that Ethiopian farmers normally sow manually by broadcasting. This method exposes the seed for sunlight and leads to failure of germination, poor nutrient management and susceptibility to unnecessary losses from birds and other pests. In the Amhara region small holder framing is characterized by low level agricultural technology and dependence on traditional tools and farming coupled with low application of modern inputs. Farmers are not well aware of row planting technologies and less accessibility of planters is the major problem, affecting agricultural production and productivity.

2.4. Forms of Agricultural Mechanization for Maize production

As the study undertaking by Jagvir Dixit *et al.,* (2017) agricultural mechanization equipment to produce maize includes:-

1. Field Preparation Equipment: Seedbed preparation for sowing/ planting to different crops is done through primary and secondary tillage operations. Loosening of soil is done to achieve a desired granular soil structure for a seedbed and to allow rapid infiltration and good retention of moisture, to provide adequate air exchange capacity within the soil and to minimize resistance to root penetration and shoot growth. After loosening of soil, smoothening of seedbed is required for proper operation of sowing machine, better distribution of irrigation water and quick disposal of excess rain water.
2. Sowing/ Planting Operation: The recommended row to row spacing, seed rate/ plant population, plant to plant spacing and depth of seed/ plant placement vary from crop and for different agro-climatic conditions to achieve optimum yield. In hilly areas, most of the farmers are using traditional methods i.e. broadcasting or seed dropping behind plow for sowing maize, which affects germination due to the non-uniform placement of seeds at the proper depth. Also, farmers apply 30-40 % higher seed rate than recommended to ensure

optimum plant population. The placement of seed at proper depth is the most important factor in sowing, which has a significant role in crop production particularly under rainfed conditions.

3. Weeding and Intercultural Operation: Weeding/ intercultural operations in maize crops are done manually. The introduction of rotary dibbler/ multi-crop planter has enabled maize planting in rows. The newly developed wheel hand hoes can be used for efficient weeding/ intercultural operations in rows. The field trials of manually operated wheel hand hoe at Various Universities in India shows that the implement reduces drudgery due to less time taken (50-55%) compared to hand weeding. The use of equipment also results in saving of cost of operation by 45 %. Farmers are of the opinion that wheel hand hoe operation in standing position of operator allowed weeding without fatigue. Due to a shortage of labor for timeliness of operation, farmers liked the equipment for enhancing productivity. The equipment proved socioeconomically viable and acceptable to women laborers for faster and higher coverage.
4. Plant Protection Equipments: Chemical are widely used for controlling diseases, insects and weeds in the maize crop. They need to be applied on plants and soil in the form of spray, dust or mist. Duster and sprayers are generally used for applying chemicals. Dusting, the simpler method of applying chemicals is best suited to vegetables and is usually requires simple equipment. But it is less efficient than spraying, because of the low retention of the dust. High volume spraying to some extent overcomes the failings of each of the above two methods while retaining the good points of both. A sprayer that delivers droplets large enough to wet the surface readily should be used for proper application. Spraying techniques are classified as high volume (HV), low volume (LV) and ultra-low volume (ULV), according to the total volume of liquid applied per unit of ground area. Initially, high-volume spraying technique was used for pesticide application but with the advent of new pesticides, the trend is to use the least amount of carrier or diluents liquid. Different designs of spraying equipment have been developed for different types of application and field and crop condition. Knapsack sprayer, foot sprayer, and duster are especially suitable for spray application in maize crop.
5. Harvesting Operation: Maize crop is harvested after normal maturity with the objective to take out maize cob and straw without loss. Harvesting of the maize crop is traditionally done

by manual methods of using a local sickle. The traditional sickle involves drudgery and is labor intensive. Rapid harvest facilitates extra days for land preparation and early planting of next crop. The use of improved tools or machine can help to harvest at the proper stage of crop maturity and reduce drudgery and operation time.

6. Shelling operation: Maize shelling is based on the principle that when some impact or pounding is given on cob, the grains are separated from cobs. Most of the farmers are using the conventional method of maize shelling like extraction of grain from the cob with the help of fingers or beating with the stick, which is slow and labor consuming process. Ergonomically, these methods of maize shelling create drudgery to the users. With the increase of mechanism, different types of manual or power operated maize shellers have been developed to improve the quality of work and produce.
7. Storage: losses of grain stored at the farm level are in the order of 8 to 10 percent depending upon the following: Physical factors, e.g. damage during harvesting, transportation and shelling. This makes maize susceptible to attacks by insect pests, mites, and molds. Temperature and humidity may encourage mould formation and create conditions for insect population growth. The losses could be: minimal in cool dry areas, marked in hot dry areas, high in cool damp conditions and very high in hot damp climates. Type of storage structures or containers used Duration of storage the storage management effected prior to and during storage (Danilo, 2003).

2.5. Gender and Agricultural Mechanization

More clearly indicated by FAO (2011) although women play a crucial role in farming and food production, they are often disadvantaged and face greater constraints in agricultural production than men. Rural women are consistently less likely than men to own land or livestock, adopt new technologies, access credit or other financial services, or receive education or extension advice. In some cases, they do not even control the use of their own time. If women had the same access to production resources as men, they could increase yields on their fields by 20 to 30 percent. The FAO calculates that this alone would raise total agricultural output in developing countries by 2.5 to 4 percent and that this, in turn, could reduce the number of hungry people in the world by 12 to 17 percent, or 100 to 150 million people.

To strengthen the concept above Fafchamps *et al.*, (2009) stipulated that in addition to women's having the same access to production resources, improvements in gender equality tend to enhance economic efficiency and improve other development outcomes, e.g. family food and nutrition security and education. The study by World Bank (2011) also indicated that gender equality is also a development objective in itself: Just as a reduction in income poverty or ensuring greater access to justice is part of development, so too is the narrowing of gaps in well-being between men and women.

Many effective innovations have been generated locally and empowering them and investing in them especially the rural women will significantly increase productivity by improving their working conditions as well as reducing the time that they will take working in the farm. It is unfortunate that agricultural mechanization is still far from women and bypassing them though it is now well established that mechanization serves to reduce women's workload and facilitate some hard operations (Abdelali-Martini, 2011).

On the other hand, the study carried out by Shamsudeen Abdulai *et al*., (2013) revealed that women performed crucial roles in the domestic and economic life of a society which affected their technical efficiency. This included the unmeasured non-economic activities (such as child care, cooking, cleaning, etc) performed by females in the household. Moreover, some customs, traditions, religious beliefs, and social norms placed restrictions on women's activities both on- and off-farm and hence their ability to access new information and use technologies.

The author Abdelali-Martini (2011) expressed that it is more challenging for women who more often than not have a greater disadvantage because they not only contend with the limited access to the farm inputs but also structural differences that arise owing to cultural factors or legal rights to access capital or even land, let alone the technical knowledge to operate the machines that are needed so as to get the desired yield. There is need for the governments in developing countries to focus on women by recognizing their input and efforts by empowering them so that they are able to contribute more in the agricultural sector as well as "strengthening their access to and control over productive resources/assets such as land, capital, knowledge, information, and technologies, remain important factors of an enabling environment for women's empowerment.

As Gerry (2002) in her study indicated the need for community-based and participatory approaches to technology generation and dissemination is now widely acknowledged. It is also widely accepted that the most appropriate focus for a community-based approach. However, communities are not homogeneous with regard to technological needs and challenges, and farmers' organizations represent economic interest groups and do not necessarily represent the whole of the community. Women may be excluded and overlooked by male-dominated extension services, yet the gender division of labor means that women's technological needs are different from men. Given the often-dominant role of women in household food supply, attending to gender-specific technological needs is likely to have a positive impact on food security.

As FAO (2018) stated that Agriculture in Africa has certainly seen a shift from traditional labor-intensive production and postharvest operations to labor-saving technologies and mechanization. The change comes in response to increasing labor scarcity and costs, as well as to the increasing feminization of farming due to the fact that more men than women migrate to urban areas. Compared with men, women have less access, control, and ownership of land and other productive resources. In addition, mechanization technologies are often designed to fit the physical build of male workers while female workers lack appropriate technologies suited to their build. The development of SAMA (Sustainable Agricultural Mechanization in Africa) must, therefore, take into account the mainstreaming of gender dimensions, as stipulated in both the Malabo Declaration and the Agenda 2063 Aspirations.

Options to be considered:

1. Collection, compilation, and analysis of gender-disaggregated data (labor, income, decision-making, access to assets and control of resources) to increase awareness among bank managers, research and extension leaders, and policymakers in order to reduce gender inequalities in access to resources and economic opportunities related to mechanization services.

2. Implementation of legislative changes to assure property rights of women to farm machinery and other related assets. Legal entitlement to land would also facilitate women's access to institutional credit.

3. Ensuring that mechanization positively contributes to the empowerment of women by increasing their labor productivity and reducing the drudgery associated with on-farm and post-harvest operations. Specific attention should be paid to ensuring that women are not displaced and do not lose their sources of income and employment in more traditional systems due to the introduction of mechanization technologies.

4. Design and development of gender-friendly mechanization technologies, capacity building programs and support systems for the provision of mechanization services.

2.6. Agricultural Mechanization for maize producer Women farmers

Most developing countries, and indeed, African countries have an economy strongly dominated by the agricultural sector. Agriculture generates up to 50 percent of gross domestic product (GDP), contributing more than 80 percent of raw materials to industries. Women make essential contributions to the agricultural and rural economies in all developing countries. Their roles vary considerably between and within regions and are changing rapidly in many parts of the world, whence economic and social forces are transforming the agricultural sector. In as much as agriculture can be an important engine of growth and poverty reduction, the sector is underperforming partly because women, who are often a crucial resource in agriculture and the rural economy, face constraints that reduce their productivity. Furthermore, 30 to 40 percent of agricultural produce is lost owing to poor post-harvest handling, storage, and processing methods. The low level of engineering technology inputs in agriculture had been cited as one of the main constraints hindering the modernization of agriculture and food production system in Africa (Lyly, 2016).

Agriculture mechanization has many important implications for gender mainstreaming and gender relations. Women's role in agriculture is prevalent; they work in all aspects of farming operations like seed cleaning, sowing, planting, weeding, applying fertilizer/manure and pesticides, threshing and harvesting. Agriculture mechanization can help reduce women's workload and facilitate difficult operations. However, experiences in many countries show the promotion, adoption, and benefits of mechanization are not gender-neutral. Mechanization technologies have mostly been adopted in relation to men's tasks often with negative consequences for women. But detail assessment and analysis is needed to know how laborsaving

technology are most expected to be most impactful for female farmers because they work on to do both on-farm activities and household activities (FACASI, 2014).

A study of Danilo (2003) pointed out that women play a very essential and important role during the crops production and postproduction systems either in Asia, Africa, Latin America Women are key, not a marginal part of agricultural production of the food system of the third world. In line with this statement, the other authors Saeed Ghazvineh and Yousefi (2012) confirmed that about one third to one half of the total labor contribution to agriculture is made by women.

Cognizant to the above idea FACASI (2014) clearly stated that women constitute half of the rural farming community in Ethiopia, contributing 48% of labor overall agriculture, and 70% of household food production. Investments in women's access to agricultural inputs and agronomic practices can bring up to a 30% increase in production. Similarly, addressing gender inequality at the national level can contribute up to a 1.9% increase in GDP. Further, investments in women farmers' productivity and income has a ripple effect on improving household nutrition, children's schooling, and the ability of the household to make further investments through nest egg savings. Realizing this fact, the national Growth and Transformation plan has clearly underlined the need to involve both men and women, supporting women's institutions and targeting at least 30% female-headed households (FHHs) in all extension services.

ARARI (2016) stipulated that maize is currently grown in Ethiopia across 13 ago-ecology zones which cover about 90 percent of the country. Moreover, it is an increasingly popular crop in Ethiopia, in the country, maize (Zea mays) is mainly produced for local consumption. In addition, leaves are used as feed for animals and the stalk is used as fuel. In view of its high demand for food grains and high yield per unite area, maize has been among the leading food grains selected to achieve food self-sufficiency in Ethiopia. Thus, Womens' engagement in production of maize is very high in the country.

Women maize farmers participate actively in the maize economy through their involvement in the production, post-harvest, and processing activities. They are also active participants in decision-making about technology adoption. On one hand, some women manage whole farms as female household heads or in the absence of their husbands; on the other, women also manage individual plots within male-headed households and, most importantly, women provide

significant input into negotiations regarding technology adoption where farming is managed jointly (CGIAR Research Program on maize, 2015).

The above information also evidenced by the research caried out by (Dagninet & Wolelaw, 2016) that mechanization may be a means of freeing women and children from agricultural work to more rewarding occupations and education. Women in rural areas spend 1-2 hours daily on domestic transport, carrying water, firewood and crops on their heads and traveling on foot. Therefore, mechanization technologies by easing the drudgery of farm work and providing more time for women enable to achieve the economic empowerment through other employment opportunities.

Concerning such cases Lyly (2016) argues that although women play a crucial role in maize production, they are often disadvantaged and face greater constraints in using agricultural technologies than men. Maize producer women are consistently less likely than men to own land or livestock, adopt new technologies, access credit or other financial services, or receive education or extension advice.

2.7. Feminist Theories in Relation to Women Farmer

As clearly stated by Brandth (2002) feminism indicates a theoretical stance and a desire to make the world different for those victimized by the gender system. It has very much been a silent issue in agricultural institutions, and at times there has been open resistance on the part of rural women towards equality principles.

Women do the majority of work in agriculture at the global level, elder men, for the most part, still own the land, control women's labor, and make agricultural decisions like using agricultural technologies in patriarchal social systems. It has also been pointed out that it legitimated the subordination of women as (Fink, 1992) pointed out.

Agreeing with the above evidence Marshall (1994) in his counterpart stipulated that modern changes were all gendered. The nuclear family was one in which women and men had different roles and spheres of activity. Hence, the transition from traditional to modern did not mean more equal gender relations, neither in the sense of sameness nor equal worth. On the contrary, as women were confined to the private, excluded from the public realm and economically dependent, their subject position became unrecognized.

Concerning farm women, it is not evident that they saw the family (even if it was patriarchally organized) as a site of oppression. Historically, farm women who were in charge of indoor work on the farm, exercised great influence in their area of work. But, when they participated in outdoor work, they became farm hands or helpers to the male farmer. Also, outdoor work for farm women usually meant an increased total workload, as they were not relieved of domestic work. In making farm women's social, economic, and occupational situation visible, academic feminism probably was an ally (Brandth, 2002).

The author Hooks (1984) in his book explained that feminists and scholars have divided the movement's history into three waves. The first wave refers mainly to women's suffrage movements of the nineteenth and early twentieth centuries. The second wave refers to the ideas and actions associated with the women's liberation movement beginning in the 1960s. The third wave refers to a continuation of and a reaction to the perceived failures of second-wave feminism, beginning in the 1990s. Hence, there are different feminist theories which emerged at different times. These theories tried to identify the root cause of women oppression and subordination from their own perspectives and suggested possible solutions to overcome the problem. Among others, liberal, radical, Marxist and socialist, cultural, black and eco-feminism are the major ones. Of the above listed feminist theories, the finding of this study mainly inclined with liberal feminist theory.

2.7.1. Liberal Feminism Theory

The term feminism describes a political, cultural or economic movement aimed at establishing equal rights and legal protection for women. Feminism involves political and sociological theories and philosophies concerned with issues of gender difference as well as a movement that advocates gender equality for women and campaigns for women's rights and interests (Butler,1990).

As Eisenstein (1981) pointed out that liberal feminism is derived from the liberal political philosophy that emphasizes the traditional understanding of human nature and personhood; rationality, individual autonomy, and self-fulfillment. According to this theory, the root cause of gender inequality is sexism and legal traditions. Liberal feminism asserts the equality of men and women could achieve through economic and legal reform. It is an individualistic form of feminism which focuses on women’s ability to show and maintain their equality through their

own actions and choices. Liberal feminism uses the personal interactions between men and women as the place from which to transform society.

In a similar way, in line with the above liberal feminist's views, the findings of the present study are highly linked with this feminist perspective. From the very beginning, the finding of this research asserted that there should be a suitable environment and compatible socio-demographic, economic opportunity and institutional factors which help to encourage women to use IAT.

FAO (2018) pointed out that Agriculture in Africa has certainly seen a shift from traditional labor-intensive production and postharvest operations to labor-saving technologies and mechanization. The change comes in response to increasing labor scarcity and costs, as well as to the increasing feminization of farming due to the fact that more men than women migrate to urban areas. Compared with men, women have less access, control and ownership of land and other productive resources. In addition, mechanization technologies are often designed to fit the physical build of male workers while female workers lack appropriate technologies suited to their build. The development of SAMA (Sustainable Agricultural Mechanization in Africa) must, therefore, take into account the mainstreaming of gender dimensions, as stipulated in both the Malabo Declaration and the Agenda 2063 Aspirations.

Women play a very essential and important role during the crops production and postproduction systems either in Asia, Africa, Latin America (Danilo, 2003). Women are key, not a marginal part of agricultural production of the food system of third world. About one third to one half of the total labor contribution to agriculture is made by women (Saeed and Yousefi, 2012).

2.8. Opportunities of women farmers to use Agricultural Mechanization

As Gerry (2002) stipulated that where potential for increased production is available, so that larger farmers may demand labor saving technologies. Thus, high level of production motivates farmers to use improved technologies.

The same author futher describes in different inistitutions the policy has place strong emphasis on giving farmers (especially smallholders) a strong voice in setting research priorities, conducting research and validating results. It promotes reform of public sector research and extension bodies to make them more responsive to farmers' needs and assists in the development

of multi-agency national research systems, which include the private sector, civil society and rural producer organizations.

Women farmers have some opportunity that enables them to use agricultural technologies in using agricultural mechanization although it had some limitation on the study site. As Burie Zuria Woreda Agricultural office (2018), showed that in the woreda there are different opportunities for farmers to improve their production. From those, presence of development agents and a cooperative union at Kebele level are the first and they are willing to support the farmers. The other is seed and fertilizer availability to farmers and irrigation system is also available, better market access because roads are improved almost in all kebeles of the woreda. In the woreda, there is also agricultural mechanization like water pumping technologies, tractor and maize sheller. Capacity building institutions (university, agricultural colleges, and farmers training centers and projects) are willing to support the initiative. The woreda is also productive in which farmers are experienced in using agricultural technology. The report further elaborated women farmers have access to extension service, technologies, and capacity building training proportionally.

The report by FANRPAN (2017) women are already engaged in farming and seeking ways in which to increase their productivity and earnings. If women received the same education and similar inputs and assistance as men, overall farm yields could rise by as much as 22 percent. In recent years, a number of initiatives have been developed to improve rural livelihoods and reduce poverty through better access to agricultural input. Currently, these are being promoted by international donors.

Consistent with the above idea Bahir Dar University, ASMC Project (2016) in its report also stated that the project transfer, sustain and intensify the applicability of agricultural technologies yielded through the project works on the targeted areas of Amhara region of Ethiopia such as Bahir Dar zuria woreda, Burie zuria woreda and Dangla woreda. The introduction of locally-adapted technologies has the potential to raise incomes and nutritional security, reduce drudgery and empower women and youth. Much of the consortium works are a focus on how to build local capacity to ensure the sustainable implementation of new and adapted technologies. Hub facilities are available to reach out to farmers, particularly women farmers. Farmers will attend train-the-trainers' courses, and opportunities for farmer-to-farmer learning will also be facilitated.

2.9. The Determinant Factors on Agricultural Mechanization for Maize Production of Women Farmers

To nutshell, in the above review, it is assessed that the determinants of AM for maize production of women farmers varied according to the place where it is carry out; time and individuals who are carry out maize production activities. Moreover, influencing factors of AM for maize production of women farmers (i.e marital status, availability of technology, utilization of technology, access to credit service and knowledge) were significant negative or positive impact on the maize production of women.

Nigussie *et al.,* (2014) in their study showed that showed that male headed households own more of productive resources such as agricultural inputs as compared to female headed households. In line with this ccording to Uwandu, Chisom Norberth *et al*., (2018) marital status significantly associated with agricultural information use. One of the most important factors affecting the level of production and productivity on peasant farms is the composition and size of farming family. Thus, marital status contributed significantly to the farmers production.

Tesfaye & Alemu (2001) stated that level of education is one of the demographic characteristics which influence the adoption decision of improved maize technologies. The exposure to education increases farmer's ability to obtain, process, and use information relevant to the adoption of improved technologies. The level of education tended to be highly associated with die adoption of improved technology.

Nigussie *et al*., (2014) described that farmers accessing to agricultural inputs has positive impact to increase the productivity of agriculture. As ARARI (2016) maize production is constrained by traditional method of production and the low-level of new technology use. According to FAO (2011) rural women are consistently less likely than men to adopt new technologies, access credit or other financial services, or receive education or extension advice. The study of Fafchamps *et al.,* (2009) also stipulated that women's having the access to production resources like agricultural technologies and its, improvements on production tend to enhance economic efficiency and improve other development outcomes

The study of Abdelali-Martini (2011) expressed that women contend with the limited access to the farm inputs, capital and the technical knowledge to operate the machines that are influencing factors for maize production. Similarly, CGIAR Research Program on MAIZE (2015) stated that

key determnants to maize production include lack of knowledge, access to agricultural inputs, and microfinance service like credit.

2.9.1. Technological Factors

Even though women have some opportunities to use IAT, they encountered several challenges in the world generally and in the study area specifically. Different studies pointed out these facctors in a different way based on their findings. Thus, the study carried out by Sims, B.G. & Kienzle (2015) describes this issues that opportunities that agricultural mechanization can offer to women in rural areas, and to the development of local economies, is often underestimated. Currently, 50% of the population in developing countries lives in the rural sector and this is projected to fall to 30% by 2050. Given the current importance of human muscles in smallholder agriculture, the power limitation implications are grave.

The need to achieve large and sustainable productivity gains in almost all of sub-Saharan Africa represents an immense and expensive technological challenge, yet investment in agricultural research is low and has been falling in most of the poorest countries. There is still a supply of "off the shelf technologies" that can, with local adaptation, help enhance food security in many areas. While further work is needed on removing constraints to applying existing technologies, there are also legitimate concerns that the supply of appropriate new technologies in the pipeline is dwindling (Gerry, 2002).

