

**Assessment of the current status of Agricultural Machinery Availability and
Utilization in East Wallaga Zone, Oromia Regional State**



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A Thesis Submitted in Partial Fulfillment of the Requirements for the
Degree of Masters of Science in Agricultural Machinery Engineering

Office of Graduate Studies

Adama Science and Technology University

June 2023

Adama, Ethiopia

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DECLARATION

I hereby declare that this Master thesis entitled “Assessment of the current status of Agricultural Machinery Availability and Utilization in East Wallaga Zone, Oromia Regional State” is my original work. That is, it has not been submitted for the award of any academic degree, diploma, or certificate in any other university. All sources of materials that are used for this thesis have been duly acknowledged through citation.

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RECOMMENDATION OF ADVISORS

We, the major and co-advisor of this thesis, hereby certify that we have closely advised the student while developing this thesis and read the draft thesis entitled “Assessment of the current status of Agricultural Machinery Availability and Utilization in East Wallaga Zone, Oromia Regional State” prepared under our guidance by Hika Endalu Chibsa Summited in partial fulfillment of the requirements for the degree of Master of Science in Agricultural Machinery Engineering. Therefore, we recommend the submission of a revised version of the thesis to the department following the applicable procedure.

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APPROVAL PAGE

We, the major and co-advisors of this thesis entitled “Assessment of the current status of Agricultural Machinery Availability and Utilization in East Wallaga Zone, Oromia Regional State” by Hika Endalu Chibsa, hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

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ACRONYMS

2WTs	Two-wheel Tractors
4WTs	Four wheel Tractors
AMA	Agricultural Mechanization Strategy
AUL	Agricultural Used Land
BBM	Broad Bed Maker
BOA	Bureau of Agriculture
DA	Development Agent
FAO	Food and Agricultural Organization
MOA	Ministry of Agriculture
SPSS	Statistical Package for Social Science
TOT	Transfer of Technology
UN	United Nation
UNIDO	United Nations Industrial Development Organization
WARD	Woreda Agricultural and Rural Development
WFP	World Food Program

ABSTRACT

Agriculture accounts for the majority of economic development in many developing countries, including Ethiopia. Agricultural machinery is a necessary component for modernizing agriculture, and without modernized agriculture, the country would not be modernized. Many farm households in the Oromia region particularly, the East Wallaga zone are still unable to feed themselves, and the agricultural machinery and implements, availability, utilization and factors hindering are not studied in the study area. Based on these issues, the study sought to investigate the current availability, utilization, and the influencing factors, of agricultural machinery and impairments in the study area. Various strategies were utilized to attain the study's goal. Descriptive-statistics research approach was employed, and structured questionnaires were developed. Data were obtained from purposively selected woredas and kebeles in the study area, a total of 380 respondents, contacted from which 360 are farmers and 20 of them are experts from zones, woredas, and DAs. MS Excel 2016 was used for data coding and entry and SPSS version 29 was used for data analysis. To investigate characteristics related to the availability and utilization of agricultural machinery, descriptive statistics were used. According to the study's findings, capital, cost, a lack of suppliers, productivity, a lack of replacement parts, and maintenance service may all have a significant impact on the availability and usage of machinery. Lack of credit access, lack of capital, cost unaffordability, lack of government consideration, and Absence of brokers were factors that affect the availability of Agricultural machinery. Whereas topography, land size, the goal of production, productivity, absence of service provider, and family size were factors that affect the utilization of agricultural machinery. Participants who had primary and below education levels were 49%, who had above primary education were 5% and no negative effect shown on the availability and utilization regarding the educational level. There was significant difference between productivity of farmers who technology utilizes and non-user by (35%). Agricultural machinery is an ideal technology that facilitate modern farming system so that further studies will conduct to improve the availability of appropriate machinery based on land size and topography as well utilization of the technology for small-scale farming.

Keywords: Agricultural Mechanization, Agricultural Machinery, Availability and Utilization of Agricultural machinery.

CHAPTER ONE

INTRODUCTION

1.1. Background and Justification

The development of agricultural mechanization has made a significant contribution to the success of the modernization process of the agricultural system in many developing countries today (Degefu, 2020). It is because agricultural machinery is an essential element of modernizing agriculture and then becomes a crucial input in the agricultural production process (Yigezu, 2021). The mechanized operations of agriculture have helped to increase the primary productivity of land and labor, reduce production costs and drudgery on farm labor, and improve the timeliness and quality of farm work (Deribe & Getnet, 2021). The mechanized farming system is also expected to make agriculture more attractive and reduce rural-urban drift. Agricultural mechanization refers to the use of Agricultural machinery and other engine power and equipment for carrying out farm operations, which later replaces human labor and animal power used in agricultural operations (Paman et al., 2018).

The adoption of mechanization by farmers has followed an evolutionary process that is influenced by a set of country-specific agro-climatic factors, economic factors, and social conditions on which the government's policy choices have an impact. Furthermore, many factors are affecting the utilization and development of machines, such as agricultural conditions, farming requirements, farm management scales, economic conditions, the technical level of manufacturers, and farmers' experience (Kirui & Braun, 2018). Ethiopian agriculture has low input and low output, resulting in crop productivity levels much below regional and worldwide standards (Deribe & Jaleta, 2019). In Ethiopia in terms of total arable land, animal traction is the primary farming technology used by smallholder farmers, and it dominates crop production (Kelemu, 2015). Agricultural mechanization contributes significantly to agricultural development by boosting land and labor efficiency, bringing more land under agriculture, and saving energy and resources (Paman et al., 2018). Ethiopian agriculture, which employs 85% of the population, continues to rely on hand tools dating back thousands of years (Amare & Endalew, 2016). These implements are hand tools or operated using animal power, which is mainly oxen (Analysis & Scale, 2014). Recognizing the benefits of agricultural mechanization and the ongoing dynamics, the formulation of the Agricultural Mechanization Strategy (AMS)

and amendment of import duty on mechanization inputs are the steps taken to encourage the development of mechanized farming in Ethiopia (Mrema et al., 2018).

Mechanization contributes to the efficient utilization of resources and increased factor productivity due to the benefits of higher precision, timely operation, reduced drudgery, and labor-saving (WFP, 2020). However Ethiopian agricultural activity remains the least mechanized and plowing, threshing, and transportation are all done using animal power (Li et al., 2023). Agricultural machinery in agriculture uses various farm power resources, advanced agricultural tools, and equipment, for the farmer thereby increasing crop production and productivity (Kuto et al., 2018). Ethiopia needs a massively available program on mechanization that delivers knowledge and awareness amongst farmers through potential entrepreneurs and extension agents (Indraningsih et al., 2021). The introduction of machinery at various stages of farm operations will not only improve agricultural commodity chains but also enhance rural employment opportunities and the profitability of farming. To improve Agricultural mechanization in Ethiopia, it is necessary to find out the challenges and solutions to them in the agriculture sector (Yigezu, 2021).

Tractor-farm equipment has become increasingly popular among smallholder farmers in recent years, at the expense of draught animals (Mrema et al., 2018). However, Within the agricultural production chain, the use of tractors should not be considered alone because mechanization does not mean only tractorization (Adela, 2022). Machinery is an important element of agricultural growth and a factor in the transformation of agricultural production and rural communities at large (Negrete, 2019). Agricultural machinery technology plays a key role in improving agricultural production in developing countries and should be considered as an essential input to agriculture.

However, to meet the demands of each local area it is necessary to form an integrated system in which researchers, developers, manufacturers, and distributors are present locally and are engaged in collaborative efforts to solve farmers' mechanization problems locally (Kuto et al., 2018). The importance of demanding agricultural machinery and utilization inputs (like tractors tillers, harvesters, irrigation pump sets, and diesel-powered engines) has been showing an increasing and improving trend of Agricultural mechanization and is estimated to be growing at a

rate of 1 to 1.5 percent per year but the tractor density in Ethiopia is only four tractors per 100 square kilometers of arable land, which is the lowest in Sub Saharan Africa (WFP, 2020). Effective Agricultural mechanization can contribute to the increase in the production of agriculture and it can be in two effective methods the first method is the timeliness of agriculture operations in farming, and the second method is the betterment of the quality of agricultural work (Kuto et al., 2018).

In Ethiopia in general and specifically in the Oromia region, there were rising complaints at different forums from development practitioners for low utilization of the technology of agricultural mechanization and there is a need to identify the reason for the case (Gebiso, 2016). The different research output has shown that only 11% of the sampled farmers (even though their samples were not representative as they mentioned) were reported to have used different machines (Workneh et al., 2021). In Oromia, there are considerable numbers of agricultural mechanization technologies centers but there is a big problem facing adoption and availability even though there is high demand pressure from farmers for most technologies. Farmers continue to employ animal power for agricultural activities such as plowing, threshing, and transportation despite recognizing the benefits of agricultural machinery and the disadvantages of animal power. This is due to the country's scarcity/limited availability of mechanization.