However, it is not necessarily possible to predict how the introduction of new technologies may affect the patterns of labor, resource and land allocation between men and women, or how this, in turn, may influence whether the new technology will be adopted or not, and who will benefit or not. Both intended and unintended impacts can occur at individual, household and/or community level. The challenge of estimating potential consequences, therefore, relates both to gender considerations, as well as to broader aspects of human and sustainable development (Doss, 2001).

Further the issue stipulated by Esther L.et al (2018) the lack of capital is one of the constraints limiting technology adoption. Related to this is the lack of access to credit. If the recommended new technology requires a fairly large investment, its adoption is hindered by a lack of funds and difficulty in accessing credit.

Moreover the study carried out by Dereje *et al*., (2016) tries to explain the challenges of women farmers especially in Ethiopia as follows. The agricultural production system in Ethiopia is highly dominated by traditional farming and the application of modern agricultural inputs has been extremely limited. The country severely suffers from the inability to feed them and to depend on food imports and food aid. Farmers' continuous use of traditional farming tools will make it difficult for the government to achieve maximum agricultural growth. Designing appropriate intervention programs to address the continuing challenges especially women's challenegs of limited use of improved agricultural inputs requires an adequate understanding of the physical, technological, and cultural and socio-economic constraints associated with improved inputs use. Further all improvements in agricultural technologies has to be women centered since they play a vital role in agriculture production.

2.9.2. Inistitutional Factors

CGIAR Research Program on MAIZE (2015) stipulated that key constraints to maize production include insufficient institutional support, lack of knowledge, access to fertilizer and other inputs, and microfinance service like credit. The research program investigates major constraints of maize producer women farmers are gender stereotype and social restriction, traits and technology preference, information and value chain, vulnerability and risk (CGIAR Research Program on MAIZE,2015).

One of the greatest constraints that poor women farmers face is access to new knowledge and reliable information on new technologies and practices. Information is important to women whether or not they are the final decision-makers on what seed, fertilizer or other inputs to buy. When deferring to their spouses, it helps the women to discuss and debate from the standpoint of knowledge. On the same note, it is best when both spouses have adequate information. (CGIAR Research Program on maize, 2015).

2.9.3. Socio Cultural Factors

Often exclude women from research and extension programs, and from participation in farmer participatory experiments, demonstrations and field days. When men migrate, and women are left in charge of the farm labor, production relations are affected. Women sometimes face several constraints in addressing these challenges, for instance, a lack of access to technical knowledge and technologies which can reduce their drudgery and provide additional income. Moreover,

women's triple roles to the extent that domestic and caring responsibilities may limit their mobility, women often lose out on crucial opportunities for learning and interactions that could stimulate agency and innovation.

The author Dagninet (2017) in similar manner revealed that among the social-cultural constraints, the low level of education is observed to be the single most important reason for refusal or hesitation of technology adoption. Cultural perceptions and norms associated with male dominance and resistance to change are perceived as adoption constraints in Madagascar and Ethiopia. Inclination towards the familiar traditional methods of farming also hinders the adoption of new technologies by women farmers.

In this regard CGIAR Research Program on MAIZE (2015) explains the issues as other gender differences in preferences, needs, and constraints, may apply to other types of technologies (e.g. related to post-harvest storage, labor saving, crop or natural resource management practices) or manifest themselves differently under different circumstances. As empirical evidences for instance by GIAR Research Program on maize (2015) stated that the same technology may have a positive impact in one context or for one social group, but not in another context or for another social group. Such examples present trade-offs related to agricultural technologies, which in general are associated with positive development impacts.

As Alston, M. and Whittenbury, K (2014) in their counterpart stated that, due to their socially-constructed roles and responsibilities and the various constraints that tend to weigh heavier on women, women are often particularly vulnerable to shocks such as climate variability and change, and depletion of the natural resource base For example, as custodians of household food security in many contexts, women have a lot more at stake when a season fails, because they bear the brunt of managing hungry, malnourished, and sick children.

Men and women both make significant contributions in maize-based farming systems and livelihoods, although gender roles in maize cultivation vary greatly across and within regions. On average, women comprise 43 percent of the agricultural labor force in developing countries, ranging from 20 percent in Latin America to 50 percent in Sub-Saharan Africa and East Asia (Quisumbing *et al.*, 2014).

2.10. Benefits of women in using Agricultural Mechanization

Agricultural mechanization is an investment for farmers and they have to generate income and profit from their investment by means of greater production or increased value. It also promotes the local farmer's status by reducing the farmer's workload and creating more leisure time (Lyly, 2016).

The other author Bhasin (2002) explores that agricultural productivity can be improved either through the development and adoption of new technologies or through the efficient use of the existing technologies without damaging the natural resource base. The mechanization of farm operations is a very important step toward increasing production efficiency

In the same manner the same author stipulated that the improvement in agricultural technology coupled with mechanization positively impacts the lives of women from all socio-economic backgrounds, by reducing the amount of time that they will work in their farms as well as improving their income and more importantly enabling them to manage and implement their entrepreneurial skills having been relegated to manual agricultural laborer in the absence of mechanization. This is coupled with the access to and control over productive resources or assets such as land, capital, knowledge, information as well as financial resources.

Farm mechanization is regarded as more important to reduce the human drudgery and enhance the agricultural productivity (Dagninet &Wolelaw, 2016). According to Karim Houmyet *et al*., (2013) agricultural mechanization has made a significant contribution in enhancing cropping intensity. Inputs of hard labor by farmers and their families can be substantially reduced if they have access to a carefully selected use of tools, machines, and equipment. The labor released can be used for other productive activities. The use of improved mechanical technologies can also have a direct impact on yields and area under production. Such technological interventions are commonly referred to as agricultural mechanization.

The author Lyly (2016) in her study revealed that mechanization has the potential to increase production; boost operation timeliness more so when most women the rural areas continue to rely on hand hoes as a tool for cultivation. Agricultural mechanization can also raise the income of farmers and conserve natural resources by intensifying sustainable crop production practices which creates a farming cycle that leads to higher income for the farmer because the farmer can make saving out of the improved productivity.

In agreeing with the above information FACASI (2014) confirmed that agricultural mechanization has many important implications for gender mainstreaming and gender relations. Women's role in agriculture is prevalent; they work in all aspects of farming operations like seed cleaning, sowing, planting, weeding, applying fertilizer/manure and pesticides, threshing and harvesting. Thus, agriculture mechanization can help reduce women's workload and facilitate difficult operations. Female farmers work on to do both on-farm activities and household activities, as a result, if there is gender sensitive agriculture input adoption, it saves their labor, time and drudgery.

Dagninet & Wolelaw (2016) on their counterpart stated that the benefits of technology as gains of time saved, freedom from overburdened work, improvement in social status, increase in overall production, timeliness of operations, reduction in cost, increase in the number of cropping and adoptions of inter-cropping. Likewise Gerry (2002) in her counter part pointed out agricultural scientists argue that technology is the only route to achieving sustainable increases in food production.

Manual maize shelling method practiced is problematic, in that it requires much time and hard work. In addition, it induces huge post-harvest loss. Therefore in order to alleviate these post-harvest handling problems on maize, introducing appropriate threshing and shelling methods, that saves time, decreases losses and reduce drudgery is imperative. maize Sheller reduces the time required for shelling maize, by half than traditional shelling. Fingertip injury was commonly observed when farmers shelling maize traditionally, by their finger tip, for a longer duration, so the Sheller alleviates this suffering. In addition, farmers found that, the sheller is best suit for shelling maize since it doesn't break the grain while shelling which makes the product more quality (ARARI, 2016).

2.11. Exiting needs of Women Farmers

According to Gerry (2002) where technological change aims at reducing poverty and boosting food security through the production and sale of a surplus, the demand-led approach must take consumer demand fully into account Use participatory methods such as participatory rural appraisal and other visualization and group-based tools to assess the different technology needs of each group of rural people in a context.

As Dagninet & Wolelaw (2016) clearly stipulated that broad-based poverty reduction in Africa, including Ethiopia, simply will not occur without a vibrant agricultural sector providing income, employment and affordably priced staple foods. What is more important is the contribution of mechanization should not be overlooked hear.

The need for community-based and participatory approaches to technology generation and dissemination is now widely acknowledged. It is also widely accepted that the most appropriate focus for a community-based approach. However, communities are not homogeneous with regard to technological needs and challenges, and farmers' organizations represent economic interest groups and do not necessarily represent the whole of the community. Women may be excluded and overlooked by male-dominated extension services, yet the gender division of labor means that women's technological needs are different from men. Given the often-dominant role of women in household food supply, attending to gender-specific technological needs is likely to have a positive impact on food security (Gerry, 2002).

As the finding of ARARI (2016) showed that in some area Ethiopian framers plant maize in row, which is opening furrow by a traditional plough *(Mareha*) and dropping seed and fertilizer by hand and cover during the second furrow opens. Labor requirement is high because two persons are required for dropping seed and fertilizer simultaneously and one person to guide the animals. However, line sowing method which is advantageous for the introduction of planter. Generally agricultural work is widely carried out on small scale manually hand tools. To increase productivity, it is necessary to expand the range of hand tools used by laborers. Improved planters are the possible tool which can be adopted to improve efficiency and early planting.

2.12. Conceptual frameworks of the study

Increased availability and use of improved farm technologies enhance the livelihood of women farmers through increased productivity and surplus production. Indeed, ASAM has a great contribution for maize producer women farmers since maize production activity highly undertaken by women. In this study, efforts have been made to identify influencing factors that affect women farmers in using ASAM. To this regard, the study will focus on socio-cultural factors, institutional factor, technological and demographic factors. Therefor the researcher has tried to identify the constraints and the opportunities of maize producing women to use ASAM. These are the following point.

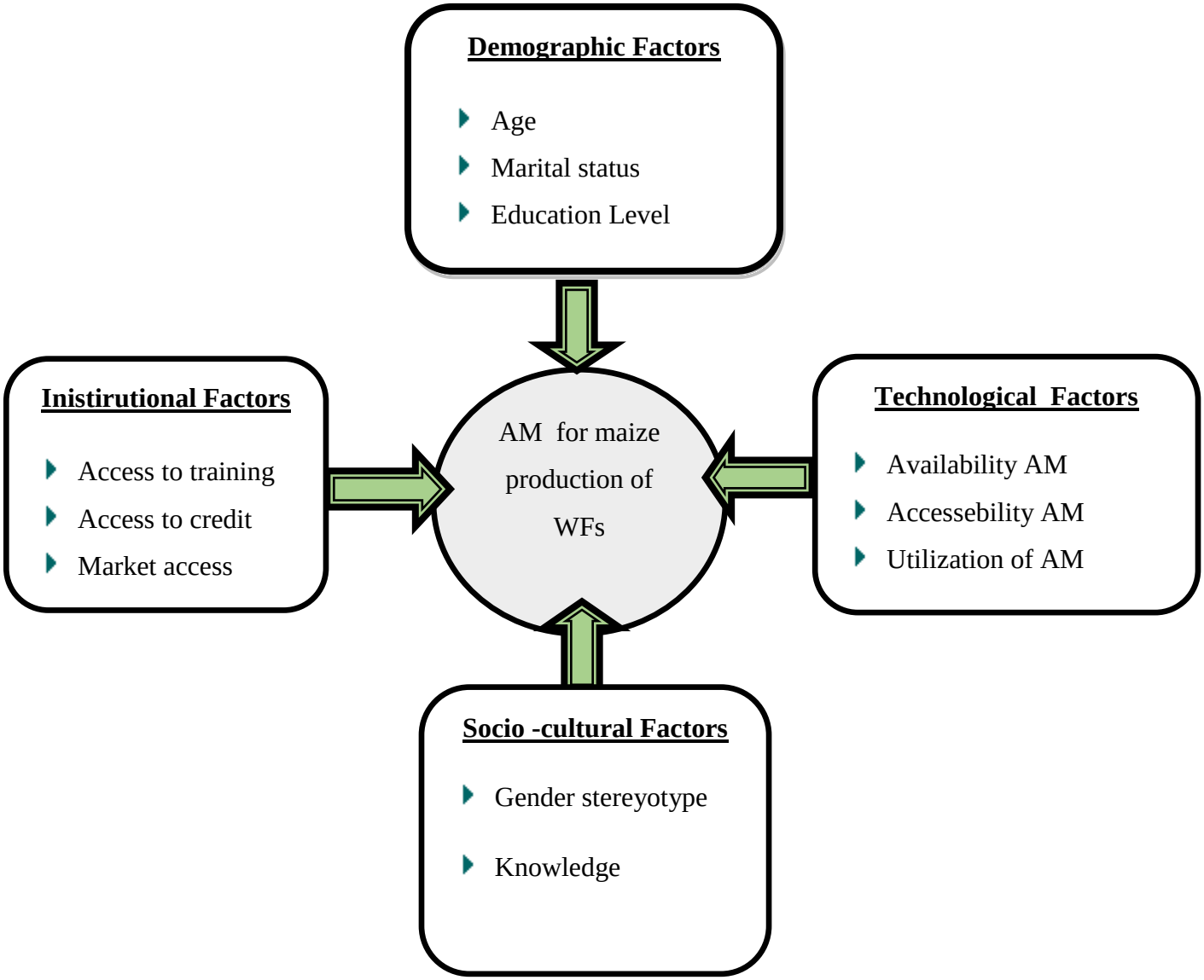

Figure 2. 1: Conceptual frameworks of the study

CHAPTER THREE

DESCRIPTION OF THE STUDY AREA AND RESEARCH METHODOLOGY

3.1. Description of the Study Area

3.1.1. Location and Agro-ecology characteristics of Burie Zuria Woreda

Bure Zuria woreda is one of the 15 woredas of West Gojam Administrative Zone, and one of 106 in Amhara National Regional State, respectively. It is located between latitude $10^0$17'-10^0 49' North, and longitude 37^0 00'-37^0 11' East. The capital city of the woreda, Bure, is 400 km North-west of Addis Ababa and 148 km south-west of the Regional State capital, Bahir Dar. (BoFED, 2006).

According to Burie Zuria Woreda Communication Affairs Office (2018), Agro-ecologically the woreda is classified into moist and wet lowland (10%), wet Woina-Dega (82%) and wet Dega (8%) (IPMS, 2007). Similarly, according to the data obtained from the Woreda Office of Agriculture, the woreda is classified into Dega (1%), Woinadega (77%) and Kolla (22%). The altitude ranges from 700 to 2,300 meters above sea level (masl). The lowest point is found at the Nile gorge. Annual mean temperature ranges from $17c^0$ to $25c^0$, the minimum and maximum level of temperature respectively.

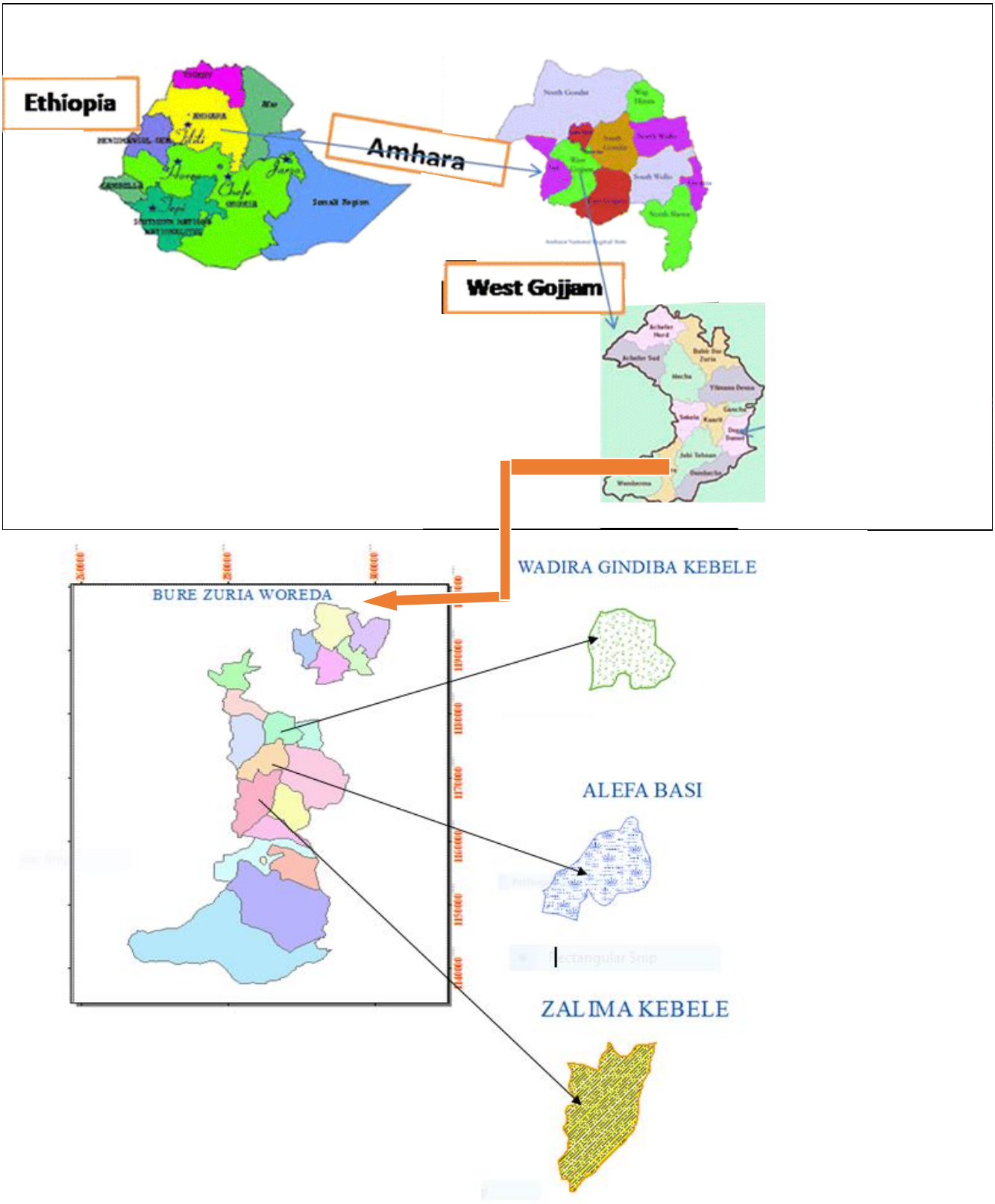

Figure 3. 1: Location Map of the study area (Burie Zuria Woreda and Selected kebeles).

3.1.2. Demographic and Socio-Economic Characteristics of Burie Zuria woreda

The human population of the woreda is 140, 906 of which 135,341 (96%) and 5,565(4%) live in rural and urban areas, respectively. Out of the total population, 69, 467 (49.3%) are male and the remaining 71,439 (50.7%) are female. In rural areas, the population is 66,890 male and 68,451 female, whereas in urban centers it is 2,577 male and 2,988 female. The woreda has 20 kebele administrations of which one is urban kebele (Kuchi) and 19 are rural kebeles (FDRE,Central Statistical Agency, 2013).

According to Burie zuria Woreda Agriculture office (2018), the dominant crops grown in the district are Maize, *Teff*, barley, wheat, bean, and root and tuber crops like potato and sweet potato. Maize is the first cereal crop and covers 40.08% production in the woreda. There are 14,935 male headed and 2,152 female-headed maize producer households in the woreda.

3.2. Research Methodology

This section discusses the approach the researcher was followed in doing the research. It is well articulated in the research methodological literature that the choice of a research approach is influenced by several factors including the researcher's world view, which, in turn, is dictated by the nature of the research problem.

3.2.1. Research approach

The study was conducted by using a mixed research method (combines both quantitative and qualitative research approach). The reasons why mixed method approach was applied for this study were in order to avoid the drawbacks of each individual paradigm, they are a compliment to each other and they are allowed for a more complete analysis of a research problem. In addition, the fact that the mixed research approach minimizes some of the limitations of using a single method because quantitative or qualitative research methods are not sufficient to address the complex technological phenomena when they are treated separately.

Qualitative methods suffer from the limitations of generalizing the results beyond the specific research area and go through subjectivity during data collection and analysis. The quantitative method on the other hand always fails to capture an in-depth understanding of issues Creswell, *et* al (nd).

Cognizant with the above the other authors Angell, B.and Townsend, L, (2011) clearly indicated that when quantitative and qualitative research methods are used in combination in one study, they complement to each other and allow for a more complete analysis of the research problem.

3.2.2. Research Design

The study was conducted within the confines concurrent mixed method design. There are certain rationales why the researcher was utilized concurrent mixed method research design, firstly, it gives equal priority to both quantitative and qualitative data. To mean that the researcher valued both quantitative and qualitative data and see them as approximately equal sources of information of this study. Secondly, it enables the researcher to compare the results of quantitative and qualitative analyses to determine if the two databases yield similar or dissimilar results. Thirdly, this design enables the researcher to gather information that uses the best features of both quantitative and qualitative data collection methods.

A research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure. In fact, the research design is the conceptual structure within which research is conducted; it constitutes the blueprint for the collection, measurement, and analysis of data (Kothari, 2004).
Creswell (2003), stated that the descriptive method of research is used to gather information about the present or existing condition. A research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure.
In a similar manner, the same author pointed out that the main purpose of descriptive research is a description of the state of affairs as it exists at present. The main feature of this method is that the researcher has no control over the variables; she can only report what has happened or what is happening. Descriptive research consists of purely describing the state of things as they are and employs polls and surveys as part of an information gathering mechanism.

Hence, this study was used concurrent parallel research design to describe the contribution of ASAM for maize producing women. The descriptive survey design was chosen because it allows the study to collect in-depth data from the respondents using research instruments such as questionnaires and interview schedules which gave a detailed account of the research.

3.2.3. Sampling Techniques

The rationales why the researcher has selected the area of this study were the following. Firstly, Burie Zuria woreda is one of the leading maize producer woredas of West Gojjam Zone and uses ASAM for maize production. The second was that the woreda was one intervention area of BiT;ASMC project, which sponsored this thesis to do. Thirdly, the researcher knew the study area profoundly. Hence, knew the geographical setting and cultural context of the population was to minimize costs and time. Fourthly, the researcher was willing to assess the contribution of AM for maize producing women in special references. Because different researchers and academicians were not concerned about the issues and there was no much enough study on the area. Thus, the researcher was motivated to conduct research on the study site entitled as "Contribution of Agricultural Mechanization for maize producing women farmers". The three selected kebeles also selected because they are intervention kebeles of BiT;ASMC project.