The entire field operations at small-scale agriculture are performed with very simple farm tools with mainly human and animal power sources. Therefore, appropriate management practices are urgently required to address the constraints and increase crop production while preserving the potential for future generations. The distribution and utilization of agricultural mechanization technology in Oromia are minimum and so different from zone to zone when it is compared, especially the availability and utilization of it in the Wallaga zone are approached zero with other parts of the country region. The availability of Agricultural machinery is not enough to support agricultural activity and there is also no effective distribution of mechanization technology which can solve the problem of small-scale farmers and increase productivity. Therefore, for the ease of policy intervention by the policymakers, and development practitioners, the factors that hinder the utilization/adoption of those technologies must be enumerated and identified. Because the successful implementation of mechanization requires considerable effort by policymakers,

institutions, and extension workers to introduce new mechanical techniques and adapt them to the agricultural production process on a small scale. This study will also be initiated to systematically investigate the availability and utilization rate and factors that hindering of the technologies in the study area.

1.2. Statement of Problems

The agricultural machinery utilization level in Ethiopia is poor; it does not appear to have reached the desired levels compared to developed and other developing countries (Diriba, 2020). The government's modern agriculture program aims to increase production, improve productivity and reduce farming costs through mechanization technology and machinery utilization (Negrete, 2019). However the agricultural machinery utilization of farming activity in Ethiopia is minimum and Even with abundant agricultural resources and following a consistent agricultural policy to boost agricultural productivity, the expected productivity increment was not achieved (Bihon, 2015). Ethiopian farmers have stuck with the centuries-old tillage tool known as the maresha, which is still used for both primary and secondary tillage (Oromia & Boka, 2022).

The agricultural activity uncorroborated by technology in many parts of the Oromia, resulting in low yields and farmers caught in a cycle of poverty and food insecurity. Many farm households in the Oromia region particularly, the East Wallaga zone are still unable to feed themselves as a result of their production system is low in input and low in output which is highly traditional. The availability and utilization of agricultural machinery and the factors hindering are not known in this area. However the mechanization technology (machinery) have great role in the increasing the agricultural production (Worku, 2019). So the agricultural mechanization is needed, the study of the availability and utilization of the agricultural machinery and identifying the factors affecting is necessary. Therefore this study is needed to show the availability, utilization as well as the factors hindering the agricultural machinery in the East Wallaga Zone.

1.3. Objective of the Study

1.3.1. General Objective

The general objective of the study is to investigate the availability and utilization of agricultural machinery in the East Wallaga zone of the Oromia Regional state.

1.3.2. Specific Objective

- To evaluate the availability and utilization of agricultural machinery and implements for agricultural operations in the study area.
- To evaluate current status of agricultural machinery and implements in the study area.
- To assess the factors hindering the availability and utilization of agricultural machinery in the study area.

1.4. Significance and Beneficiary of the Study

The significance of this study was to show the status of agricultural mechanization utilization, availability, and distribution of Agricultural machinery in the Wallaga zone of the Oromia Region. This research work is important to find out the problems that limit and hinder mechanization technology utilization and distribution of Agricultural machinery in the study area. The information that was generated from the study will be used by development practitioners and the community in the area to accept and adapt mechanization technology based on the findings to improve the distribution of Agricultural machinery and practices of utilization.

The finding of the study can also support identifying the challenges, and alternatives in policy formulation and the planning of appropriate programs regarding the availability, distribution, and utilization of Agricultural machinery on small-scale farms. In addition, the finding of this study will be used by individual researchers, the community, the government, and NGOs in the woreda and as baseline data for further study. Also, farmers, laborers, dealers, researchers, and manufacturers are among the beneficiaries of the study. To provide distributors, mechanization extensions, and researchers in similar areas access to information regarding the problems in the availability, distribution, and utilization of machinery and they can utilize this as an initial guide to investigate more research and find better ways of effectively utilizing mechanization technology in the study area.

1.5. Scope of the Study

The focus of this research was limited to examining the availability and utilization of agricultural machinery for the agricultural activity of farmers in the Guto Gida, Diga, Sasiga, and Gida Ayana districts in the East Wallaga Zone of Oromia regional state. The evaluation considered different parameters on the availability and utilization of machinery and factors hindering the current status of mechanization technology through structured questionnaires, interviews, field observation, and focus group discussion.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Overview of Ethiopian Agriculture

Agriculture is the second-largest contributor to overall economic growth and a significant contributor to reducing poverty. It accounted for about 42.9% of the national GDP (only slightly behind the service sector at 45.2%) almost 90% of foreign exchange earnings and 85% of employment (Oromia & Boka, 2022). While agricultural productivity in Ethiopia is improving, there are still major gaps in productivity when compared with the rest of Africa in some crop areas, and almost universally, when compared with the global output level.

For example, the African average production of wheat is approximately 10% higher per hectare, and the global average is about 50% higher than in Ethiopia (Paul & wa Gĩthĩnji, 2018). In countries like China, there has been a significant correlation between the increased use of agricultural mechanization and increased productivity. Even with significant improvement in productivity in recent years, Ethiopia is still a net wheat importer. In addition to this, approximately only 12% of the total arable land is utilized for agriculture, with the expectation that this percentage will grow, both in relative and absolute terms. Ethiopia's farmers are also diverse; agriculture is dominated by smallholder farming (Semahegn, 2021).

2.2 The Role of Mechanization in Agriculture

Mechanization in the agriculture industry has been defined in different ways. FAO defines mechanization as “the application of tools, implements, and machinery to achieve agricultural production”(Tesema, 2021). To mechanize means to employ machines to accomplish jobs or procedures. A machine may be as simple as a wedge or an inclined plane, or as complicated as an airplane. Agricultural mechanization, therefore, is the employment of any machine to execute a task or operation involved in agricultural production (Ajama, 2022). The role of mechanization in agriculture is to reduce labor peaks by enhancing the quality of work and aiding in carrying out work on a schedule (Gego, 1986). Mechanization is a fundamental component of the technology that permits agricultural productivity to be intensified. When there is an increasing need for food, additional land must be brought under cultivation, or intensely cultivating the current land, requiring more labor use per unit of land, mechanization will be adopted.

Mechanization is the continued introduction of farm equipment to make activities such as land preparation, crop production, harvesting, processing, and transport of goods more efficient (Africa, 2016). Higher accuracy and promptness in operations, reduced drudgery, and overall labor savings lead to increases in resource use efficiency, labor productivity, and land productivity, all of which improve quality of life (Leta, 2017). Mechanization is regarded as a motor for agricultural transformation; only very specific farm operations are still accomplished manually in high- and middle-income countries (Suleyman & Nuradin, 2020). The demand for mechanization in agriculture has emerged over many years due to several different variables. The evaluation of farming systems and increase in irrigation use, access to institutional credit, increase in land size holdings, urbanization, lower risk aversion, and access to extension services and education are all drivers that have helped push mechanization's demand (Gebiso Challa, 2016).

Agricultural mechanization deals with the design, utilization, and management of technological systems and processes of engineering for the production, storage, treatment, and processing of agricultural goods. Also, it aims to increase land and labor use, work to increase the cultivated area, save resources (seed, fertilizer, water), and improve energy products and quality protecting the environment; through proper use of inputs, saving sustainability of agricultural production, creating attractive jobs for men and women, to prevent rural exodus, improving farm management and multi-farm use, and increasing farm income (Bishaw & Atilaw, 2016). Farming will become more profitable and the agricultural supply chains will be improved with the use of mechanization at various levels of farm operations. Agricultural Mechanization is an important link in the achievement of effective growth in production and it needs to be addressed in a larger context (Dawit & Eshetu, 2016). Agricultural mechanization implies the use of various sources of improved Agricultural machinery and equipment to make farm operations mechanical, especially to replace manual labor. Using machinery reduces human drudgery, increases productivity, and improving the timeliness of agricultural operations such as planting and harvesting, and reduces peak labor demands are among the most prominent (Gebremariam et al., 2021). Mechanization technology keeps the change with industry growth of the country and the socioeconomic advancement of farmers whereas declining interest in agriculture of the land owner and non-availability of agricultural labor for field operation may be one of the major

socio-economic issues in the highly industrialized nation, increased and labor productivity with dignity are the mechanization requirement of the developing country.