Consequently, women from both male headed and female-headed households were used as the primary component of the analysis. In this study, the list of male headed and female-headed households was obtained from the selected three kebeles. In doing so, the researcher was used purposive sampling techniques in order to select the study area, Burie Zuria Woreda.

3.2.3.1. Sample Size Determination for Quantitative survey

There are a number of strategies in determining a sample size including using a census for small populations, imitating a sample size of similar studies, using published tables, and using formulas to calculate sample size (Israel, 1992). Among such strategies, the researcher was used formula based on the real context of this study.

In applying the formula, one has to consider certain factors to determine the appropriate sample size such as the level of precision, the level of confidence or risk, and the degree of variability in the attributes being measured in addition to the purpose of the study and population size as noted by (Israel, 1992). Using formulas to calculate a sample size can provide a useful guide in determining the sample size of proportions (Amugune, 2014).

As quoted by Isreal (1992) when the population is more of heterogeneous, then there should be a large sample size in order to get a given precision level. However, if the population under

investigation is more of homogeneous, then only a relatively smaller sample size is needed for the same purpose.

Thus, the sample size of each kebele was decided according to Yamane as cited in (Israel, 1992), there is a simple formula to calculate the sample size. The formula is:

$$n = \frac{N}{1 + N * (e^2)}$$

Where n is the sample size, N = is the population size

n = the required numbers of sample

e= the level of precision.

The precision can be ±3%, ±5%, ±7% and ±10% with a 95% confidence level. Accordingly, the researcher would like to use a 95% confidence level and precision e = ±7%.

When we apply the formula, $n = \frac{939}{1+939*(0.07^2)} = \frac{939}{1+939*(0.0049)} = \frac{939}{1+4.6011} = \frac{939}{5.6011} =$

<u>167.654 ===168</u> *<u>sample</u>*s

Therefore, the required sample sizes of this study were 168 maize producer women. This sample size allotted to the three *kebeles* of the woreda based on proportionate sampling method. Though with this method each kebeles was fairly represented, proportional allocations of the sample have been made based on the size.

Through this formula, each kebeles was fairly represented as follows:

1. Sample size of Wadra Kebele =340 *168/939 = 61 women
2. Sample size of Alefa kebele =249 *168/939 = 44 women
3. Sample size of Zalima kebele =350 *168/939 = 63 women

As already mentioned above, among the target population of 939 (women farmers in male-headed and female-headed household), the researcher took 168 respondents as calculated based on the above formula. Lastly, the required sample households were selected via systematic random sampling within each kebeles, based on the lists every 1st element (i.e. every 6$^{tth)}$ until to reach the required sample size after the first respondents selected randomly.

Table 3. 1: Summary of sampled women farmers by kebeles

Sample Kebeles	Technology adopter farmers			Number of sample women farmers taken from each kebele		
	Male headed	Female headed	Total	Male-headed	Female-Headed	Total
Wadra Gindiba	279	61	340	50	11	61
Alefa Basi	198	51	249	35	9	44
Zalima	283	67	350	51	12	63
Total	***760***	***179***	***939***	***136***	***32***	***168***

Source: Field survey, 2019.

3.2.3.2. Sampling Techniques for the Qualitative Component

In this study, the participants for qualitative information were selected using purposive sampling. Participants in the focus group discussion were selected that had experience in using AM for maize production. The inclusion criteria were either having two and above years' experience in using technology or having experience in using two and more than two items of technology. Therefore, the participants in focus group discussions were selected purposively in each kebele in such a way because the researcher intended to hold one group discussion on each of the selected *kebeles*. Accordingly, five key informants and 23 focus group discussants with three groups 9 members in one group, 8 members in the other and six members in the remaining groups were taken to get acquired results respectively. Group members composition differences were due to unavailability of invited participants during discussion time. Similarly, purposive sampling was employed to select key informant interviewees: since it used to enable to select the individuals who know about the issues and specific expertise about the needed information. Hence, Key informant interviewees were selected from kebele development agents and kebele administrators (who lives and works in the kebele two and more than two years). Thus, the researcher obtained information from 3 DAs and 3 kebele Administrators. In addition, one expert from the woreda Agriculture Office; Crop production and protection technology promotion department purposively was used as a source of relevant data for this study.

3.2.4. Data Sources

The sources of data to this research was used both primary and secondary sources though the study predominantly used primary sources. Survey respondents, KIs and FGD participants were the primary data sources for this study. Secondary data sources were different relevant books, documents, journals, articles, and related research works. In line with this, Kothari (2004), indicated that using secondary data that are collecting and analyze by someone else or to written sources enable to interpret or record primary data.

3.2.5. Data Collection Instruments

In order to obtain firsthand information and to collect primary data, Survey questionnaire, key informants' interview, FGDs, and direct observation were applied whereas document review was used to gather secondary data so as to get additional information that is relevant for this study. For the primary data, collection instruments are explained as follows.

Survey Questionnaire

The structured questionnaires were prepared by the researcher composed of both close and open-ended types of questions. The questioners were designed in a sequential and clear manner to make it familiar with respondents for the sake of obtaining relevant data. The questionnaires were also tried to cover various issues to investigate information from survey respondents on demographic characteristics, technological availability and utilization, institutional services and socio-cultural situation, and also their constraints and opportunities, benefits of respondents in using AM to produce maize and the exiting IAT needs of WFs.

Structured questionnaires are those questionnaires in which there are definite, concrete and pre-determined questions. The questions are presented with exactly the same wording and in the same order to all respondents. The resort is taken to this sort of standardization to ensure that all respondents reply to the same set of questions. The form of the question may be either closed (i.e., of the type yes or no) or open (i.e., inviting free response) but should be stated in advance and not constructed during questioning (Kothari, 2004).

The survey questioner was prepared in English and translated into Amharic because respondents' local language is Amharic. Before the interview, the schedule has been administered, the draft was evaluated, and unnecessary details and vague questions were removed. The pretest was

conducted to detect the weakness in design and instrument and to provide alternative data for the selection of probability sample as well as to ensure that the items in the questionnaires bear the same meaning to all respondents and to assess the average time that is required to administer an instrument. Hence, a pilot test was carried out on 15 randomly selected WFs to ensure the validity, to avoid vague or ambiguous questions and to easily understand by the respondents. This helped to refine the questions.

The researcher and 3 enumerators and 1 supervisor, all are able to speak the local language were conducted the survey. The enumerators were first trained by the researcher about how to present and explain each question to respondents. The enumerators also advised informing each respondent regards to the purpose of the survey before starting the actual survey. Finally, a total of 168 interview schedules were administered from respondents' via gone into respondents' homestead in February, 2019 and all were returned for further analysis.

Focus Group Discussion (FGD)

Focus group discussion is a type of group interview that concentrates on an in-depth discussion of a particular theme or topic. In most cases, the group is made up of people who have particular experience or knowledge about the subject of the study or who have a particular interest in it (Kothari, 2004).

So as to get detail information that can consolidate the survey questioner, focus group discussion was implemented. The FGD is to supplement and confirm the information generate in survey questioner. The participants were selected purposively from the three targeted kebeles with one group discussants from each kebele. These group discussions were carried out with assistant note takers who were provided proper information by the researcher regards to how to organize the minutes. In addition, the FGD was conducted where the discussants preferable and comfortable place and time

As described by Gillham (2000), states that focus group discussion using semi-structured questions allows researchers to look into more deeply into the research issues and develop new lines of inquiry that arise from interviews.

Key Informant Interview

The researcher was carried out in-depth interviews with key informants they were selected purposely. In-depth interviews covered such issues as factors that challenge of women farmers and opportunities to use AM. The open-ended checklists were prepared in a semi-structured and flexible manner. The time and place for key informant interview was decided by the key informants themselves and the majority of interviews were held in the place they selected.

In relation to this, UCLA (2011) clearly indicated that key informant interviews are qualitative in-depth interviews which include a wide range of people including community leaders, professionals, or residents who have firsthand knowledge about the community.

Direct Observation

Direct observation was helped the researcher to have a better understanding of the various phenomena under investigation. Some of the phenomena that were observed in the field survey during harvesting season were that women's participation in the agricultural activities of maize shelling and plowing land by using the tractor and also using Pics bag storage to store the grain. Thus, from the observation, the researcher has understood the contribution of AM for women farmers.

In related to the above idea, Cresswell (2009), clearly stated that Personal observation was employed to get some information about the issue under investigation. Observation is a systematic process of recording a behavioral pattern of participants, objects, and occurrence without questioning the participants.

Secondary Sources

The secondary sources for this study were included books, journals, proceedings, conference papers, thesis results, magazines, newspapers, and brushers, which have direct relations to the study.

3.2.6. Data Analysis Techniques

Here, data-analysis techniques were used on the nature of the data and the type of research questions that are addressed. However, both quantitative and qualitative data analysis techniques were employed and then, a combination of data analysis methods was required and carried out

for this study. Then after, both descriptive and inferential statistics were used to analyze the quantitative data. The quantitative data analysis is a process of tabulating, interpreting and summarizing empirical and numerical data for the purpose of describing or generalizing the population from the samples. Upon completion of the data collection, the data were put in a code, edit and enter into the SPSS (Statistical Package for Social Scientists) software version 20 and analyzed to use descriptive and inferential statistics. Next, to this, the quantitative results were supported or triangulate by the qualitative result and discuss with previous studies.

Descriptive statistical tools were used to present the quantitative data. The important statistical measures that are used to summarize and categorize the research data are means, percentages, frequencies, standard deviations, and also inferential statistical methods (Chi-square test and multiple linear regression models) is used. Chi-square test employed the association between categorical variables.

The study employed multiple linear regression for the reason that the dependent variables agricultural mechanization for maize producer women farmers which is a continuous variable in the model. The independent variables include demographic, socio-cultural, institutional and technological factors as shown in the CFW in (Figure2.1). Mulitiecolinarity was cheeked using variance infliction factor (VIF) and tolerance and no violations were observed (see Table 4.9). Besides, linearity and normality were checked and no violations to the assumptions made (see Appendix 5). Model summary and ANOVA result were also calculated evidenced that the model is fitted. On the other hand, the data was summarized and analyzed what heard during the discussions into words, phrases or patterns which was also the major tasks that were accomplished in the qualitative data analysis. Hence, the information that was collected through KIs interviews, focus group discussions and observations in relation to challenges and opportunities of women to use agricultural mechanization, benefits of AM to and exiting needs of IAT of WFs were documented and analyzed textually to complement the statistical results from the structured questionnaire. In other words, thematic analysis was employed in identifying key themes and issues in each context.

As data collected in interviews and group discussions do not fall into neat categories and linking to one another, they have to be analyzed according to themes and topics being discussed by

participants (Lester, 1999). According to Clarke &Braun (2006), thematic analysis is a method for identifying, analyzing and reporting patterns or themes with sin data.

The data gathered through the interview was analyzed by using thematic data analysis technique. In general, the collected qualitative data was analyzed through narrations, descriptions and direct quotations.

3.2.7. Description of Variables and Working Hypothesis

Dependent Variable

Agricultural mechanization for maize production of women farmers: This is the predicted or outcome variable of the study. Agricultural mechanization for maize production of women farmers and multiple linear regression model was utsed to analyze this outcome variable. Because of many independent variables predict that one dependent variable on agricultural mechanization for maize production of women farmers.

Independent Variables and Working Hypothesis

Here, the independent variables hypothesize as those variables positively or negatively determine the dependent variable (AM for maize production of WFs) in the study site. Accordingly, based on the review of diverse literature and related research findings, 11 potential explanatory variables have identified as shown below.

1. **Age of women:** Age is a continuous variable measured in years. It is one of the factors that determine contribution of AM. Therefore, this study hypothesizes a positive or negative relationship between the age of women farmers and the contribution of AM.
2. **Marital status**: constitutes three marital status categories and stipulates whether respondents are married, divorced, and widowed. It is hypothesized that type of marital status was positive or negative determine contribution of AM
3. **Educational Level of women**: Education is a potentially important determinant of contribution of AM. If educational levels of women increase, simultaneously their IAT utilization also increases. Therefore, it is expected that this predictor variable positively determined the predicted variable.

4. **Availability of technology:** this refers to Presence of technology nearby for maize producer women farmers. Thus, if there is adequate availability of technology women farmres maize production will be improved. Hence, the availability of technology is expected to have a positive impact on women maize production
5. **Access to appropriate technology:**This implies the right or ability to use a resource or input to use for maize production, but not the exiting actual utilization by women maize producers. Hence, access to appropriate technology was expected to have positive impact on women farmers maize production.
6. **Utilaization of technology:** This refers to the real exting agricultursl technology using status of women farmers for maize production. A farmer with longer experience in using agriculture technologies might be more productive. Thus, this variable was hypothesized to have a positive or negative relationship with women maize production.
7. **Access to Training:** women farmers may obtain information from different source and may learn also from DA through extension program. However, unless they can obtain required skill through training, they may face problem to understand and apply maize production technology. So, those farmers who got training on improved technology are more willing than those who didn't get training. Therefore, a positive relationship was assumed between contribution of AM and availability of training.

8. **Access to credit service:** Adoption of technologies among poorer households is also inhibited by an inability to afford the technology coupled with limited availability of credit or savings, and low levels of awareness (Lemlem et al., 2011). Those farmers who have access to agricultural credit are believed to more used from AM. That is they will have higher income and use AM than those who have no access to credit. This indicates women farmers cannot finance these technologies for maize production unless they get alternative means.

9. **Access to market:** adequate market access is crucial to buy or rent IAT for maize production. The response of respondents was measured as either there is sufficient market accessibility or not. Accordingly, it was supposed to affect the maize producton of WFs positively.

10. **Gender Stereotype:** is a pathrarichal thinking of the community towards women. The negative impact on women affects their IAT utilization. Thus it was hypothesized that to determine contribution of AM negatively.
11. **Knowledge:** is a level of awareness of women farmers in relation to AM. Having knowledge was hypothesized that had positive impact on maize production of women farmers.

Table 3. 2: Description of explanatory variables in multiple linear regression model

Variables	Variable Description	Regresion out come
Age of women	Continuous variable	+
Marital status	Categorical variable 1= Married 2= Divorced 3= Widowed	_
Educational Level of women	Categorical variable:-1= illiterate,2=if women can read and write,3=if a woman has 1-4 grade, 4 =if woman has 5-8 grade and 5 =if woman are grade 9 and above	-
Availability of technology	Dummy variable: 1=Yes and 0=No	+
Accessibilty of appropriate technology	Dummy variable:1=Yes and 0=No	+
Utilaization of technology	Dummy variable: 1=Yes and 0=No	+
Access to Training	Dummy Variable: 1=Yes and 0=No	+
Access to credit service	Dummy Variable: 1=Yes and 0=No	_
Access to market	Dummy variable: 1=Yes and 0=No	+
Gender Stereotype	Dummy variable:1=Yes and 0=No	_
Knowledge	Dummy variable: 1=Yes and 0=No	_

3.2.8. Issues of Validity and Reliability

So as to assure the reliability of this study, a reliability test was carried out. Thus, some respondents were selected for pre-testing and piloting. This was because it helps to identify questions that don't make sense to participants/feel uncomfortable or problems with the questionnaire that might lead to biased answers.

Pre-testing and piloting are helpful to test hypotheses, allowance for checking statistical and analytical procedures, a chance to reduce problems and mistakes in the study as well as the reduction of costs incurred by inaccurate instruments (Isaac, S. and Michael, B., W., 1995).

Moreover, to ensure the reliability and validity of the result of this research, the study triangulated with the findings through FGDs and key informant interviews. As well, the findings and results of this study were interpreted in relation to the review of the related literature and previous research studies for the purpose of analytical generalization. Above all, the use of mixed research approach has increased the validity and strength of the result of this study in which the data that was gathered through qualitative data collection methods was a supplement to the statistical data.

3.2.9. Trustworthiness for Qualitative Section

For the sake of ensuring trustworthiness, the researcher has employed data triangulation for ensuring reliability, while the researcher has employed a rich and deep explanation to convey the finding by examining evidence from the sources and utilizes it to construct a reasonable explanation for themes, which has been provided by the researcher to ensure transferability. After a deep discussion with them, the researcher got their approval on what they said. However, the researcher also made a little amendment on the result part that did not get member approval. In addition, take notes were made during interviews, observation, and discussions to consolidate the study found.

3.2.10. Ethical consideration

The researcher was agreed to comply with the following principles which was a means for protecting the dignity and privacy of every individual who was in the course of research work carried out under the study, request to provide personal or commercially valuable information about him/herself or others (hereinafter referred to as a subject of research), these are FGD, KII participants. The respondents were notified on aims, methods, anticipated benefits and potential hazards of the research his/her rights to withdraw from participation in the research. The information gathered from the respondents will also keep confidential and it will never reveal at all.

Moreover the researcher was firstly provided a formal supportive letter which was written from Bahir Dar University, Gender and Development Studies department with detail explanation of the purpose of the research to communicate key informant interviewees. In addition, the researcher has taken permission letter from Burie Zuria Woreda Agriculture Office.

FGD participants were asked their willingness to be involved in the study. They were also informed that the identity of the participants should not be written in the study document. Further, in order to express their words with confidence suitable places, date and time was chosen according to their suggestions. Similarly, key informants were contacted by showing the letter of cooperation, which was written by the Department of Gender and Development Studies, Bahir Dar University with the explanation of the purpose of the study.

CHAPTER FOUR

RESULTS AND DISCUSSION

Basically, this chapter deals with the analysis, interpretation, and discussion of results obtained from the sample survey through questionnaires, focus group discussants and key informant participants. A total of 168 questionnaires were distributed and the whole questionnaires were completed for further analysis. Accordingly, the first part of this analysis presented maize producer women farmers demographic characteristics whereas the second part provided detailed analytical elaboration on benefits they enjoyed from AM. The third was opportunities of women farmers to use AM. The fourth explores the challenges of women farmers in using technology in the study site followed by the fifth discussion on their existing technological needs of women farmers in the study site.

4.1. Respondents Demographic characteristics

Description of demographic characteristics would give some basic information about age, marital status and educational level of respondents. Since demographic characteristics of a given population have their own implication and relation with a particular study i.e. using AM to produce maize, having a description of them were so vital.

The study carried out by Dereje et al, (2016) confirmed the above statement as although the use of improved inputs in production is desirable and very important, not all farmers use the improved agricultural inputs due to various reasons. These reasons broadly categorize the factors that influence farmer use of improved inputs as demographic characteristics, institutional factors, and characteristics of the input/technological factors.

4.1.1. Age category of the Respondents

This study was carried out on 168 WFs involved in maize production in the study area. As it is indicated in Fig 4.1, there were four age groups of WFs. Of the total respondents, about 42.3% were between 31-40 years old, 26.2% were between 20-30 years old, 24.4% were between 41-50 and 7.1% were over 50 years old. The result revealed that age of the respondents' falls into the

adult age of labor force. Thus, the highest working force, especially in agriculture sector, is believed that in this range regards to researcher knowledge.

In line with the survey result, empirical studies also evidenced that age has been found to have a significant influence on women farmers production increment which motivated them to use agricultural technologies. Dereje *et al*., (2016) agreed that, young farmers are thought to be more open to change and hence eager to try out new ways of doing things, thus the relationship between adult age and using improved inputs are stronger. Regards to the issue OTU W. IBOK *et al*., (2015) stated that young people are very active on the farm and more responsive to agricultural extension programmes. This could lead to a boost in agricultural activities. According to Tesfaye & Alemu (2001) level of education is significant influence to the adoption decision of improved maize and chemical fertilizer.

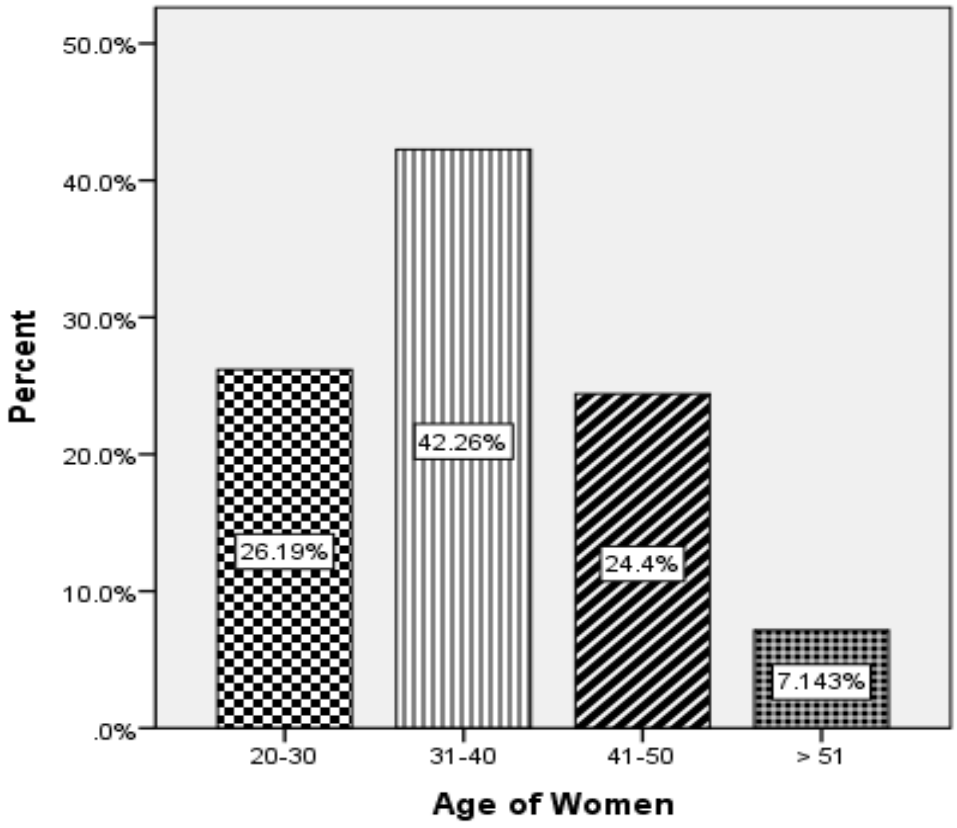

Figure 4. 1: Distribution of respondents' response based on their age characteristics

Source: Obtained from survey data, 2019

4.1.2. Marital Status of the Respondents

With regard to marital status, the majority of the respondents (81%) were married women, 11.3% were widowed and the remaining 7.7% were divorced (See Fig 4.2). From the result, it can be concluded that majority of the respondents concentrated on married marital status and the remaining were widowed followed by few divorced. The FGD participants and KIIs were argued that male-headed household (married women) are using IAT better than women headed household (widowed and divorced women).

This was because men are near to information and they can access improved agricultural technologies easily than women farmers as FGDs pointed out.

> ---------- *the man has the experience of going to outdoors to a cooperative or other institution or service provider. It is the man who cares in a turn, paying for a rental fee as a salaried to service provider association when we need services. We were able to do this, but how can we be treated as men?*

From empirical evidence, for instance, Dereje *et al.,* (2016) confirmed the result that a higher proportion of male-headed households than female-headed households used different agricultural inputs and technologies in agriculture. The higher probability of male-headed households using inputs and technologies in maize production than female-headed households may be related to economic status and/or level of information access by households.

Similar with the above result Nigussie *et al.,* (2014) clearly showed that male headed households own more of productive resources such as land, livestock, labor and other agricultural inputs as compared to female headed households. Uwandu, Chisom Norberth *et al*., (2018) in their side revaled that marital status is associated with agricultural information use.

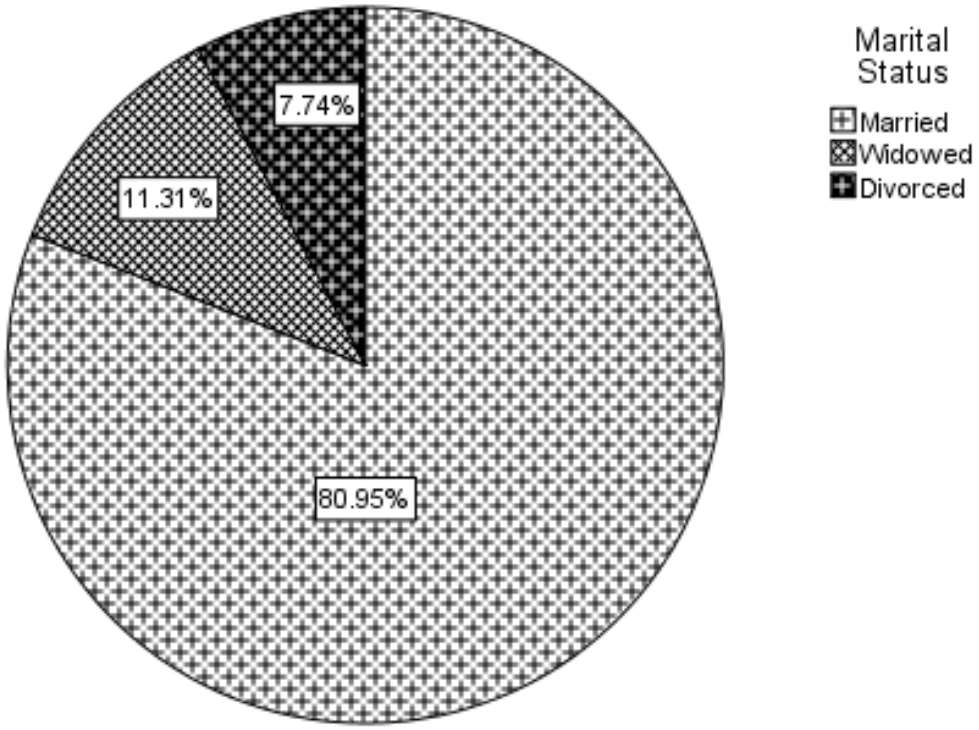

Figure 4. 2: Distribution of respondents' response based on their marital status

***Source*:** Obtained from survey data, 2019

4.1.3. The education level of Respondents

Education enables the individual farmers to know how to seek for and apply information on improved farm practices. An illiterate farmer is generally apathetic, and lacks choice of improved technologies (Uwandu, Chisom Norberth *et al*., 2018).

Table 4. 1: Educational Background of the Respondents'

Demographic Factors	Categories	Frequency	Percentage (%)
Education level	Illiterate	71	42.3
	Read and Write	39	23.2
	1-4 grade	27	16.1
	5-8 grade	23	13.7
	grade 9 and above	8	4.8
	Total	168	100.0

***Source*:** Obtained from survey data, 2019

The survey results in table 4.1 revealed that 42.3% of the respondents were illiterate, whereas about 23.2% of the respondents could read and write, 16.1 % had primary education (1-4) and in a similar manner 13.7 % primary full cycle completed and a small number of respondents 4.8% had secondary education or above respectively. Focus group discussants reported that women's capacity to adopt technologies was constrained by their low literacy level implying the need for promoting functional literacy for women farmers. Better literacy seems to have helped the respondents to wisely adopt ASAM.

In line with the result from FGDs the study carried out by Tesfaye & Alemu (2001) was confirmed that education is basic to adopt new technologies. Level of education is influence the adoption decision of improved maize technologies. The exposure to education increases a farmers' ability to obtain, process, and use information relevant to the adoption of improved technologies. The level of education tended to be highly associated with die adoption of improved technologies. On the other hand inconsistent with the above empirical data the level of education might not have influence on the adoption decision of farmers to use IAT.

4.2. Technological and Related Characteristics

4.2.1. Accessibility of Appropriate Technology

Improved technologies are vital for agricultural production increment. As can be shown from table, more than half of the respondents (72.6%) responded that there was no adequate availability of ASAM for maize production. While a small number of the respondents (27.4%) expressed that there was the availability of ASAM. Regrads to IAT utilization trend and women farmers, 87.5% of respondants have agood trend to use IAT and the remaining 12.5% were have not good trend meaning they might be on and off in using different technologies (see table 4.2.)

In order to see the association between technologies accessiblity and AM for maize production of women farmers, chi-square test was employed. The result showed that the association between technologies accessiblity and w AM for maize production of women farmers was statistically significance association at $p<0.05$, X^2 (1) =14.386, p=0.000. Like wise the chi-square test was employed to see the association between between appropriate IAT utilization trend and women farmers maize production. Thus, the result showed that the association between appropriate IAT

utilization trend and women farmers has statistically significance association at p<0.05, X^2 (1) =21.741, p=0.000(see Table 4.2 for both cases).

From the result, it can be concluded that there were not adequate accessebility of technologies for better maize production in the study area. This implied that the absence of appropriate technology for women farmers in the study area was constrained the probability of improving maize production. The FGDs and KIIs argued on this idea. The finding shown in table 4.2 was supported by group discussants and key informants of this study (FGD 1).

> *---------from the problem of lack of adaptation technology, shortage of supply is the first-line for us. There is only maize sheller in our kebele. Therefore, when we want to use it, the turn is too much. The other is that the grain storage Pics bag is not easily found nearby, and the cost price of the bag is expensive. Therefore, we should keep only the maize we use for home consumption only without having chemical, not for all product. The remaining will be stored in local storage called 'Gotta" by adding a chemical. Moreover, grain in the local storage requires repeated checkup and adding chemical. This responsibility is given to women as well as it requires extra time and labor. The third is the shortage of tractor supply and the higher the price of its rent. Therefore, it is more accessible and used by only high-income farmers but households with a low-income including women headed household faces difficulty to use it.*

On this regard, one key informant participant from kebele Administrator asserted the information as narrated below (KIIs, Code 6).

> *It is possible to say that there is nothing in our kebele. This is because the service provider comes from other kebeles, both at the institution or the individual level. Both tractor and maize sheller ownership are difficult to say is our kebele resident, but Women farmers are using the service within its constraint. When service providers bring technology from another place to our kebele, female farmers can obtain information through their Development Army and use the service.Thus, technology utilization trend in our kebele is good but the problem is lack of adequate availability and accessebility.*

Table 4. 2: Adequate availabilities and Utilization of appropriate technologies

Variables discerption	Options	Frequency	Percentage (%)	X^2	df	P-value
Technologies accessible	Yes	46	27.4	14.386	1	.000
	No	122	72.6			
Approprate IAT Utilization trend of WFs	Yes	147	87.5	21.741	1	.000
	No	21	12.5			

***Source*:** Obtained from survey data, 2019

On the other hand, a single table was created based on respondents' responses to a variable (i.e. adequate Availability and accessibility of improved plow/tractor, planter, maize Sheller and storage). Accordingly, as far as adequate availability and accessibility of improved plow/tractor, the table demonstrates that more than half of respondents (54.8%) did not have the accessibility of improved plow or tractor and replayed that as there was no improved plow nearby to use. On the contrary, about (45.2 %) of the respondents had plow/tractor accessibility (see table 4.3).

Consistent with the survey data One of FGD participant (FGD 1, Code 1), for example, said something regards to plowing/tractor,

> *I was planned to plow my farm this year. But I did not have access to use it because the service provider has a lot of orders at the same time from different kebeles and even from our kebele. So, I forced to get plowing my farm by using my oxen. This requires too much time and effort.*

This research finding is also consistent with Tesfaye & Alemu (2001). They found out very few farmers are used improved farm implements. The reasons for not using improved farm implements are unavailability of the implements. This implies that a concerted effort has to be made by concerned institutions to develop and distribute the required appropriate farm implements in order to facilitate the adoption process of improved farm implements in an area where needed.

Amazingly, regards to the planter, all respondents (100%) had no planter accessibility and no one respondent responded as there was a planter in the study site (see table 4.3). In relation to the survey result the study cascaded by ARARI (2016) confirmed that maize production is

constrained by traditional method of production and the low-level of new technology use. Sowing is one of the basic operations needed to get better revenue from agriculture, as recommended by the agronomists. Also, there is a problem of placing the seeds at correct depth and correct soil coverage. This leads to higher intercultural operation costs.

In the case of maize sheller (see table 4.3), a significant number of respondents (56.5%) expressed that as there was adequate availability of maize sheller and it was accessible for them. Likewise, focus group discussants result indicated that the maize sheller was accessible for the majority of respondents. WFs who responded as maize sheller was available in survey questioner and FGDs, those were who get the technologies from ASMC project and agriculture office freely and the others were in the kebele where rental maize sheller was available.

One focus group discussant (FGD 2, Code 14) also shared the following information,

> *Especially in this year, we can say that improved technologies were available and accessible for us. Thus, improved plows, yoke, and maize sheller are available in our area those helps women farmers to produce maize. For the first time, we got these the above mentioned technologies, especially from the Bahir Dar University; ASMC project, and we were got the service by the project freely as well as the kebele agricultural expert is facilitated the situation of using free service.*

Similar with FGD information, the key informant interview also confirmed the result. One of the interview idea (KII, code 3) is pointed as follows.

> *As a kebele level there is scarcity of agricultural technologies. However in this year few farmers especially women farmers have got maize sheller service from Bahir Dar University; ASMC project without payment. The project brings the sheller to our kebele and provide shelling service for few farmers freely.*

The remaining 43.5% (see table 4.3), were responded as there was no adequate availability of maize sheller in their locality or kebele. The qualitative result from informants and discussants also confirmed that the lack of adequate availability of sheller has a serious problem for women farmers of the study area. From FGDs (FGD 3 participants) were reported the following points.

There was one maize sheller in our locality which was for the farmer training center, however at this time it is not functional, and the owner is not make maintenance to it. Thus, from technologies we are using now, many of them including sheller are private machines that come from another place. There is no adequate availability of maize sheller in our kebele. Thus, we forced to use rental sheller comes from another place. It had its own limitation including lots of turns to use it. Since it comes from a way the cost also increased in this year and challenges us to use as we need.

As presented in the above table (see table 4.3), from all participants 79.2% of the respondents had no accessed to storage. The only 20.8% of them are accessible for the Pics bag; types of storage. The survey result was supported by FGD participants. One FGD participant (FGD 1, code 5) expressed her filling as follows.

Frankly speaking, it is difficult to say there is grain storage availability sufficiently in our area. Even though I purchased a pics bag for maize storage, it was from individual merchant seller there for it is so expensive. I have bought 5 Pics bag in which I spent 45 Ethiopian birrs for each sack and it is difficult for me to have a more additional sack to store all maize I had. Thus, I have store maize only for home consumption. And I stored the remaining grain in local storage called "Gotta" by applying chemicals. So, storage is not available in our area to access it easily.

The study carried out by Befikadu (2018), concludes that Storage problem is one of the serious problems in Ethiopia in general where the majority of post-harvest loss arises. Post-harvest losses for staples in Ethiopia ranges from 10-50%, which is very high in a country where a large number of populations is suffering from food insecurity. For instance, the post-harvest losses storing maize grain for the period of 2-12 months in a country ranges from 11-100% which is very ironing. Poor storage facilities and harvest mechanisms contribute many losses to Ethiopian grain produced. Store their crops simply in polyethylene sack and put in their own living or part of the house constructed for their animals and 28.30% store in a traditional unprotected and unsafe storage called "*gotera*".

Table 4. 3: Adequate availabilities and accessibility of appropriate technologies

Technological Factor	Variables	Options	Frequency	Percentage (%)
Availability and Accessibility of differet Technologies in the study area	Adequate Availability and accessibility of improved plow/tractor	yes	77	45.8
		no	91	54.2
	Adequate Availability and accessibility of planter	Yes	0	0
		no	168	100.0
	Adequate Availability of and accessibility maize Sheller	yes	95	56.5
		no	73	43.5
	Adequate Availability and accessibility of storage	yes	35	20.8
		no	133	79.2

***Source*:** Obtained from survey data, 2019

4.2.2. Frequent Uilization of Appropriate Scale Agricultural Mechanization

Experience of the respondents in using technology frequently indicates that the most significant number of response, 68.5% were repeatedly used, maize sheller. The remaining 17.9% and 13.7% were used plow/ tractor and storage respectively. For general speaking, approximate to three quarters (68.5%) of WFs in the study areas were used maize sheller (see table 4.4).

Table 4. 4: Percentage distribution of respondents' response to repetedly used technology.

Variable	**Categories**	**Frequency**	**Percentage (%)**
Frequent utilization of technologies in tyepe	Plough/tractor	30	17.9
	Sheller	115	68.5
	Storage	23	13.7
	Total	168	100.0

***Source*:** Obtained from survey data, 2019

From the result, it can be concluded that women farmers are interested and more experienced in using maize sheller even though there were not adequate availability. This was because there was a high level of maize production in the area and not damage farmers hand or finger, this was

what the researcher confirmed during field observation. Moreover, (KII, code 5) confirmed this idea as follows.

> ---------*women farmers are using the IAT within its constraint. This is because in our kebele maize production is very high. Thus, it is difficult to shell manually. Regard to this women farmer is motivated to use maize sheller to accomplish the shelling activity within short period of time. So they do this even though there is a large turn to get the service.*

In the study area, most women farmers used maize sheller because of its enormous benefits including the absence of damaging their hand figure. This research finding is supported by empirical studies, for instance, Dagninet (2017) in his study revealed out maize sheller has minimum damage and loss to the kernels, it is more efficient compared to direct hand shelling, it reduces work tedium and finger soreness and required no special skills. The Shellers avoid damage to palms and fingers and save their time. Further, in traditional methods maize is mostly shelled by women and children. However, the Sheller removes this demarcation and all family members can participate during different occasions when they are idle in their home. Even at the coffee ceremony, the thresher can use to shell both by male and female without any isolation. At all the Sheller avoids drudgery and saves their time reasonably.

As can be understood from the table demonstration, it can be concluded that tractor and storage utilization experience of women farmers were limited. This was because of different problems like lack of adequate availability and accessibility of improved agricultural technology.

On the other hand, based on respondents' responses a single figure was created to see to utilization of IAT with their marital status.Thus, when we see the technology utilization percentage distribution by respondents' marital status, a significant number of married WF respondents (73.5%) were used maize sheller, while a small number of the respondents 14% and 12.5 % married WFs used the storage and plow/tractor respectively. On the other hand, 69.2% of divorced women were used maize sheller, and on the other side, 15.4% and 15.4% divorced WFs used plow/tractor and storage equally. The survey also demonstrates that half of widowed WFs

(57.9%) were used plow/tractor to produce maize. The remaining 31.6% and 10.5% widowed WFs are experienced in using sheller and storage respectively (see fig 4.3).

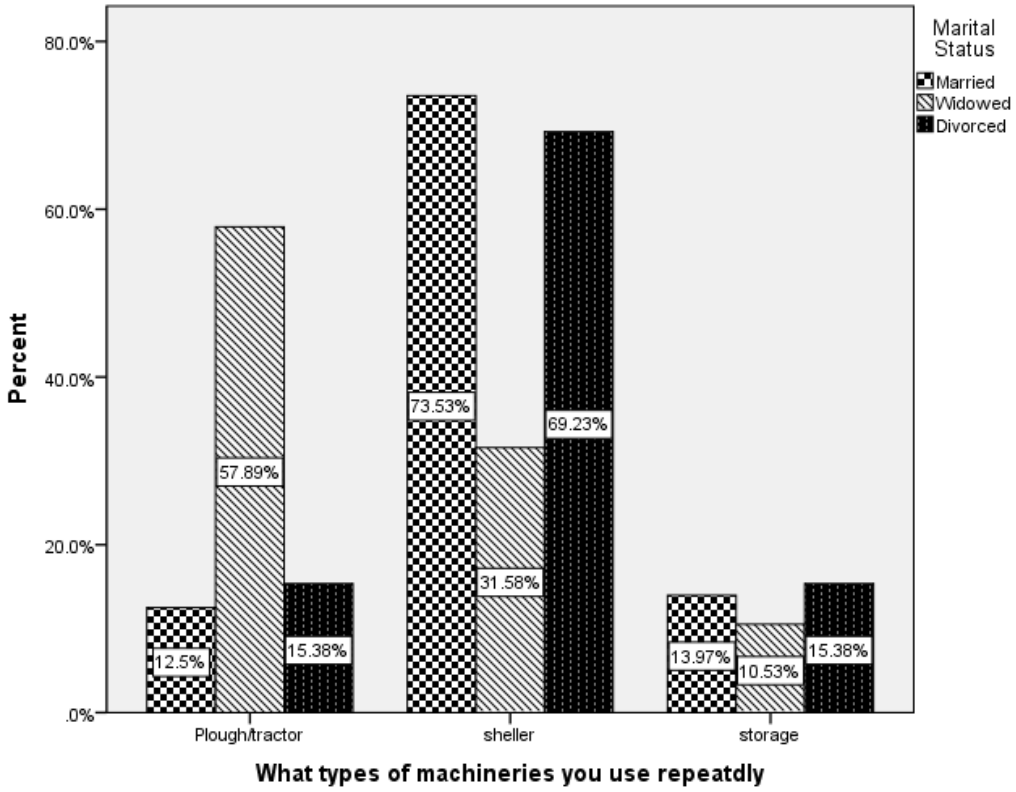

Figure 4. 3**:** Repeatedly used Agricultural Technologies based on their marital status

Source: Obtained from survey data, 2019

In addition to this, as can be understood from the figure demonstration, widowed WFs were used plow/tractor dominantly, married and divorced WFs were used, maize sheller. From the result, it can be concluded that majority of the respondents from all marital status group used maize sheller and very few respondents from all group used storage. Thus, when we see the predominant technology which was used by WFs is maize sheller followed by plow/tractor and storage respectively. The qualitative result from informants and discussants also confirmed that those widowed women were experienced in using plow/ tractor. Here again, informants of this study gave emphasized that the tractor is preferred by widowed women of the study area (KII, code 6).

------tractor is used by women farmers especially for women headed household. Because they cost a great deal of money for the laborers to plowing land. In order to produce maize, it needs plowing land repeatedly. Thus, it is costy and spend a lot of money to plowing land by using daily laborer, including five days of cooking food for them. But if once they plow land by using tractor, they only want to plowing land during sowing. So, the tractors are very useful for short-term handling of the land. Thus, they are mostly using this technology.

Bhasin (2002), finds out that agricultural productivity can be improved either through the development and adoption of new technologies or through the efficient use of the existing technologies without damaging the natural resource base. The mechanization of farm operations is a very important step toward increasing production efficiency.

4.2.3. Ownership of used technologies

The data presented in table 4.5 illustrates that among the technologies used in the study area, rental technologies account the first rank followed by gifted technologies and finally very few WFs used their own technologies like tractor and sheller. As can be shown from the table 4.4, a significant number (72%) of respondents were used rental technology, while the remaining 21% and 7% of respondents were used gifted and their own technology. From rental technology user WFs, 41.7% respondents used from Farmer unions, from private owners 'consist 29.2% and agriculture office in its side contributes 3.6% service provision for WFs. On the other side, respondents who said "No Gift" (25.6%) got the technologies either through gift or it was for their own (ses table 4.5).

This table demonstration also depicts that there were WFs who used the technologies from gift and even few of them had their own. From those WFs, 10.1% of respondents were gifted technology from BiT, ASMC project followed by gifted from agriculture office (7.7%) and neighboring (3%). On the contrary, respondents who said, "No Gift" (79.2%) (see table 4.4) got the technologies through rent either from farmer unions, agriculture offices or private ownership and it will be for their own.

Table 4. 5: Percentage distribution of respondents' response to technology ownership

Categories	Options	Frequency	Percentage (%)
Ownership of Used technologies	Their own	12	7.1
	Rental	121	72.0
	Gift	35	20.8
	Total	168	100.0
If rental, from whom	Agriculture office	6	3.6
	private owners	49	29.2
	Farmer unions	70	41.7
	NO rent	43	25.6
	Total	168	100.0
If a gift, from whom	ASMC project	17	10.1
	Neighboring	5	3.0
	agriculture office	13	7.7
	No gift	133	79.2
	Total	168	100.0

***Source*:** Obtained from survey data, 2019

From the result, it can conclude that majority of the respondents were used rental technology. In other hand, BiT, ASMC project takes the lion part by giving free services for maize producer Women farmers. Along with this the project also provided technologies for WFs without fee, like improved plow and yok. The qualitative result from informants and discussants also confirmed that the project delivers different types of technologies to WFs in the study area. In addition to this statistical data, focus group discussants (FGD 2, code 2) also conveyed the qualitative information as outlined below.