The quality of input of mechanization and consequently land and labor productivity in both situations may differ considerably (Oromia & Boka, 2022). The farming system typically moves from hand tool technology to the selective use of draught animals or tractors for a certain operation. The ability to mechanize is determined in part by the nature of the operation as well as other technological, economic and financial, and environmental considerations. It passes through three mechanization levels. These three levels of mechanization have their degree of sophistication. For example, for land preparation: hand tools technology (the simplest and most basic level of agricultural mechanization) requires tools and simple implements like a hoe, spade, etc. Draught animal technology refers to the implement (steel plow, spike harrow, disc harrow, and ‘Maresha’) and utilization of animal muscle as the main power source while mechanical power technology refers to the highest technology level in agricultural mechanization. It consists of all machinery that obtained its main power from the other sources other than muscular power (Tesema, 2021).

The mechanization covers all levels of production and agricultural processing technologies, from simple hand tools to the most sophisticated motorized equipment. Mechanization facilitates and reduces heavy work, alleviates the lack of labor, improves productivity and opportunity of agricultural operations, improves the efficient use of resources, strengthens access to markets, and contributes to the mitigation of climate-related threats. Sustainable mechanization considers aspects of the technological, social, environmental, and cultural fields to contribute to the sustainable development of the agricultural and food sectors (Negrete, 2019). The organization of all production inputs, including land, capital, and labor, as well as research, education, communication/information, and engineering/technology in agricultural activities is known as agricultural mechanization (Asoegwu, 2017). For agricultural land development, crop production, harvesting, preparing for storage, storage, and on-farm processing, it embraces the use of tools, equipment, and machinery.

2.3. History of Agricultural Machinery in Ethiopia

Ethiopia's agriculture has shown amazing resilience over many millennia but is now gradually failing. This was proved by the astonishing way it has sustained a continually rising Ethiopian population with millennia-old tools and ways of production. Ethiopia was one of the initial locations for crop and livestock domestication that started during the Neolithic Revolution ten thousand years ago (M. Baker et al., 2019). Ethiopian farmers have persisted in using their ancient production system despite shifting ecological and population constraints, feeding, although with difficulty, Ethiopia's expanding population into the twenty-first century by utilizing generationally acquired wisdom and abilities. Ethiopia has a lengthy history of participation in agricultural machinery such as 4WTs, 2WTs, irrigation pumps, and equipment.

To nurture agricultural mechanization, state farms both irrigated and rain-fed have played a very big role, especially during the second period of “socialist experimentation”, when large mechanized state farms were established totaling about 200,000 hectares, out of which about 47,000 hectares were irrigated (FAO Vol.20, 2013). Another mechanization approach tried in the 70s to 90s period was government-operated tractor hire schemes. These were later abandoned; partly due to the heavy financial burden on the government as a result of subsidizing the service (Analysis & Scale, 2014). Furthermore, the timeliness of the agricultural operations was difficult to achieve because of conflict among users of the service. Studies on the economic benefits of these schemes were also carried out during this period and it was concluded, based on the various shortfalls identified, that government-managed and operated tractor hire schemes were not successful and were consequently largely abandoned in the late 1990s.

In Ethiopia, an estimated 5,090 tractors were in use as of 2010, a significant increase since 2004 when the number was about 3,000. The 2010 figure increases to about 6,000 when “walking” or pedestrian tractors are included. The number of tractors per 100 square km of arable land was about 4.0 and 4.7 respectively with and without the pedestrian tractors. This steady increase in the number of tractors is primarily attributable to the growing number of foreign private investors engaged in large commercial agriculture in Ethiopia, mainly from China, India, and Saudi Arabia (WB report, No. 68237). Even though there is an increasing number of machinery, its availability and demand do not match, and very low mechanization. Systemic obstacles to

agricultural and rural transformation in Ethiopia can be summarized as a lack of sustained and intergenerational commitments to transformation, constitutional and legal constraints, government crowding out the private sector leadership, a lack of mechanization options, and a constrained input supply system, a lack of effective and accountable organizational capacity, a lack of agricultural and rural finance and credit facilities, and environmental degradation.