> *Currently, we are receiving rental maize sheller from Farmer union, private ownership and agriculture office in our area or nearby. Moreover, thanksgiving to Bahir Dar University and DAs, some of us have received maize sheller service from ASMC project freely; the university bring the sheller to our home and shell our maize. In addition to the maize sheller, we are using improved plows and yoke and even solar Maji pump*

technologies with gaining training on improved machines and its utilization from BiT; ASMC project. The project provided us all the technologies and services without a fee. In collaboration with the university, DAs has works to increase our awareness by providing training about the technology usage and provided follow up to use the technology for different additional production like growing vegetables and seedlings.

According to Burie zuria Woreda Agriculture office (2018) farmers are used different improved agricultural mechanization. There are technologies in the wereda which helps farmers to improve their productivity. The problem is that scarcity in its item and quantity. Most of the farmers used the tractor and maize sheller from farmer unions and private service providers respectively. However some times some farmers specially model women farmers received gifted technologies from different NGOs and projects like Feed The Future and ASMC project as a demonstration.

4.3. Training and Information source for Women Farmers to Agricultural technology

4.3.1. Training

As presented in Table 4.6, less than half of respondents (48.2%) had access to technological training, while the remaining participant (51.8%) of the respondents hadn't access to technology-related training. To prove the association between training access and women farmers chi-square test was run. The result showed that the association between training access and women farmers was statistically significant association X^2 (1) =11.065, p=0. 001 (see Table 4.6).

Table 4. 6: Percentage distribution on training access

Variables discerption	Options	Frequency	Percentage (%)	X^2	Df	P-value
Training access	Yes	81	48.2%	11.065	1	.001
	No	87	51.8%			

***Source*:** Obtained from survey data, 2019

In addition to the above, a single table was created to see from whom women farmers get training. From the respondents who had access to training 51.2% were from DAs, 10.1% were from ASMC project, and the remaining 8.9% had access to training from woreda agriculture office respectively (see table 4.7). From the result, it can possibly argue that development agents

followed by BiT, ASMC Project was better than other institutions to provide training for women in the study areas. In other speaking, DAs were on delivering different trainings for women farmers since they were near to the community in the study area.

Table 4. 7: Percentage distribution of respondents' response to training providers

Variables	Options	Frequency	Percentage (%)
From whom you get the training	Das	86	51.2
	ASMC project	17	10.1
	woreda agriculture office	15	8.9
	from self-experience	50	29.8
	Total	168	100.0

***Source*:** Obtained from survey data, 2019

On the other hand, out of the respondents who were reported as "From self-experience" were 29.8% and it was because they were not received training from individual experts or institutions (see table 4.7). This was due to different problems with them like gender stereotype or cultural myth. In relation to this statistical data, one of the focus group discussants (FGD 3, code 18) also clearly reflected the qualitative information during the discussion time as presented below.

> *Related to gender stereotype one of the things that can hurt female farmers in using the technology in our culture which is the community tradition. Often, men are outdoors for everything. Our husbands do not want us to go out, it's very unlikely to go out because they can't help us in domestic activities. Women farmer who is not involved in training may not be able to use technology in any way. Local habits for training included or motivated men, not women.*

The result was strengthened by Fink (1992) women do the majority of work in agriculture at the global level, elder men, for the most part, still own the land, control women's labor, participate in different trainings and make agricultural decisions like using agricultural technologies in patriarchal social systems. It has also been pointed out that it legitimated the subordination of women.

Agreeing with the above evidence Marshall (1994) in his counterpart stipulated that modern changes were all gendered. The nuclear family was one in which women and men had different roles and spheres of activity. Hence, the transition from traditional to modern did not mean more equal gender relations, neither in the sense of sameness nor equal worth. On the contrary, as women were confined to the private, excluded from the public realm and economically dependent, their subject position became unrecognized.

The training of rural women is very important, especially with the adoption of modern agricultural techniques that are tailored to local conditions and that use natural resources in a sustainable manner, with a view to achieving economic development without degrading the environment. Women are not perceived as 'farmers' even when they do most of the farm work. As a result, agricultural extension and information on new technologies are almost exclusively directed to men, even when women are increasingly responsible for farm work (Kelkar, 2011).

4.3.2. Information source

Uwandu, Chisom Norberth *et al.,* (2018) opined that agricultural information creates awareness among farmers about agricultural technologies for adoption. Information is the first and indispensable step of an adoption process. The characteristics of a good information source are relevance, timelessness, accuracy, cost effectiveness, reliability, usability, exhaustiveness and aggregation level.

Women farmers obtained different information about ASAM from various source. The finding of the study indicated that (see fig 4.4) out of the total respondents more than half (58.3%) of them got information from Developmental Agents (DAs). Next, to DAs, neighbors (36.9%) had played a great role to inform women farmers to use agricultural technology. ASMC project (3%) and other (1.8%) were from self-experience regarding the presence and importance of technology for maize production.

In comparison, DAs in the study areas/districts had taken the lion's share of the source of information for WFs to use ASAM. During the group discussion participants revealed that WFs got information from BiT, ASMC project that project has played a role for women farmers in many areas like adopting and adapting appropriate agricultural technologies, small irrigation

through solar Maji pump and cascading experience sharing with other its intervention woredas eg Dangila and Bahirdar Zuria woreda.

Beyond this, focus group discussants reflected the qualitative information from their points of view with respect to the information source for WFs as described below (FGD 3).

> *We get information on how to use ASAM from kebele development agents and agricultural experts from woreda through seminars, workshops and trainings and also from neighbors. In addition to these we also get information about improved technologies like improved plows, yoke, and maize sheller those are available in our area from the Bahir Dar University, ASMC Project.*

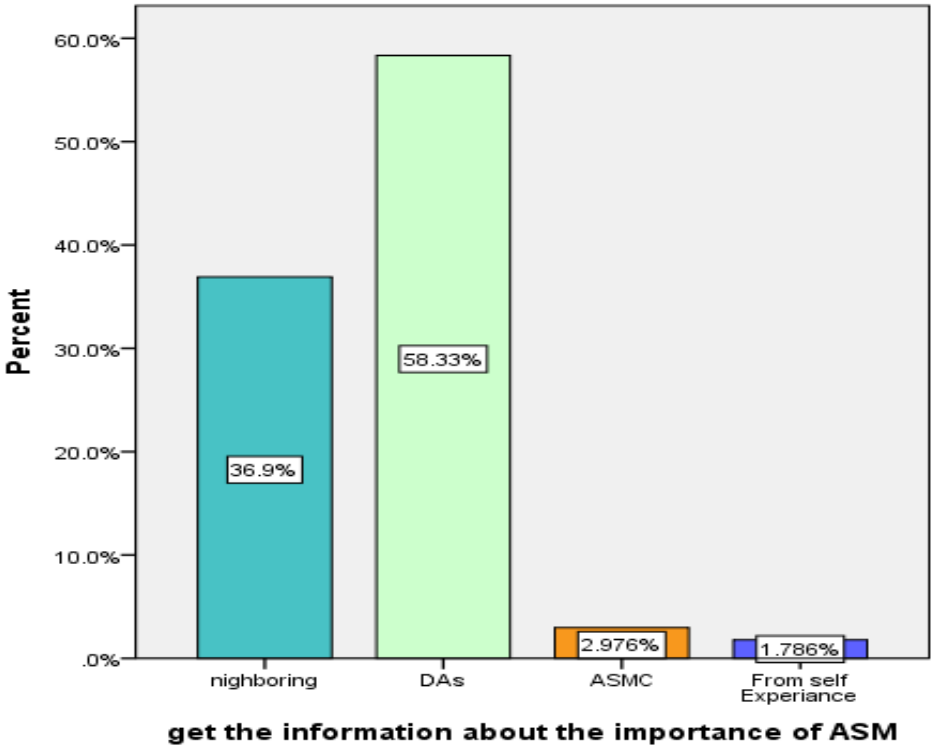

Figure 4. 4: Distribution of respondents to the information source

***Source*:** Obtained from survey data, 2019

Similarly, as it was stated by key informants, the information related to technology was introduced through different ways for different communities in the study area. For instance, key informants (KII, Code 1) revealed the information as follows,

Information regards to appropriate technology is diffused for female farmers by preparing various training for the community. Like creating awareness in different forums and model trained farmers were also shared their experience by attending in different training In addition, different trainings are also prepared and given to women farmers separately. Especially, regards to pics bag storage one NGO called Feed The Future provided 50 pics bag to Agriculture office within free cost for the purpose of exemplary. Thus, we create motivation for female farmers to use it by preparing a demonstration and describing its importance. This was done by giving for model farmers and make them demonstrate the storage for their neighbors. As a result, women farmers start using the bag by buying from a private provider.

Based on the result from the above, it was possible to conclude that access to information for the increment of women farmers IAT utilization is critical. There were also empirical studies' results which were agreed with the findings of the current study. For instance, Tamrat (2016) and UCLA (2011) in their study stipulated that the main information sources for farmers were DAs, mass media, research centers, other NGOs, and neighbors.

According to Oladele (1999) cited by Uwandu, Chisom Norberth *et al.,* (2018), the efficiency of technologies generated and disseminated depends on effective communication which is the key process of information dissemination.

Yahaya (2001) cited by OTU W. IBOK (2015) posited that women are less likely to participate in sourcing for agricultural information and utilization because they have limited time to access or utilize available information due to pressure of household responsibilities. Tesfaye Zegeye and Alemu Haileye (2001) agreed with the issues regards to access to extension information. The probability of adopting improved technology increased for who had access to extension information.

4.4. Opportunities of WFs in Using ASAM

There were a few opportunities, which can help WFs to use ASAM in the study area. Table 4.8 shows opportunities for WFs in using an appropriate scale agricultural mechanization. According to the data, generally, the majority (63.1%) of respondents has an opportunity to and utilizes ASAM, whereas 36.9% have no opportunity of access to and use the ASAM. Likewise,

the findings indicate that WFs have an opportunity of technology using experience in their kebele (57.1%), Availability of extension service (50.0%), High-level production (56.5%), Presence of free service or gifted technology (47.0%). The remaining respondents in each variable were responded as there were no opportunities. As it can be shown from the table, some respondents argued as WFs had no an opportunity of technology using experience in their kebele (42.9%), Availability of extension service (50.0%), High-level production (43.5%), Presence of free service or gifted technology (53.0%).

Table 4. 8: Opportunities of Women Farmers in using ASAM

Variables	**Options**	**Frequency**	**Percentage (%)**
Good opportunities that could enhance to use ASAM?	yes	106	63.1
	no	62	36.9
	Total	168	100.0
Technological using experience in the kebele	yes	96	57.1
	no	72	42.9
	Total	168	100.0
Availability of extension service	yes	84	50.0
	no	84	50.0
	Total	168	100.0
High-level production	yes	95	56.5
	no	73	43.5
	Total	168	100.0
Presence of free service or gifted technology.	yes	79	47.0
	no	89	53.0
	Total	168	100.0

***Source*:** Obtained from survey data, 2019

As we can understand from the table demonstration, more than half respondents responded there was no opportunity related to free service or gifted technology this was because BiT, ASMC project provided free service for limited WFs in the study area as well as Agriculture office provided free service for few model farmers only.

The opportunities were discussed based on the data obtained from participants through survey questioner. In this regard, even though women farmers encountered a dozen challenges, there is

also an opportunity for them to use the technology. Thus, in addition to this statistical data, focus group discussants (FGD 2, code 16) also conveyed the qualitative information as outlined below.

> -------*from opportunities of women farmers to use appropriate technologies in our locality, the existence of maize sheller from cooperative which helps us to use it through rent even though it is not adequately accessible. Especially in, this year, we enjoy the service free of charge from Bahir Dar university; ASMC project. In addition, although it was for a few farmers, Agriculture office also provided free service. The other opportunities are consecutive training and awareness raising programs by DAs for women farmers. The other thing is that our maize production is high and more than other crops, so it forced us to use the technology because to do this manually it is difficult since it needs more time and labor.*

Similar to focus group discussants, one key informant participant (KII, code 5) also pointed out that.

> *The opportunities for women farmers to use technology are that they have awareness, created in different trainings on different occasions through agricultural extension services. The kebele by itself is also more potential for crop production especially for maize, so it is a convenient place to use. Thus, this high production potentiality of the kebele motivated the community to use the technology and a lot of farmers were used different types of technology in consecutive years. From these farmers, women who haven't husbanded also included.*

From empirical evidences, the above data is evidenced by the study of Gerry (2002) as she stipulated that where potential for increased production is available, so that larger farmers may demand labor saving technologies. Thus, high level of production motivates farmers to use improved technologies.

The result is agreed with the information of Burie Zuria Woreda Agricultural office (2018), the report which showed that in the woreda there are different opportunities for farmers to improve their production. From those, presence of development agents and a cooperative union at Kebele level are the first and they are willing to support the farmers. The other is seed and fertilizer availability to farmers and irrigation system is also available, better market access because roads are improved almost in all kebeles of the woreda. In the woreda, there is also

agricultural mechanization like water pumping technologies, tractor and maize sheller. Capacity building institutions (university, agricultural colleges, and farmers training centers and projects) are willing to support the initiative. The woreda is also productive in which farmers are experienced in using agricultural technology. The report further elaborated women farmers have access to extension service, technologies, and capacity building training proportionally.

The other evidence is from Bahir Dar University, ASMC Project (2016), the sustainable intensification of agriculture offers smallholder farmers huge opportunities in the Amhara region of Ethiopia. The introduction of locally-adapted technologies has the potential to raise incomes and nutritional security, reduce drudgery and empower women and youth. Developing technologies, however, is not an end in itself. Much of the consortium work will focus on how to build local capacity to ensure the sustainable implementation of new and adapted technologies. Hub facilities are available to reach out to farmers, particularly women farmers. Farmers will attend train-the-trainers courses, and opportunities for farmer-to-farmer learning will also be facilitated.

4.5. The Determinant Factors on Agricultural Mechanization for Maize Production of Women Farmers

Multiple linear regression analysis was employed to show the relationship of dependent variable on agricultural mechanization for maize production of women farmers and a set of explanatory variables. Eleven explanatory variables were selected to explain the dependent variable. However five variables (marital status, availability of technology, utilization of technology, access to credit service and knowledge) were significant predictors at $P < 0.05$ agricultural mechanization for maize production of women farmers. While age of women, education level of women, training access, access to technology, gender stereotype and access to market showed insignificant influenced agricultural mechanization for maize production of women farmers in the study area(see table 4.9).

The model summary showed that all independent variables entered in the model explained 85% of the total variations of agricultural mechanization for maize production women farmers. The

ANOVA result showed that there is a strong linear relationship between the dependent and explanatory variables at $P < 0.05$ (see Appendix 5). All these evidenced that the model is fitted.

The multiple linear regression results revealed that marital status and agricultural mechanization for maize production women farmers had negative relationship being other variables remain constant, a unit marital status of women increase, utilization of AM decreased at the coefficients of 0.037.However, the result was statistically significant at $p<0.05$ in all case (see table 4.9). This means that marital status of women decrease utilization of AM. This result is consistent with the study of Dereje *et al.,* (2016) as reported, marital status and use of improved technologies had a negative relationship.

Similar with the above empirical evidence, Nigussie *et al.,* (2014) also showed that male headed households own more of productive resources such as land, labor and other agricultural technologies as compared to female headed households. On the other hand Uwandu, Chisom Norberth *et al*., (2018) in their side revaled that marital status is associated positively with agricultural mechanization utilization .

The multiple linear regression results revealed that availability of technology and AM for maize production of WFs had positive relationship being other variables remain constant a unit high availability of technology to increased maize production at the coefficients of 0.288. The result was statistically significant at $p<0.05$ in all case (see Table 4.9). This means that women who have got adequate availability of improved agricultural technologies, it have agreat contribution for women maize producer farmers. Because women are more engaged from planting to post harvest activities of maize production. This result is consistent with the study of Dagninet (2017) as pointed out availability of agricultural technologies was associated with farmers utilization ability.

As can be understood from the table, the multiple linear regression results revealed that utilization of technology and AM for maize production of WFs had positive relationship. Being other variables remain constant, a unit utilization of technology to increased AM for maize production of WFs increased at the coefficients of 0.236. The result was statistically significant at $p<0.05$ in all case (see table 4.9). This means that the utilization of AM plays a vital role for women maize producers. The result consistent with the study of Dereje *et al*., (2016) agricultural production and using agricultural technology had postive relation ship. The study revealed that

when farmers adopt technology on their farm their production also improve. Like wise Tesfaye & Alemu (2001) evidenced that as agricultural mechanization and production have a positive relation ship.

Moreover, with the respect to access to formal credit, women who had no access to credit service, it decreases maize production because of startup capital to generating higher maize production which helps women farmer to acquire all the necessary input in right quantity and quality at the right time. As the MLR result showed that access to formal credit and AM for maize production of WFs has positive relationship being other variable constant, unit access to formal credit decreased to maize production decreased by a factor of 0.095.the result was statistically significant at $p<0.05$ in all case (see Table 4.9). This implies that the absence of credit service consternated by the factors of collaterals, the high interest of the loan, the short time duration of returned the loan as well as the frustration of group members are less access to formal credit by this case to decrease maize production. since their IAT utilization constrained by finance . This research finding is consistent with Dereje *et al.,* (2016), similarly Dagninet & Wolelaw (2016) as they found that farmers' access to credit and use improved technologies had positive relationship between.

As can be seen from the table 4.9, multiple linear regression analysis was employed, knowledge of women and maize production have had negative relationship being other variable constant, a unit knowledge of women decrease to maize production decreased by a factor of 0.090. So, the result was statistically significant at $p<0.05$ in all case (see Table 4.9). This means that knowledge of women have well not experienced and AM for maize production of WFs were decreased because of knowledge is very important to update and skill of farmers on farm technologies practice or activities. The study is agreed with the finding of Dereje *et al.,* (2016) they revealed that lack of knowledge and farmers utilization of improved technologies have negative relationship. Because educated farmers are believed to have higher ability to perceive, interpret and respond to new information about improved technologies than their peers with little or no knowledge. More educated and aware farmers are thus more likely to access information and advice from extension workers which influence their adoption and use of improved technologies.

Table 4. 9: The result of multiple linear regression analysis

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.684	.086		7.918	.000		
	Age of Women	.027	.014	.085	1.891	.061	.506	1.977
	Marital Status	-.037	.011	-.119	-3.300	.001	.778	1.285
	Education Level	-.001	.009	-.003	-.069	.945	.696	1.436
	Availability of technology	.288	.022	.482	12.895	.000	.728	1.373
	Utilaization of technology	.236	.011	.758	20.655	.000	.756	1.323
	Training access	.028	.025	.047	1.106	.271	.572	1.749
	Accessibility of appropriate technology	.047	.026	.070	1.832	.069	.700	1.428
	Access to credit service	.095	.024	.149	4.003	.000	.731	1.369
	Gender Stereotype	-.033	.023	-.055	-1.402	.163	.669	1.496
	Access to market	.034	.023	.054	1.465	.145	.738	1.356
	Knowledge	-.090	.022	-.151	-4.117	.000	.759	1.318

Source: Obtained from survey data, 2019

4.5.1. Institutional Factors

Towards the institutional factors as presented in table 4.10, the result showed that few (12.5%) of the respondents reported that, they had market access to buy or rent. In contrary majority (87.5%) of the respondents had not to access to rent IAT. Like wise the result also showed that about (48.2%) of the respondents reported that, they had obtained training regards to how they can use and benefits of the technology. 51.8% of the respondents had not to access to any of the technological training.Out of the respondents', the majority of them (66.7%) had not access to credit service to produce maize. On the other side remaining 33.3% were obtained credit service for their maize production. Hence, it implied that the inability of getting credit from institutions poses the problems for many women farmers technology usage. Here, so as to observe the association between training access and AM for maize production of WFs, Chi-square test was

employed. Thus, the result demonstrated that statistically significant association was observed between training access and AM for maize production of WFs of the study site i.e. P<0.05 X^2(1)=11.065, df =1, p=0. 001 (Table 4.10).

Table 4. 10: The respondent's response to the inistitutional factors

Variable discerption	Response	Frequency	Percent	X^2	Df	P-value
Access to market	Yes	21	12.5	.093	1	.760
	No	147	87.5			
Training access	Yes	81	48.2	11.065	1	.001
	No	87	51.8			
Access to credit service	Yes	56	33.3	2.204[a]	1	.138
	No	112	66.7			

***Source*:** Obtained from survey data, 2019

On the other hand, focus group discussants (FGD, Code 1) forwarded their agreements about the market inaccessibility to rent nearby. In line with the survey result and focus group discussion, key informant interviewees also agreed and accepted the challenges related to IAT accessibility and utilization. From those (KII, code 6), reported the issue and coated below.

> ------- *The first problem of women farmers to use appropriate technology is lack of adequate availability and lack of accessing the technology nearby due to lack of market the shortage of service providers. It is very difficult to find it easily when they need to use the service. Thus, even to have rental technology the market is not enough accessible and to have rental service turn is mandatory. Thus, they forced to shell their maize manually. It also requires a lot of money to rent, especially for tractor, up to 3,000 Ethiopian birrs per hectare. The turns for a long period of time were due to the presence of high demand of users. Another problem is that one cannot get the plowing or shelling service unless he/she make a prepayment.*

The result confirmed with the report prepared by FAO (2011), which highlighted that currently many of smallholder farms have limited access to production inputs, especially mechanization, and so achieve low levels of productivity. They also have fewer opportunities to access markets to take advantage of the numerous values adding activities that more developed food systems can provide.

According to FANRPAN (2017) most advanced technology includes ploughs, cultivators, planters, harvesters and irrigation equipment. Technology is designed by men to do work in extensive and well prepared terrains rather than on the sloppy and rugged plots owned by women. Women farmers lack the know-how and the confidence to use the improved technology and most of the new technologies are too expensive and too sophisticated for women.

Agreeing with the above result Gerry (2002) stated that technologies have in the past been promoted which, although technically suited to a particular farming or production system, were unsustainable because of a failure to take into account adverse marketing conditions (e.g. no accessible market, or only a thin market in which poor marketing infrastructure, or non-availability of credit, etc). Similarly FANRPAN (2017) stated that lack of market research and information limit women farmers to less market opportunities in which technologies will available.

The issue was stated by focus group discussants in one kebele. The data from participants (FGD, Code 2) were quoted below here;

> *There are problems we encountered when we use ASAM, the first is a large amount of money to cover the cost of renting appropriate scale technologies especially to rent a tractor and did not have sufficient supply even. There is only one maize sheller in our locality owned by Farmer Union, and we cannot get it at any time as we wanted. We must wait for a turn for a long period of turn with prepayment.Thus absence of credit services limited our utilization of technologies.*

The other key informant interviewee also supported the above survey result and FGDs idea. One KII explained the issue as quoted below (KII, Code 7).

> ----------*When I told you openly, the financial service providers are not providing credit service as expected for farmers to use agricultural technology. Although there are saving*

and credit service providers like ACSI (Amhara Credit and Saving Institution) and Harbu in our woreda, they provide credit services for the purpose of different income generation activity rather for the technology utilization. Thus, women farmers are challenged by lack of finance to buy and use improved agricultural technology. But, if these institutions provide credit service for women farmers to buy and use improved agricultural tools, maize production will increase in amount and quality.

Consistent to the above result FANRPAN (2017) clearly stated **w**omen cannot access credit as the banks consider them to be high-risk borrowers without collateral, they are usually inexperienced on matters of borrowing and without cooperatives they are unable to access credit. They fail to obtain credit because of lack of cash to effect the down payment. The use of credit for maize production might be associated with adoption of improved technologies.

Regards to this FAO (2011), revealed that although women play a crucial role in farming and food production, they are often disadvantaged and face greater constraints in agricultural production than men. Rural women are consistently less likely than men to adopt new technologies, access credit or other financial services, or receive education or extension advice. In some cases, they do not even control the use of their own time. The report also estimates that if women had the same access to production resources as men, they could increase yields on their fields by 20 to 30 percent. The FAO calculates that this alone would raise total agricultural output in developing countries by 2.5 to 4 percent and that this, in turn, could reduce the number of hungry people in the world by 12 to 17 percent, or 100 to 150 million people.

Acoording to FANRPAN (2017) most extension focuses on large-scale commercial farming and they have no time to for the small farms owned by women and women's entitlement to opportunities is different from the men.

Consistent with this finding, a research did by CGIAR Research Program on MAIZE (2015) resulted as key constraints to maize production include shortage of agricultural trainings, insufficient institutional support, lack of knowledge, lack of access to fertilizer and other inputs, and microfinance service like credit.

4.5.2. Socio-cultural factors

In line with the above factors, women farmers experienced socio-cultural challenges in using technologies when they produce maize. From those problems, gender stereotype is ranked the first followed by lack of knowledge. From table 4.10, more than half of respondents (54.8%) were faced with gender stereotype challenges from the community. On the other hand, 45.2% of respondents reported that they had not faced a gender stereotype problem. So as to observe the association between gender stereotype and AM for maize producuction of WFs, Chi-square test was employed. Thus, the result demonstrated that statistically significant association was observed between gender stereotype and AM for maize producuction of WFs in the study site i.e. P<0.05 X^2=9.281, df =1, p=0. 002 (Table 4.11).From the result, it can conclude that majority of the respondents had challenged by gender stereotype. Accordingly, the result of the previous research work stated that patriarchal attitude and socio-cultural discrimination had put WFs in a disadvantaged position because of the asymmetrical power relationship between men and women.

Table 4. 11: Respondents response to Socio cultural factors

Variable discerption	Response	Frequency	Percent	X^2	df	P-value
Gender Stereotype	Yes	92	54.8%	9.281	1	.002
	No	76	45.2%			
Knowledge	Yes	81	48.2	.276	1	.599
	No	87	51.8			

***Source*:** Obtained from survey data, 2019

Cognizant to the survey result the study carried out by Esther L. *et al.*, (2018) clearly stated that the cultural perceptions and norms associated with male dominance and resistance to change this culture are perceived as adoption constraints in Madagascar and Ethiopia. Inclination towards the traditional male domination way of life also hinder the adoption of new technologies by women farmers.

The qualitative result also confirms that there was gender stereotype in the study area. In relation with this statistical data, on the one hand, focus group discussants highly articulated how gender stereotype against women challenged them in using ASAM in the study setting. For instance, one focus group discussant asserted this idea as narrated below (FGD 1 , Code 2).

> *It's OK. For example, female farmers do not go to the service provider to use maize sheller. In our locality brought maize sheller from the service provider to home to shell maize is the responsibility of male. This is because the man has the experience of going to a cooperative or other institution or service provider. It is the man who cares in a turn, paying for a rental fee as a salaried to service provider association. We were able to do this, but how can we be treated as men in the community? Often, men are outdoors for everything. Our husbands do not want us to go out, it's very unlikely to go out because we are busy in domestic chores and they cannot help us in domestic activities. Women farmer who is not involved in training may not be able to use technology in any way. Local habits for training included or motivated men, not women.*

This result is in agreement with works of Shamsudeen Abdulai (2013), which shows that women performed crucial roles in the domestic and economic life of a society which affected their technical efficiency. This included the unmeasured non-economic activities (such as child care, cooking, cleaning, etc) performed by females in the household. Moreover, some customs, traditions, religious beliefs, and social norms placed restrictions on women's activities both on- and off-farm and hence their ability to access new information and use technologies.

The writer named Eisenstein (1981) tried to show the solution for the above pointed statement standing from the book as liberal feminism asserts the equality of men and women could achieve through economic and legal reform. It is an individualistic form of feminism which focuses on women's ability to show and maintain their equality through their own actions and choices. Liberal feminism uses the personal interactions between men and women as the place from which to transform society.

Similarly, one FGD participant was shared her experience related to the presence of gender stereotype in the study area and which affects her utilization of IAT (FGD 3, Code 23).

---------I'm a woman, and I do not have a husband. This year, I was waiting for the tractor owner to plow my farm field. However, since there is a male prerogative, another male farmer advised him to go to his farm at night and begin to comfort him. In the morning, I went out to the tractor owner and checked out and tried to convince him that the time was my turn. But his response was only as he bring tractor back to my own land when he finished. I paid him equal to the male user, but the reason given to the male was that he was male, and I did not bring any. I returned home, unable to contend my own arguments since there is male dominance. Later he came to me and plow my land. These all were, because all technologists are male and they do not take into account the burden of women. In addition, service providers might have a strong relationship with other male farmers in various ways than women farmers.

There is also an argument related to the above issues revealed from KIIs (KII, code 2) pointed as below.

--------in the community trend the men are responsible to rent out technology from the unions but not women farmers unless they hadn't husband. Moreover the sheller is not women-friendly or not appropriate; it requires much human energy to move to home. Fourthly, the bag is expensive because the supplier is not in the area. As a general, another problem is, such as the domestic workloads of female farmers; which restricts them from participating or makes them out of the reach of the different types of technology and usage training and workshops.

Agriculture mechanization has many important implications for gender mainstreaming and gender relations. Women's role in agriculture is prevalent; they work in all aspects of farming operations like seed cleaning, sowing, planting, weeding, applying fertilizer/manure and pesticides, threshing and harvesting. Agriculture mechanization can help reduce women's workload and facilitate difficult operations. However, experiences in many countries show the promotion, adoption and benefits of mechanization are not gender-neutral. Mechanization technologies have mostly been adopted in relation to men's tasks often with negative consequences for women. But detail assessment and analysis is needed to know how laborsaving

technology are most expected to be most impactful for female farmers because they work on do both on-farm activities and household activities (FACASI, 2014).

Consistent to the above result the author Abdelali-Martini (2011) expressed that it is more challenging for women who more often than men, not have a greater disadvantage. Because they not only contend with the limited access to the farm inputs but also structural differences that arise owing to cultural factors or legal rights to access capital or even land, let alone the technical knowledge to operate the machines that are needed so as to get the desired yield.

Moreover, the finding of the current study agreed with research did by the CGIAR Research Program on MAIZE (2015). As to this study, Gender stereotypes and social restrictions often exclude women from using improved technologies and extension programs, and from participation in farmer participatory experiments, demonstrations and field days. Women sometimes face several constraints in addressing these challenges, for instance, a lack of access to technical knowledge and technologies which can reduce their drudgery and provide additional income. Moreover, women's triple roles to the extent that domestic and caring responsibilities may limit their mobility, women often lose out on crucial opportunities for learning and interactions that could stimulate agency and innovation. The lacks the knowledge and/or capacity to challenge these practices.

From the above table (Table 4.11) demonstration, most of (51.8%) respondents were reported as lack of knowledge was not a huge problem for them to use IAT, while the remaining proportional (48.2%) respondents believed that lack of knowledge was one hindering factor from using ASAM. However, different ideas were forwarded from key informants concerning to is lack of knowledge a challenge for WFs or not?. From those (KII, Code 5) also clearly reflected the qualitative information during the discussion time as presented below.

> *Lack of knowledge is a major problem for female farmers. Even if we tried to bring tractor and maize sheller from other kebeles, all the female farmers did not have access to these technologies because of lack of knowledge sometimes in addition to long turn, so they forced to shell by using their hands manually. Because women are not much involved in training or exchange of experiences rather they are more concentrated in-home activity.*

As (ARARI, 2016) stated that in the Amhara region small holder framing is characterized by low level agricultural technology and dependence on traditional tools and farming coupled with low application of modern inputs. Farmers are not well aware of row planting technologies and less accessibility of planters is the major problem, affecting agricultural production and productivity.

Although the survey results showed that as lack of knowledge was not a problem of WFs, KIIs were against it. This is because the survey result is inconsistent with KIIs idea and more over KIIs idea is agreed with the findings of CGIAR Research Program on maize (2015). This emperical evidene indicates that one of the greatest constraints that poor women farmers face is access to new knowledge and reliable information on new technologies and practices. Information is important to women whether or not they are the final decision-makers on what seed, fertilizer or other technological inputs to buy. When deferring to their spouses, it helps the women to discuss and debate from the standpoint of knowledge. On the same note, it is best when both spouses have adequate knowledge and information regards to agricultural inputs.

According to Dagninet & Wolelaw (2016) ultimately, for farm power is to have a greater role in rural livelihoods, farmers will have to be informed, educated, skilled and financially empowered to purchase, repair and maintain farm-power resources.

4.6. Benefits of Women Farmers from Appropriate Scale Agricultural Mechanization

Farm mechanization is regarded as very important to reduce the human drudgery and enhance the agricultural productivity (Dagninet & Wolelaw, 2016).

Thus from the survey result, there was a different type of benefits, women farmers have got from ASAM. These include saving time, saving labor and savin drudgery. The survey results in table 4.12 revealed that the majorities (92.9%) of the respondents were benefited from ASAM, whereas very few (7.1%) of the respondents were not benefited from ASAM. From the result, it can be inferred that the majority of the respondents had obtained benefits from using ASAM for their maize production in the study area. In corresponding, the result also demonstrated that a very significant number (91.7%) of respondents reported as ASAM was saved their time followed by saving labor (71.4%) and saving drudgery (69.0%) respectively. Whereas the remaining respondents don’t agree in regards to saving time, saving labor and saving drudgery

(8.3%), (28.6%), (31.0%) respectively. Hence, it implied that most of the respondents were benefited from maize sheller. This was through, it saved time, labor and drudgery.

According to Karim Houmyet *et al*., (2013) agricultural mechanization has made significant contribution in enhancing cropping intensity. Inputs of hard labor by farmers and their families can be substantially reduced if they have access to a carefully selected use of tools, machines, and equipment. The labor released can be used for other productive activities. The use of improved mechanical technologies can also have a direct impact on yields and area under production. Such technological interventions are commonly referred to as agricultural mechanization.

Table 4. 12: Percentage distribution of respondents' response to Benefit of ASAM

Variables	Options	Frequency	Percentage (%)
have you benefited from ASAM?	Yes	156	92.9
	No	12	7.1
	Total	168	100.0
Saving Time	Yes	154	91.7
	No	14	8.3
	Total	168	100.0
Saving Labor	Yes	120	71.4
	No	48	28.6
	Total	168	100.0
Saving drudgery	Yes	116	69.0
	No	52	31.0
	Total	168	100.0

***Source*:** Obtained from survey data, 2019

In line with the survey result, focus group discussants (FGD 1, code 7) forwarded their agreements about the benefits of maize sheller. Moreover, the data collected in the focus group discussions also showed another benefit which was not included in survey questioner including educating their children. Their arguments are pointed out as follows;

Before we got sheller, we forced to shell our maize manually. Our, women's occupation was very large. We will run from a fortnight to a month to the food preparation and accommodation that will be available at shelling time for laborers. Next, we will set up a floating space and we will fix it. We have to prepare food, we are involved in shelling along. We filled the maize in sack and beating it with stick to shell. It would have been ruined, and the grain would be scattered and demolished or face drudgery. Despite this, the shelling has to spend a lot of time. Additionally, it adds workloads for females. But now, one of the benefits is that our time has saved by using sheller. This means that the shelling process, which takes 3-4 days previously when we manually shell, will only end in 1-2 hours. The second is the sheller will be accomplished only in a few places and save the crop from drudgery. The third is it saves labor. The huge amount of energy needed to shall maize in manually for many days and preparing and providing food for the laborer. With the use of the sheller, we are able to collect our crop at the end of a short time, so that we will not be able to cook food at all. In addition, we forced our children to leave out of school. Since we wanted them to help us during shelling season, we wanted them especially our girl children to help us, for food preparation, and they left school until they were finished. Now, the sheller has accomplished shelling activity in a short period of time so that we cannot keep them out of school and keep up their education. Another benefit of the sheller using is related to cumulative labor saving. When we have to shell the maize manually we will use neighbor labor for 3-4 days and we forced to return this used labor to our neighbor when they shell their maize use it for our neighbor for 3-4 days again, so we will invest a lot of days labor to finalize shelling activity. Fourth, the sheller reduced the hours we spent tryixng to clean the crop. It does not take time to isolate maize from corncob, the sheller produces maize in one side and the corncob on the other side.

The above result is confirmed by the findings of ARARI (2016) as indicated that the easiest traditional system for shelling maize is to press the thumbs on the grains to detach them from the ears. Another simple and common shelling method is to rub two ears of maize against each other. These methods require a lot of labor, and a person can hand-shell only a few kilograms an hour. Shelling of maize can be more efficiently accomplished by striking a bag full of ears or heads with a stick. Maize can also be shelled by rubbing the ears or heads on a rough surface. Beating

of cobs results in breakage and cracking of some grains thus rendering them more susceptible to insect attack in store. Manual shelling is labor intensive and is carried out by both men and women.

Manual maize shelling method practiced is problematic, in that it requires much time and hard work. In addition, it induces huge post-harvest loss. Therefore in order to alleviate these post-harvest handling problems on maize, introducing appropriate threshing and shelling methods, that saves time, decreases losses and reduce drudgery is imperative. maize Sheller reduces the time required for shelling maize, by half than traditional shelling. Fingertip injury was commonly observed when farmers shelling maize traditionally, by their finger tip, for a longer duration, so the Sheller alleviates this suffering. In addition, farmers found that, the sheller is best suit for shelling maize since it doesn't break the grain while shelling which makes the product more quality (ARARI, 2016).

With supporting the above information, the other one FGD participants (FGD 2, code 11) spoke out her experience narrated below.

> ---------*the benefits of using technology are numerous. I have been deprived of my resources for other home expense because ASMC project providing free service for me in this Year. It has been saved my time and energy. It also protected my maize from drudgery. Moreover, my husband is not alive, he passes away before 4 years and I am widowed at this time. Thus, plowing my farmland become my responsibility. I used traditional plows until last year. It was very difficult for me to even carry it to the farm since it is heavy, and it was difficult for me to plow. This year, I am very happy by Bahir Dar University; ASMC project to give me a chance to have an improved plow and Yoke freely. It's very simple and convenient, so it's best suited to carry to farm filed and to plowing. In addition to this, the project also provided me maize sheller service. Thus, it saves my time and shelled my maize within 1 hour, saved labor and drudgery. The maize was very clean and the sheller was not cut off each piece of maize.*

With support this study finding, the study of Lyly (2016), also indicates that the improvement in agricultural technology coupled with mechanization positively impacts the lives of women from all socio-economic backgrounds, by reducing the amount of time that they will work in their farms. It has the potential to increase production; boost operation timeliness more so when most

women the rural areas continue to rely on hand hoes as a tool for cultivation. Agricultural mechanization can also raise the income of farmers and saving out of improved productivity.
By Strengthened the above result Karim houmyet *et al*., (2013) and in the same manner Dagninet and his friend (2016) pointed out as inputs of hard labor by farmers and their families can be substantially reduced if they have access to a carefully selected use of tools, machines, and equipment. The labor released can be used for other productive activities. The use of improved mechanical technologies can also have a direct impact on yields and area under production. Such technological interventions are commonly referred to as agricultural mechanization.

In addition, key Informants (KII, code 4) of this study elaborated that there are enormous benefits from technology, especially for women farmers. It is narrated bellow as follows;

> *Improved technology has a lot of benefit for female farmers. For example, in our locality women cannot plowing land because it is a role given to men. As a result, women farmers especially those who have no husband, are vulnerable to seek out a laborer to plowing their land. But if they used tractor they didn't need daily laborer and even it saves time. There are also many benefits from maize sheller like it saves time, labor and avoids drudgery. Thus, appropriate technology is essential to improve their maize production. Because its importance is not questionable for all farmers in general and women farmers in particular for maize production in our locality.*

The other key informant interviewee (KII, code 1) revealed that the benefits of technologies as;

> *Improved technology has benefit for female farmers from the time of preparing land or plowing the land to storage. For example, tractors help women farmers to have a lot of plowing land in the short run, and it will save time. The maize sheller also reduced the time and energy spent on a week and the cost of a meal prepared for shelling time. Because only 1-2 hours will accomplish all the maize shelling activity and reduce the amount of drudgery, the crop will more clean and quality. Pics bag storage is very important for female farmers. The one-time buyer will be served for 5-7 years. Women are also involved in the applying of chemical in crops, cleaning, and arranging crops for household consumption as well as for market. Applying chemical is not a one-time activity, but it often requires repeated application. During this time, women will be*

overworked. However, when using the storage, the pics bag didn't need chemical application. It is also very difficult to get out of the crop when women want to use what they have stored in traditional storage called Gotta. But the bag is suitable for women.

The result is consistent with the finding founds out by Lyly (2016), Agricultural mechanization is an investment for farmers and they have to generate income and profit from their investment by means of greater production or increased value. It also promotes the local farmer's status by reducing the farmer's workload and creating more leisure time.

In agreeing with the above information FACASI (2014) confirmed that agricultural mechanization has many important implications for gender mainstreaming and gender relations. Women's role in agriculture is prevalent; they work in all aspects of farming operations like seed cleaning, sowing, planting, weeding, applying fertilizer/manure and pesticides, threshing and harvesting. Female farmers work on do both on-farm activities and household activities, as a result if there is gender sensitive agriculture input adoption, it saves their labor, time and drudgery.

4.7. Exiting needs of Women Farmers

As Gerry (2002) pointed out that disadvantaged groups such as women farmers, poor farmers and subsistence producers may be targeted to identify, develop and promote technologies appropriate to their specific needs. Special arrangements may be needed to ensure that the voices of the disadvantaged (women, ethnic minorities, the poor, subsistence farmers, child-headed households in HIV/AIDS-ravaged areas) are heard.

As it is indicated in table 4.13, Near to all participants (95.2%) of respondents reported that they need technology adoption for maize production, whereas very few (4.8%) indicated that they didn't need technology adoption. As can be shown the table from the respondents who need technology adoption 54.2%, 61.9%, 97.6% and 81.5% of respondents need plow/tractor, planter, sheller and storage technologies respectively. From the result, it can possibly argue that almost all participants need technology adoption although their need varied in technology type. The result also describes that majority of (97.6%) WFs need maize sheller adoption for maize production in the study area.

The above survey result is supported by the findings of Lyly (2016). She argued that the existence and improvement of agricultural technology coupled with mechanization positively impacts the lives of women from all socio-economic backgrounds, by reducing the amount of time that they will work in their farms as well as improving their income. And more importantly enabling them to manage and implement their entrepreneurial skills having been relegated to manual agricultural laborer in the absence of mechanization. This is coupled with the access to and control over productive resources or assets such as land, capital, knowledge, information as well as financial resources.

Table 4. 13: The exiting technological needs of WFs

Variables	**Options**	**Frequency**	**Percentage (%)**
Do you need technology adoption to produce maize	Yes	160	95.2
	No	8	4.8
	Total	168	100.0
you need plow/tractor	Yes	91	54.2
	No	77	45.8
	Total	168	100.0
you need planter	Yes	104	61.9
	No	64	38.1
	Total	168	100.0
you need Sheller	Yes	164	97.6
	No	4	2.4
	Total	168	100.0
Do you need Storage	Yes	137	81.5
	No	31	18.5
	Total	168	100.0

***Source*:** Obtained from survey data, 2019

The finding shown in the above table is supported by group discussants and key informants of this study. Consistent with the survey result, the following data were collected from focus group discussants (FGD 1, code 9)

Currently, about 20-30 thousand Ethiopian birr is being invested in our area to buy a oxen and to have two oxen at a time for plowing requests cost of 40-60 thousand Ethiopian birr. So it's good to have a tractor in our locality or nearby. I would like to use tractor just like maize sheller at least through rent from service providers based on our interest at least,

farmers union have to have this tractor. The tractor also saves time, and we can plow a lot of land in short intervals, and we will eliminate the frequency of plow. So am ready to use if there service providers.

In line with the above result, the finding of ARARI (2016) showed that in some area Ethiopian framers plant maize in row, which is opening furrow by a traditional plough *(Mareha*).

Increased agricultural production and improved rural livelihoods cannot be achieved without the adoption and use of increased levels of farm power and mechanization. However, agricultural mechanization is not quite as straightforward an input (Karim Houmy*et al et al* (2013). Farm mechanization plays a significant role in every nation's economy. However, it is often misconstrued to mean modernization, beneficial only to industrialized countries with highly mechanized agriculture. Developing countries often have to rely on a variety of imported farm machines, which are seldom appropriate for small farms (FFTC, 2005).