2.4. Farm Power in Ethiopia

The level of energy input is one of the key indicators for measuring the state of mechanization. Farm power in Ethiopia in general, especially among small-scale farmers who account for about 80 % of the total farm output, relies mainly on animal traction and human power. It is based on operations that depend on the hoe and other hand tools. Using simple hand tools, a farmer can prepare an estimated 0.5 ha for planting per season. For farmers earn a living from agriculture, they cannot count only on hand-tool technologies since a person as a power unit produces only about 0.01 horsepower of continuous output and is therefore not worth much as a primary source of power (Yared et al., 2021). In general, there are three main levels of mechanization based on power sources, mechanical, animal, and human. The main goal of agricultural mechanization is to replace manual labor with machinery and other inputs in farming operations to increase productivity (Getahun & Milkias, 2021).

It encompasses the production, distribution, and use of all forms of tools, implements, machinery, and equipment for agricultural land development, farm production, crop harvesting, and initial processing in the broadest sense (Diriba, 2020). Mechanization can help boost output and profitability, improve input utilization, lower manufacturing costs, and create new job opportunities. ASAE classifies agricultural mechanization technology into three basic levels: hand-tool technology (HTT), draft-animal technology (DAT), and mechanical power or engine-power technology (EPT). Many factors influence Agricultural mechanization, but one key determinant must be the question of return on investment (Tesema, 2021). Animal power accounts for approximately 20% of agricultural mechanization in developing nations, whereas human power accounts for 70% and mechanical power accounts for 10% (Worku, 2019).

Hand tool technology

A Hand tool is the simplest and most basic level of agricultural mechanization and the use of tools and simple implements using human muscle as the main power source.

Draught animal technology

This refers to implements and machines utilizing animal muscle as the main power source. Draught animal is prestigious in Ethiopia for those whose economy is based on agriculture, particularly on crop production. From the existing condition, farmers use oxen, mules, horses, and donkeys as motive power for farm work. According to World Bank (2003), farm power in Ethiopia, like other sub-Saharan African countries relies on animate power.

Mechanical power technology

The highest technology level in agricultural mechanization and embraces all agricultural machinery which obtains its main power from other sources other than muscular power. This covers the production, distribution, use, and maintenance (both on and off-farm) of all kinds of tools, implements, machinery, and equipment for agricultural production activities, such as planting, harvesting, and processing activities. Examples include clearing, leveling, tillage, planting, and irrigation. Animal traction power, internal combustion engines, human energy (hand-tool technology), or a combination of any of the three may be used to power agricultural mechanization equipment. Mechanization is not a process that occurs in isolation, there is a close relationship between the processes as such and the characteristics of different crops since they do not have the same requirements. These have different specificities, as well as different varieties of plants within the same species nor do they exhibit the same behavior, which in one way or another affects mechanization (Kirsch et al., 2018).

2.5. Mechanization Technology and Productivity

Agricultural mechanization contributes significantly to agricultural development by boosting land and labor efficiency, reducing the difficulty of farming operations, bringing additional lands under cultivation, and saving energy and resources. The development and application of improved agricultural techniques and technology in rural regions should be prioritized to sustain agricultural growth and transformation. Economic growth is supported by agricultural

mechanization through increased yield per hectare and extension of the cultivated area, either by absorption of new land or the ability to carry out more than one plantation per year in the same area unit (Yared et al., 2021). One of the factors that have the greatest impact on the increase of agro-food productivity is the mechanization of agricultural work, according to the Operational Guide of the Program of Innovation, Research, Technological Development, and Education. Its main goal is to raise labor productivity and free human from heavy, labor-intensive, and fatigue operations. Production encourages the economical and judicious use of raw materials, processed materials, and power, as well as the decrease of prime costs and the enhancement of product quality. Mechanization of production is directly related to an increase in the skill level of employees, production organization, and the application of the method of scientific organization of labor, in addition to improvements and replacements of the machinery and the production process. Large-scale farmers are often the first adopters of mechanization as profitability is possible for them based on preparing their large land area.

With the rising cost of labor, farmers are more inclined to invest in machinery or to make use of machinery and technology-hiring services where they are available and affordable (Diao et al., 2017). Evidence from a study in developing countries shows that the combination of the decrease in farm labor and the increase in demand has resulted in a rise in land-labor ratios and a demand for labor-saving techniques, or mechanization, in agriculture (Deribe et al., 2022). It guarantees the growth of the labor force and services needed to increase the effectiveness of public production, which is being developed through intense methods (Adela, 2022). It helps the farmers to achieve timeliness and precisely meter and apply costly input for better efficiency. Timeliness is an important factor in agricultural production. Completing certain farming operations such as planting and harvesting promptly increases yields and improves profitability. Farming operations are seasonal with fluctuating labor demand. More labor is needed during planting and harvesting than during other periods of plant growth. This fluctuation in labor demand creates labor-management problems. With mechanization, it is possible to reduce peak labor demand and maintain a more stable labor force on the farm.