Similar to the above information one FGD participant (FGD 2, Code 12) reported as;

I learned from training, by Bahir Dar University; ASMC Project for selected farmers, which demonstrates exemplary grain storage and the project trained the trainees on how to use improved storage made from metal. If the supply of this storage is adequately available, I think there will be a lot of beneficiaries. Because it does not need adding chemical and retrace and even no need for sowing of crops since it is clean. After the product is brought into the home, it is a role for women to be welcomed, adding chemical, shaved. So, I personally am ready to use this technology if the provider is delivered to me. In addition, Planting/sowing maize seed in our locality is the share of women. We are very happy to have improved planter. Because planting a seed and putting fertilizer is the responsibility of women and children. I will sow the seed and another person (my children) adds fertilize and we will covered it with soil again. Children do not go to school unless I buy day laborer. So this activity is so fatigued and deadly that it is so motivated that I want to use an improved maize planter if service providers are delivering.

This qualitative result is supported by the research caried out by Dagninet & Wolelaw (2016) that mechanization may be a means of freeing women and children from agricultural work to more rewarding occupations and education. According to ARAR (2016) the reduced time

required to sowing is major benefit of using the improved planter at the peak time of planting. Improved planter users responded that hand dropping method of maize planting is tedious and causing backache due to longer hours bending and reduce human labor. For instance, labor will save by using jab planter i.e. the work done by 3 people under hand dropping method is done by two people one for handler of the animal and the other to drop seed and fertilizer by jab planter.

Jagvir Dixit, *et al.,* (2017) pointe out the recommended row to row spacing, seed rate/ plant population, plant to plant spacing and depth of seed/ plant placement vary from crop and for different agro-climatic conditions to achieve optimum yield. In most areas, most of the farmers are using traditional methods i.e. broadcasting or seed dropping behind plough for sowing maize, which affects germination due to non-uniform placement of seeds at proper depth. Also, farmers apply 30-40 % higher seed rate than recommended to ensure optimum plant population. The placement of seed at proper depth is the most important factor in sowing, which has significant role in crop production particularly under rain fed conditions. According to (Griepentrog, 1998;Karayel and Ozmerzi, 2002) cited by ARARI (2016) stipulated that uniform seed spacing and depth result in better germination and emergence and increase yield by minimizing competition between plants for available light, water and nutrients.

Regards to WFs need related to maize sheller FGD participants were argued there is a great need of the technology. From those (FGD 2) participants revealed the information below.

> *Especially since we consider the benefits of maize sheller in this year, we all female farmers plan to use the technology for the next year. Therefore, since there is only one sheller in our kebele, the government or the agriculture office or individual service providers have able to provide us the technology through rent when we want to use it. Therefore, as a recommendation shellers produced by future must be appropriate for women or women-friendly to use it easily. The other thing is that just like grain storage of Pics bag, other appropriate storage shall be available, and we are welcomed to use it. Because firstly it was very tiring to construct local storage called Gotta. Secondly, It also requires a lot of energy to getting in or getting out the crop. Although the crop in traditional storage Gotta was sprayed with chemical initially before getting into storage, it needs adding chemical frequently or repeatedly in the storage by retracing the crop well. Basically, we need an improved storage for stopping the use of chemicals to save labor.*

In line with the result Danilo (2003) stipulated that losses of grain stored at the farm level are in the order of 8 to 10 percent depend upon the following: Physical factors, e.g. damage during harvesting, transportation and shelling. This make maize susceptible to attacks by insect pests, mites and moulds · Temperature and humidity may encourage mould formation and create conditions for insect population growth. The losses could be: minimal in cool dry areas, marked in hot dry areas, high in cool damp conditions and very high in hot damp climates. Type of storage structures or containers used duration of storage, the storage management effected prior to and during storage.

There are empirical evidences those agreed with this study result. They explores different idea in line with this study. For instance according to AgroBIG (2016), except plowing women engage in almost all maize production activities from planting to harvesting and post-harvest handling. Women involvement is relatively high in post-harvest activities (shelling, packing, and sorting). In times when the men are busy in field activities women also occupied by food preparation, home management, taking care of children and other agricultural activities. It needs attention to reduce the burden in women and family members by looking at improved technologies.

Likewise the above information the study carried out by CGIAR Research Program on maize, (2015), also in agreement with the result which confirmed that women maize farmers participate actively in the maize economy through their involvement in the production, post-harvest, and processing activities. They are also active participants in decision-making about technology adoption. On one hand, some women manage whole farms as female household heads or in the absence of their husbands; on the other, women also manage individual plots within male-headed households and, most importantly, women provide significant input into negotiations regarding technology adoption where farming is managed jointly.

According to Abdelali-Martini (2011) there is need for the governments in developing countries to focus on women by recognizing their input and efforts by empowering them so that they are able to contribute more in the agricultural sector as well as "strengthening their access to and control over productive resources/assets such as land, capital, knowledge, information and technologies, remain important factors of an enabling environment for women's empowerment.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

ASAM is very essential for agricultural production improvement. In Ethiopia, appropriate agricultural technology is not much enough. There are different yields grown by Ethiopian farmers those needs technology adoption. From these yields, maize is the one what it needs large technology adoption starting from preparing the land to post-harvest storage. WFs play immense roles both in agricultural and non-agricultural activities even though their contributions are overlooked. Although there is some change in adopting technology, it is not adequately available, accessible for and used by women farmers. Likewise, different studies investigate that even though women have played roles in many agricultural activities they are not accessible for agricultural technologies and the existing technologies are not gender sensitive women-friendly.

According to the survey result, there were agricultural technologies used in the study area, whereas its adequate availability and appropriateness to women are limited. Technological using experience in the kebele, availability of extension service, high level production and presence of free service or gifted technology were good opportunities for WFs to use ASAM. These have a positive impact to women and which motivated them to have extra need towards appropriate technology adoption. The multiple linear regression model results showed that as marital status, availability of technology, utilization of technology, access to credit service and knowledge) were significant predictors while age of women, education level of women, training access, access to technology, gender stereotype and access to market were insignificant predictor to agricultural mechanization for maize production of women in the study area.

Hence, information flows and training from DAs have paramount importance to women farmers in order to use improved agricultural technology. In addition, information from neighbors, training from BiT; ASMC Project and agriculture office had their own contribution to women technology usage in the study area.

As a result of the study, WFs were benefited from agricultural technologies especially from maize sheller. Benefits women obtained from technologies are numerous. The technologies were

saved time, labor and production drudgery of women farmers. What these were argued by the majority of respondents and confirmed by FGDs and KIIs.

Finally, women farmers have needed to adopt technologies, such as plow/tractor, planter, sheller, and storage. Majority of this research participants need maize sheller followed by storage, planter and plow/tractor respectively. This was why because plowing plow is the given responsibility for men and women are much responsible or more engaged in the activities of maize production starting from planting a seed to storage due to the norm of the community in the study area as can be confirmed from qualitative result.

5.2. Recommendations

The discovery of this study showed that the existing status technology adoption was not adequately available, accessible and gender-responsive due to various reasons including its suitability for women farmers in the study area. In addition, there were different challenges women faced during agricultural technology usage.

Hence, standing from the research findings of this study the following recommendations are forwarded by the researcher assuming that they could be important inputs to the government (policy makers), NGOs, technology adapters and service providers to take into account the problems and to improve the situation of women farmers regards to ASAM adoption and utilization:

- The woreda agricultural offices and Farmer Unions have to provide the technologies from the plow to post-harvest, to improve WFs maize production. Likewise, the technology adapters (importers) and service providers should provide adequate enough technology for women farmers due to the fact that many of WFs did not get the technology and they faced the problems of using the existing technology even. Not only providing the technology, but it also should be appropriate scale agricultural mechanization for WFs to use it easily. Furthermore, woreda agriculture offices or other institutions should provide free service as a demonstration for WFs to motivate them to use other time by their own expense.

- The saving and credit institutions have to have facilitate gender sensitive credit service systems to WFs.
- The government offices like Women, children and youth affairs office and other NGOs must provide different capacity building and norm shift training for the community in general and for Women in particular. This is because the community traditionally refuses to engage women in the public square to participate in training and to use technologies by their own capacity.
- As female farmers exploited by most of the agricultural work, the government needs to support women in action, not just in planning, to ensure adequate availability, accessibility, and utilization of technology for and by women farmers. Therefore, if women have appropriate technology offerings and facilitated their use if responsible parties work on women's need-based activity, all women will be able to improve their maize production.
- Although agricultural extension services for women farmers are available but it has some limitation regards to addressing women need. Thus, a lot of works have to do much to make female farmers maize production better.
- From the response of the respondents, it can be understood that almost all respondents have the interest to use agricultural mechanization technologies and there will also many technology producers, importers and researcher centers which avail these technologies with all their technical backups. Thus, they have to recognize the WFs role in agriculture and provide gender responsive appropriate agricultural mechanizations as much as possible.
- Finally, higher education institutions like TVT and Universities have to produce women-friendly agricultural technologies. These institutions also have provided already produced technologies agricultural (either by teachers or by graduate students) by taking out from store to women farmers at ground level. According to the researcher opinion, there will be numerous types of improved agricultural technologies in each and every higher technical institute. So, these technologies have to be diffused for women farmers.

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APPENDICES

Bahir Dar University

Faculty of Social Science

Department of Gender and Development Studies

Post Graduate Program

Introduction Interview Schedule

Appendix 1: Survey Questionnaire for Women farmers involved in maize production.

Dear Respondents: -

This questionnaire is prepared to collect data for MA research entitled '**The contribution of Agricultural Mechanization for Maize producing Women'.** It is designed to generate data that will be used for academic purpose only and it is confidential. It consists of questions linked to socio-demographic characteristics, extension services, agricultural machinery availability, benefits of technologies and opportunities and constraints in the maize production system. The concrete and successful accomplishment of this study is determined by the data obtained from the participants in the data collection process. Thus, the researcher requires your support and cooperation to gather relevant information for the study. Furthermore, it will be used for policymakers, agricultural sector for adoption and adaption of appropriate scale agricultural mechanization, academicians, NGOs, and innovators. Therefore, please feel free and share your rational views.

Thank you in advance for your cooperation!!

General Directions:

- No need for writing your name
- Please respond to each question correctly and clearly and return as soon as you finished.

General Information:

Enumerator full name: _____ Signature _____

Date of Interview_____ Questionnaire Code_____

Kebele _____

PART 1. Respondents' demographic characteristics

Please circle one or use **"✓"** sign that is your choice.

1. Age _____
2. Marital Status: I. Married 2. Single 3. Widowed 4. Divorced
3. Education level: 1. Illiterate 2. Read and write 3. 1-4 grade
   4. 5-8 grade 5. Grade 9 and above

PART 2: Availability and utilization of Technology

4. IS ASAM is important for maize producing women farmers? l. Yes, 2. No
5. Are appropriate agricultural mechanizations available in your locality to produce maize?
   l. Yes, 2. No

A. Adequate availability of Plough. l. Yes, 2. No
B. Adequate availability of Planter. l. Yes, 2. No
C. Adequate availability of maize Sheller. l. Yes, 2. No
D. Adequate availability of Storage. l. Yes, 2. No

6. If you say yes, who are the owners? You can choose more than one answer

a) Individual farmers. l. Yes, 2. No
b) Farmer union. l. Yes, 2. No
c) Agriculture office. l. Yes, 2. No
d) ASMC project. l. Yes, 2. No

7. Are agricultural technologies accessible for you? 1. Yes, 2. No
8. What types of machinery do you use repeatedly?

   1. Plough 2. Planter 3. Sheller 4. Storage
9. If yes, how many times you use?

   1. 1time 2. 2 times 3. Three times 4. 4 times and above.
10. How do you get these machinery? l. Your own 2. Rental 3. Gift
11. If it is rental, from whom and where? 1. Agriculture office. 2. Private owners

    3. Farmer unions 4. No rent
12. If it is a gift, from whom and where? 1. BiT, ASMC project

    2. Neighboring 3. Agriculture office 4. No gift
13. How did you get the information about the importance of ASM?

a. Neighbors b . DAs

c. BiT, ASMC Project

d. From self-Experience.

14. When did you start using ASAM? years back---------
15. How much maize you are producing per year? (In quintal/100 kg) 1. 20 & <20 quintal 2.

    21-40 quintal 3. 41-60 quintal 4. Above 60 quintals
16. Do you feel that you have benefited from ASAM? l. Yes, 2. No
17. If you say yes, for question 14, what type of benefit you have got?

No	Technology benefit	Yes	No
1	Saved time		
2	Saved Labor		
3	Saved from Drudgery		

18. Do you need technology adaption to produce maize? l. Yes, 2. No
19. If your answer to question 18 is Yes, which technology adoption you need?

No	Technology Needs	Yes	No
1	Plow		
2	Planter		
3	Maize Sheller		
4	Maize storage		

PART 3. Opportunities and Constraints

20. In your opinion, do you feel that there are good opportunities that could enhance to use ASAM? A) Yes B) No

21. If you say YES, what opportunities do you have to use it?

Opportunity	Yes	No
Technological using experience in kebele		
Availability of Extension Services		
High level of production		
Presence of free service or a gifted technology		

22. Did you get training regards to appropriate agricultural mechanization to produce maize?

    1. Yes, 2. No

23. From whom you get the training?

    1. DAs 2. ASMC project 3. Woreda agriculture office 4. From self-experience.

24. Do you have challenges in using ASAM? l. Yes, 2. No

25. If you say yes, which constraints do you face?

No.	Constraints	Yes	No
1.	Lack of training		
2.	Limited access to appropriate technology		
3.	Lack of finance or credit service		
4.	Gender Stereotype		
5.	Lack of Market to buy/rent nearby		
6.	Lack of knowledge		

Thank You in Advance for Your Cooperation!!!

ባህርዳር ዩኒቨርሲቲ

ማህበራዊ ሳይንስ ፋካሊቲ

ድህረ-ምረቃ ፕሮግራም

የስርዓተ ፆታና ልማት ጥናት ትምህርት ክፍል

የዳሰሳ መጠይቅ

አባሪ 1፡- በቆሎ አምራች በሆኑ ሴት አርሶአደሮች የሚሞላ መጠይቅ

ውድ የመጠይቅ ተሳታፊዎች፡

ይህ መጠይቅ የተዘጋጀው በስርዓተ ፆታና ልማት ጥናት የሁለተኛ ዲግሪ መመረቂያ ጥናታዊ ፅሁፍ ለማካሄድ ሲሆን አላማውም ‹የግብርና ቴክኖሎጂ(መሳሪያ) ለበቆሎ አምራች ሴቶች ያለው አስተዋፅዖ› በሚል ርእስ መረጃ ለመሰብሰብ ነው፡፡ በዚህ መጠይቅ የሚሰበሰበው መረጃ ከዚህ የጥናት አላማ ውጪ ለሌላ ተግባር የማይውልና ምስጢራዊነቱም የተጠበቀ ነው፡፡ ከታች የተዘረዘሩት መጠይቆች የጥናት ተሳታፊዋን አጠቃላይ መሰረታዊ መረጃ፤በበቆሎ ማምረት ዘዴ ውስጥ የግብርና ኤክስቴንሽን አገልግልት፤ የማሽን አቅርቦት፤ቴክኖሎጂውን ለመጠቀም የሚያጋጥማቸው ተግዳሮቶች፤ ያሉ ምቹ ሁኔታወች እና በቴክኖሎጂው ያገኙት ጥቅም የሚሉትን ያካተተ ነው፡፡ ጥናቱ በተጨበጠና በተሳካ መልኩ ለማጠናቀቅ የሚወሰነው ከተሳታፊወቹ በሚገኘው መረጃ ነው፡፡ ስለሆነም አጥኚዋ ለጥናቱ ጠቃሚ መረጃ ለማግኘት የእርሰወትን እርዳታና ትብብር ትፈልጋለች፡፡ በተጨማሪም ጥናቱ ለፖሊሲ አውጭወች፣ ለግብራና ሴክተሩ ትንንሽ እና ተስማሚ ቴክኖሎጂውችን ለማለመድና ለማስተዋወቅ፣ ለምሁራን፣ መንግስታዊ ላልሆኑ ድርጅቶች እና ለቴክኖሎጂ ፈጣሪወች ያገለግላል፡፡ ስለሆነም እርሰዎ ነፃ ሆነው ምክንያታዊ አመለካከተወትን እንዲያካፍሉን እንጠይቃለን፡፡

በቅድሚያ ስለትብብርዎ እጅግ በጣም አመሰግናለሁ፡፡

ማስገንዘቢያ፡-

- ስምምትን መፃፍ አያስፈልግም
- እባክዎ እያንዳንዱን ጥያቄ በትክክልና በአግባቡ ይመሉ

አጠቃሊይ መረጃ፡-

የመርጃ ሰብሳቢዉ መሉ ስም _____ፊርማ_____

ቀን_____ የመጠየቅ መለያ ቁጥር_____

ቀበሌ_____

ክፍል 1. የጥናት ተሳታፊወች አጠቃላይ መሰረታዊ መረጃ

ለቀረቡት ጥያቄዎች ይበልጥ መልስ ይሆናሉ በሚሉዋቸው ላይ የ"✓" ምልክት በማድረግ ይመልሱ።

1. እድሜወት ስንት ነው ----------
2. የጋብቻ ሁኔታ፤ 1. ያገባች 2. ያላገባች 3. በሞት የተለየች 4. በፍች የተለየች
3. የት/ት ደረጃ፡ 1) ያልተማረ 2) ማንበብና መጻፍ የሚችል 3) 1ኛ-4ኛ-ክፍል
   4) 5ኛ-8ኛ-ክፍል 5) 9ኛ ክፍል እና ከዚያ በላይ

ክፍል 2፤ የቴክኖሎጂ አቅርቦትና አጠቃቀምን የተመለከቱ ጥያቄወች፤

4. ተስማሚ የግብርና ቴክኖሎጂ ለበቆሎ አምራች ሴት አርሶ አደሮች ጠቃሚ ነው?
   1. አዎ 2. የለም
5. በቆሎን ለማምረት የሚያስችሉ የተሸሻሉ ተስማሚ የግብርና ቴክኖሎጅዎች በአካባቢያችሁ አሉ? 1. አዎ 2. የለም

   ሀ. በቂ ዘመናዊ የማረሻ አቅርቦት አለ? 1. አዎ 2. የለም

   ለ. በቂ የመዝሪያ አቅርቦት አለ? 1. አዎ 2. የለም

   ሐ. በቂ የበቆሎ መፈልፈያ አቅርቦት አለ? 1. አዎ 2. የለም

   መ. በቂ የበቆሎ ማስቀመጫ አለ? 1. አዎ 2. የለም
6. መልሰወት ‹አዎ› ከሆነ ባለቤቱ ማነው? ከአንድ በላይ መልስ መምረጥ ይችላሉ።

   ሀ. ግለሰብ 1. አዎ 2. አይደለም

   ለ. የግበሬወች ህብረት ስራ ማህበር? 1. አዎ 2. አይደለም

   ሐ. የግብርና ፅ/ቤት 1. አዎ 2. አይደለም

   መ. የባህርዳር ዩንቨረሲቲ (አስሜክ ፕሮጀክት) 1. አዎ 2. አይደለም

7. የግብርና ቴክኖሎጂወች ለእርሰዎ ተደራሽ ናቸው? 1. አዎ 2. አይደለም

8. እርሰዎ ምን አይነት ማሽን በተደጋጋሚተጠቅመዋል?

1. ማረሻ 2. መዝሪያ 3. የበቆሎ መፈልፈያ 4. የበቆሎ ማስቀመጫ

9. መልሰወት ‹አዎ› ከሆነ ስንት ጊዜ ተጠቅመዋል?

1. አንድ ጊዜ 2. ሁለት ጊዜ 3. ሶስት ጊዜ 4. አራት ጊዜ እና ከዚያ በላይ

10.ይህን ማሽን እንዴት አገኙት? 1. የግለወት ነው 2. በኪራይ 3. በስጦታ

11.በኪራይ ከሆነ ከየት እና ከማን እነደሆነ ይግለፁ? 1. ከግብርና ጽ/ቤት 2. ከግለሰብ

3. ከገበሬች ህበረት ስራ ማህበር 4. የተከራየሁት የለም

12.በስጦታ ከሆነ ከማን እና ከየት አገኙት? 1. ባህርዳር ዩኒቨርሲቲ 2. ከጎረቤት

3. ከግብርና ፅ/ቤት 4. ሥጦታ የለም

13.ስለ ተስማሚ የግብርና ቴክኖሎጂ ጥቅም መረጃ እንዴት አገኙ?

1. ከጎረቤት 2. ከግብርና ባለሙያወች 3. ባህርዳር ዩኒቨርሲቲ 4. ከራሰወት ልምድ

14.ይህን ተስማሚ የግብርና ቴክኖሎጂ መቼ ነው መጠቀም የጀመሩት? ወደ ሁዋላ ያሉ

አመታት-----

15.ምን ያክል በቆሎ በአመት ያመርታሉ (በኩንታል/100 ኪ.ግ)? 1. 20 ኩንታል እና ከዚያ በታች 2. 21-40 ኩንታል 3. 41-60 ኩንታል 4. ከ60 ኩንታል በላይ

16. ከተስማሚ የግብርና ቴክኖሎጂ ተጠቃሚ ነኝ ብለው ያስባሉ? 1. አዎ 2. የለም

17. ለ13ኛው ጥያቄ መልሰወት አዎ ከሆነ፤ምን አይነት ጥቅም አግኝተዋል?

ተ.ቁ	የቴክኖሎጂው ጥቅም	አዎ	የለም
1	ጊዜ ይቆጥባል		
2	ጉልበት ይቆጥባል		
3	ብክነትን ያስቀራል		

18. በቆሎን ለማምረት ተስማሚ የግብርና ቴክኖሎጂወችን ማላመድ ይፈልጋሉ?

1. አዎ 2. የለም

19. መልሰወት አወ ከሆነ ምን አይነት ቴክኖሎጅ ማላመድ ይፈልጋሉ?

ተ.ቁ	የቴክኖሎጂ ፍላጎት እና አይነት	እፈልጋለሁ	አልፈልግም
1	ማረሻ/ትራክተር		
2	መዝሪያ		
3	በቆሎ መፈልፈያ		
4	በቆሎ ማስቀመጫ		

ክፍል 3 ተስማሚ ቴክኖሎጅን ለመጠቀም ያሉ ምቹ ሁኔታወች እና የሚጋጥሙ ተግዳሮቶች፤

20. **በእርሰወ ግምት ተስማሚ ቴክኖሎጅን ለመጠቀም የሚያስችሉ ምቹ ሁኔታወች አሉ ብለው ያስባሉ?** 1. **አዎ** 2. **የለም**

21. *መልሰዎ አወ ከሆነ፤ ይህን ለመጠቀም ምን ምቹ ሁኔታወች አሉወት?*

ምቹ ሁኔታ	**አዎ**	**የለም**
በቀበሌው የግብርና ቴክኖሎጂ የመጠቀም ልምድ ስላለ		
የግብርና ኤክስቴንሽን አገልግሎት ስላለ		
ከፍተኛ የምርት መጠን ስላለ		
በነፃ የሚሰጡ አገልግሎቶች ወይም ቴክኖሎጅወች ስላሉ		

22.**በተስማሚ ቴክኖሎጅ ዙሪያ በቆሎን ለማምረት የሚያስችል ስልጠና ያገኛሉ?**

1. **አዎ** 2. **የለም**

23.**ይህን ስልጠና ያገኙት እንዴት እና በማን ነው?**

1. **ግብርና ባለሙያወች** 2. **ባህርዳር ዩኒቨርሲቲ (አስሜክ ፕሮጀክት)**
3. **በወረዳ ግብርና ጽ/ቤት** 4. **ከራሰወት ልምድ**

24. **ተስማሚ ቴክኖሎጅን ለመጠቀም ተግዳሮቶች አሉበወት?** 1. **አዎ** 2. **የለም**

25. *መልሰዎ አወ ከሆነ፤***የትኞቹ ተግዳሮቶች ይገጥሞዎታል?**

ተ.ቁ	**ተግዳሮቶች**	**አዎ**	**የለም**
1.	**የስልጠና እጥረት**		
2.	**የቴክኖሎጂው ለሴት ተደራሽ አለመሆን**		
3.	**የገንዘብ እጥረት/ የብድር እጥረት**		
4.	**የስርዓተ-ፆታ የተወሰነ ባህሪ**		
5.	**ምቹ ገበያ አለመኖር ለመግዛት/ለመከራየት**		
6.	**የግንዛቤ እጥረት**		

ስለትብብርወት በጣም አመሰግናለሁ!!!

Appendix 2: Checklist Questions for Focus Group Discussants

This checklist is prepared for maize producer women. It constitutes questions that give supplementary descriptions for the survey questionnaire relating to maize production, availability of ASAM and opportunities and constraints of women farmers when they play their role in producing women.

1. Are there appropriate technologies for growing maize in your locality? For the first time ever, how did you get information about the technology? Who told you, where?
2. Are these technologies adequately available in your area? Who is the owner, how do you use it?
3. What benefits do you derive from the use of suited technology?
4. What opportunities would you have in order to use ASAM to improve your maize production?
5. What challenges do you face when using the appropriate technology for growing maize?
6. Is there gender-based violence's or gender-based violence when using appropriate technology? If so, what are they?
7. What technology do you currently want to improve your maize product?
8. What do you generally suggest improving the yield of maize?

Thank You in Advance for Your Cooperation!!!

Appendix 3: Checklist Questions for Key Informants

These checklist questions are prepared for the purpose of acquiring detail information regarding the contribution of ASAM for maize producer women in line with the survey questionnaire. It is forwarded to key individuals who have positions and responsibilities in the community and agricultural office.

1. Is there adequate availability of appropriate scale agricultural mechanization in your locality for maize production? Who is/are the owner? And how the information is diffused to women farmers?
2. Are these agricultural technologies accessible for maize producer women?
3. What are the benefits that women farmers have gotten from ASAM? Have women farmers saved time?
4. What are the opportunities that are created for maize producer women farmers to use agricultural mechanization?
5. What are the challenges or constraints that influence women farmers using improved technologies to produce maize?
6. What kind of technologies women do farmers need to improve maize production?
7. What did you suggest for women farmers better maize production in general?

Guiding checklists: for observation concerning the contribution of maize producer women farmers.

1. Notice the types of improved agricultural technologies women farmers used to produce maize in selected kebele.

2. Observing maize shelling activity in manually and by using sheller.

Thank You for Your Time!!!

Yichalem Mulat

GeDS MA student

Appendix 4: Background information, Date and Place of FGD participants of the Study

FGD Code	Age	Educational status	Marital status	Group	Date of discussion	Place of discussion
1	47	Illiterate	Married	I	2/19/2019	Wadra Mikael Church
2	39	Read and write	Married	I	//	//
3	45	Illiterate	Divorced	I	//	//
4	49	Illiterate	Widowed	I	//	//
5	45	Illiterate	Married	I	//	//
6	34	Grade 7	married	I	//	//
7	37	Grade 3	Divorced	I	//	//
8	53	Illiterate	Widowed	I	//	//
9	38	Grade 9	Married	I	//	//
10	58	Illiterate	Married	II	2/23/2019	Alefa kebele Tach mender gote house
11	41	Read and write	Widowed	II	//	//
12	28	Grade 10	Married	II	//	//
13	53	Illiterate	Divorce	II	//	//
14	45	Read and write	Married	II	//	//
15	52	Illiterate	Widowed	II	//	//
16	31	Grade 6	Married	II	//	//
17	25	Grade 9	Married	II	//	//
18	27	Grade 8	Married	III	2/28/2019	Zalima Kebele administration
19	43	Read and write	Divorced	III	//	//
20	38	Illiterate	Married	III	//	//
21	27	Grade 8	Married	III	//	//
22	43	Grade 3	Married	III	//	//
23	54	Illiterate	Widowed	III	//	//

Participants of Key Informant Interview

(KII) Code	Sex	Age	Position	Work Experience Year	Education Status
1	M	28	DA	6	1st Degree
2	M	48	Kebele chairman	3	Grade 6
3	M	30	DA	5	1st Degree
4	M	43	Kebele chairman	2	Grade 7
5	M	25	DA	3	Diploma
6	M	47	Kebele chairman	3	Grade 5
7	M	35	Crop production and protection technology promotion expert (woreda Agriculture office)	5	1st Degree

Appendix 5: Multiple Linear regression Results

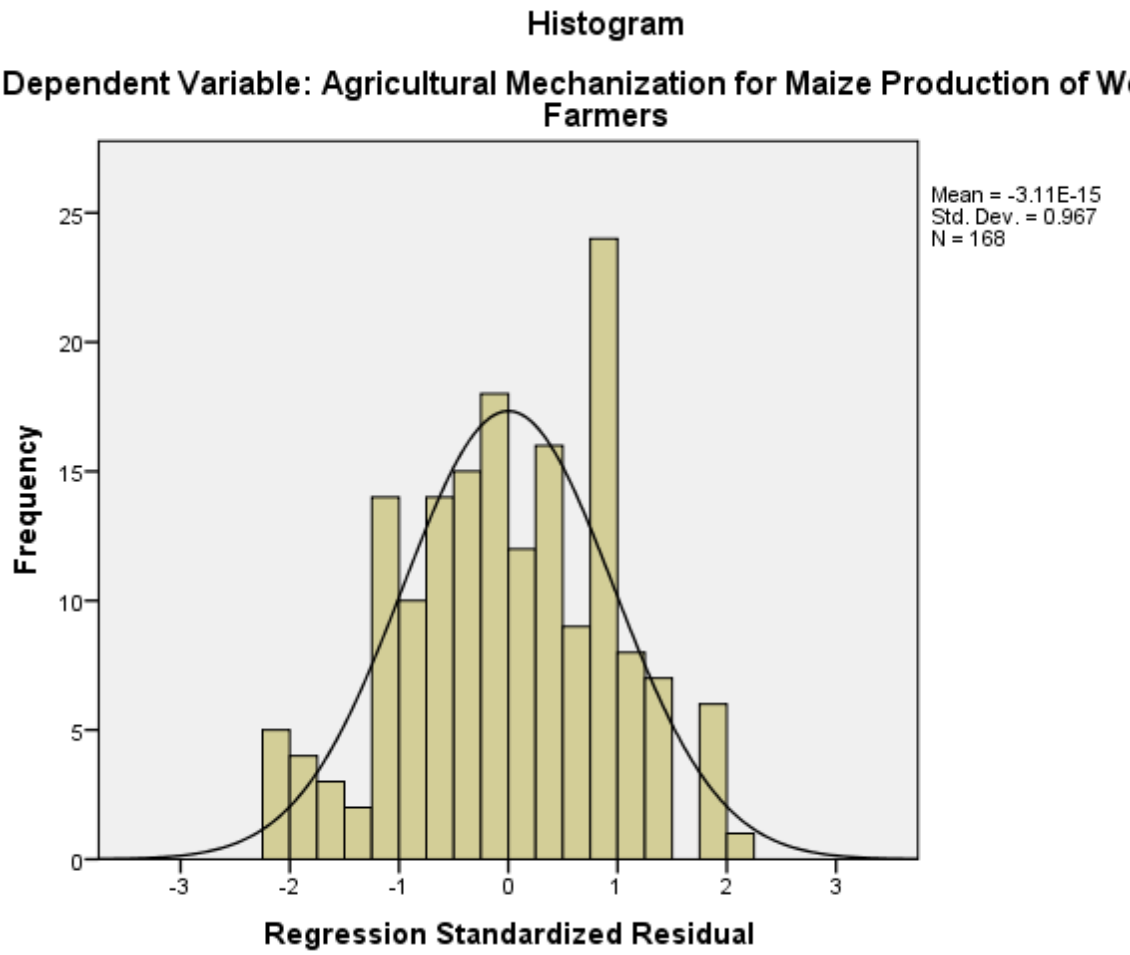
Model Summary

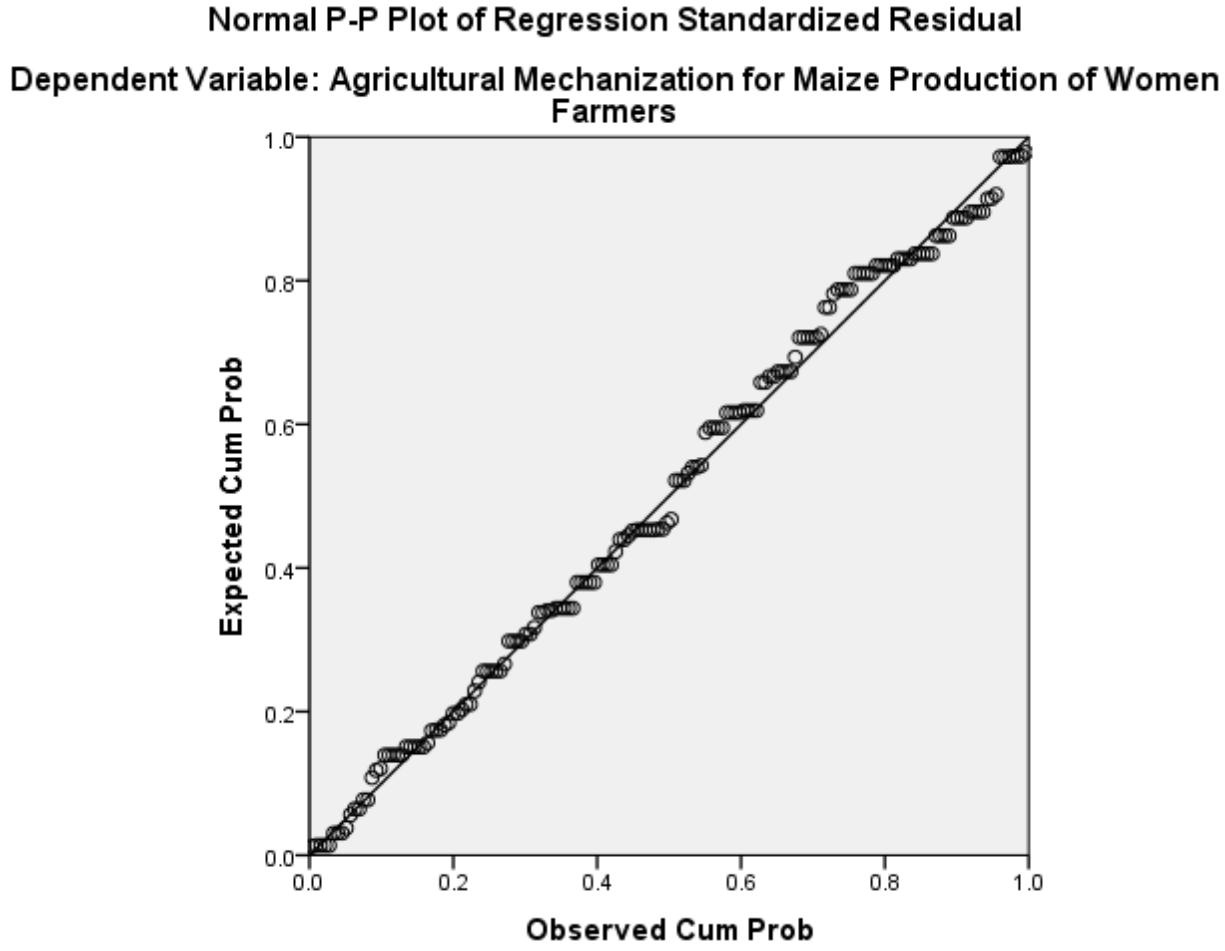
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.917[a]	.841	.830	.12344

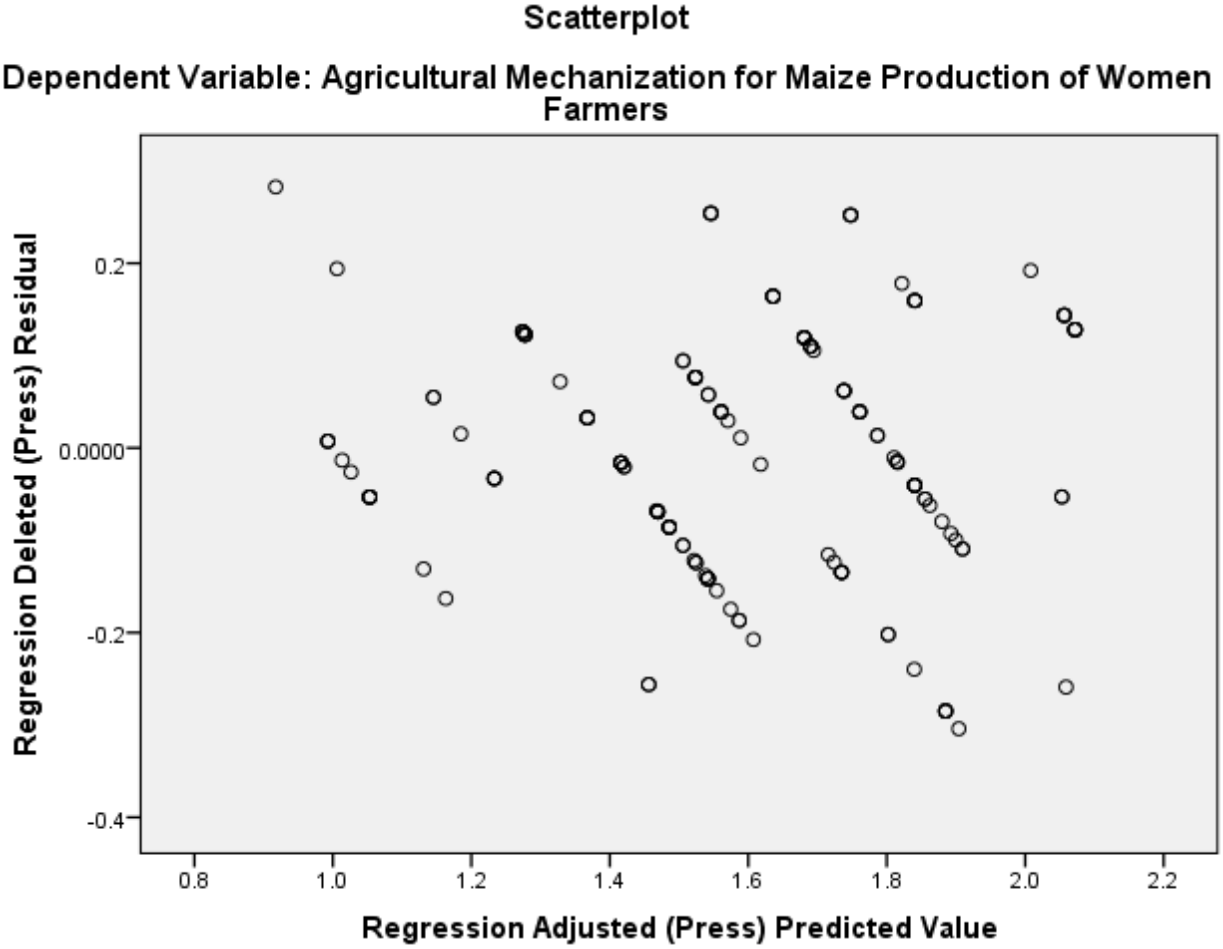
ANOVA[a]

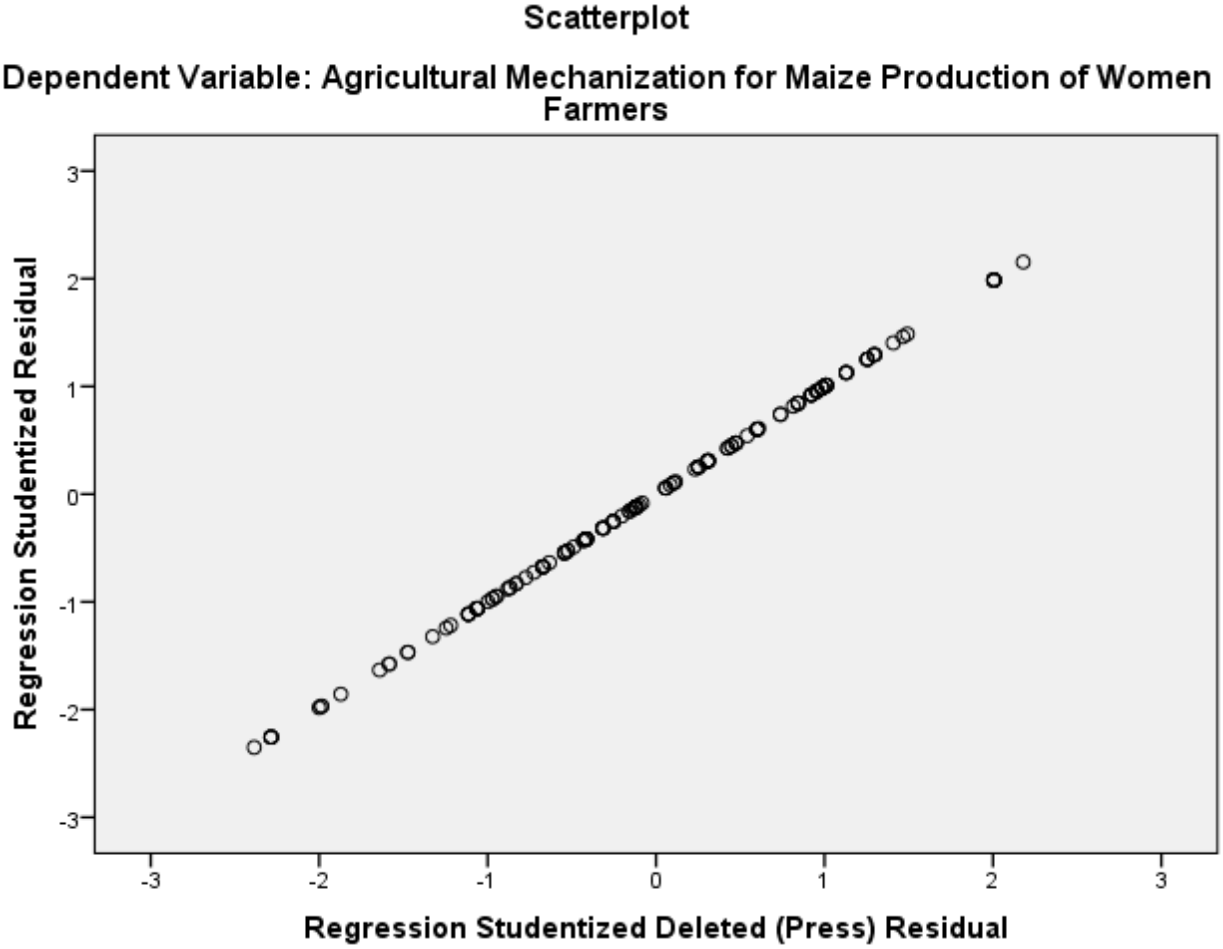
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	12.594	11	1.145	75.146	.000[b]
	Residual	2.377	156	.015		
	Total	14.971	167			

a. Dependent Variable: Agricultural Mechanization for Maize Production of Women Farmers


Histogram
Dependent Variable: Agricultural Mechanization for Maize Production of Women Farmers
Mean = -3.11E-15
Std. Dev. = 0.967
N = 168
Frequency
Regression Standardized Residual


Normal P-P Plot of Regression Standardized Residual
Dependent Variable: Agricultural Mechanization for Maize Production of Women Farmers
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Scatterplot
Dependent Variable: Agricultural Mechanization for Maize Production of Women Farmers
Regression Deleted (Press) Residual
0.2
0.0000
-0.2
-0.4
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
Regression Adjusted (Press) Predicted Value


Scatterplot
Dependent Variable: Agricultural Mechanization for Maize Production of Women Farmers
Regression Studentized Residual
Regression Studentized Deleted (Press) Residual
3
2
1
0
-1
-2
-3
-3
-2
-1
0
1
2
3

DECLARATION

I, the undersigned, declare that the thesis comprises my own work. In compliance with internationally accepted practices, I have duly acknowledged and referenced all materials used in this work. I understand that non-adherence to the principles of academic honesty and integrity misrepresentation/fabrication of any idea/data/source will constitute sufficient ground for disciplinary action by the University and can also evoke penal action from the sources which have not been properly cited or acknowledged.

Signature	Student's name	Date

The thesis work titled "The Contribution of Agricultural Mechanization for Maize Producer Women Farmers" by Yichalem Mulat is submitted for defense with my approval as her research advisor.

Signature	Advisor's name	Date