2.6. Mechanization of Small Farms

Small-scale farms have limited capacity to invest in large Agricultural machinery through funds or else they are constrained by the lack of access to formal financial services (Deribe & Getnet, 2021). The appropriate mechanization discourse is in favor of the hiring service models that smallholder farmers can access mechanization through low-cost hiring services despite assumed transaction costs (Diao et al., 2018; Kienzle, 2017). As reports indicated, not only technological solutions but also institutional approaches are essential for the enhancement of smallholder mechanization, for example, cooperative exchange and rental markets have played key roles. The farmer-to-farmer mechanization hiring service (often medium-scale farmers) is the alternative supply model, which offers diversified opportunities due to off-farm and on-farm income streams (Van Loon et al., 2020). Despite the farmer-to-farmer service being imperfect, it will be more competitive in terms of reduction of administrative costs and related inefficiency in contrast to specialized hiring services. The collective ownership service approach requires the mobilization of resources, effective governance, and enhancement of skills. The direct provision of mechanization hiring services by the government is practiced in some countries (Diao et al., 2016; Zhou, 2016) and specialized private operators are alternatives for supplying mechanization hiring services to small farms. The spatial variability of the hiring cost is correlated with per-area machinery density, constraints of mobility, shipping of machines, road conditions, and efficiency of the service market (Houssou et al., 2016; Diao et al., 2016).

2.7. Agricultural Machinery

Agricultural mechanization is concerned with the design, implementation, and administration of technical systems and engineering processes used in the production, storage, treatment, and processing of agricultural goods. Agricultural mechanization aims to increase land and labor use, save resources (seed, fertilizer, water), and improve energy products and quality to protect the environment through proper input use, saving agricultural production sustainability, creating attractive jobs for men and women, preventing rural exodus, improving farm management and multi-farm use, and increasing farm income (Gebiso, 2016). There are many areas of land available in different parts of the country today, but not all the lands are suitable for crop production, and to make them economically feasible for agricultural production, different mechanical tillage operations will be conducted (Addo & Amponsah, 2018).

The most important operations required include: adequate seedbed preparation for seed planting, germination, proper growth of the crop, mechanical weed control or application of herbicides/pesticides, fertilizer application, harvesting and conveying of farm produce to the final/designed destination (Oniya, 2021). Agricultural machinery is a significant and fundamental component of agricultural development and crop production in many countries. The primary goals of the machinery are to eliminate challenges in agricultural operations and maximize production. Most of the increased crop production which was recorded over the years in agriculture is attributed to principally the high utilization of appropriate machines and implements (Paman et al., 2018).

Agricultural machinery is an essential component of agricultural development and crop production in many countries' modern agriculture. The major goals of the machinery are to make farm activities easier and to increase output. Agricultural machinery includes tractors, plows, discs, planters, and combines, as well as any equipment used by farmers to till, plant, cultivate, and harvest (Omer, 2013). Mechanized farming reduces losses or even turns them into profit through timely farm operations (Singh, 2014). Farm energy sources are classified as human, animal, mechanical, or a combination of these (FAO, 2016). Animal power has been the major source of power accessible to Ethiopian farmers for plowing, threshing, and rural transport since ancient times. Shortages and inefficient use of agricultural electricity limit the total area under cultivation and are accountable for low crop output due to late planting, weeding, fertilizer applicators, and harvesting (Sims and Kienzle, 2006). These machines are powered by prime movers (tractors) if they are not self-propelled and are used on the farm for agricultural field operations. Most of these machines are fully mounted/ hitched, semi-mounted, self-propelled, or trailed implements (Oduma et al., 2019).

Modern agricultural operation demands the application of these field machinery and implements in different farm operations from field clearing to harvesting operations because Agricultural machinery is crucial to agricultural productivity since it streamlines tasks. For most agricultural firms, it adds a significant capital input cost. Agricultural machinery can improve an agricultural system in various ways, including greater land and labor productivity, risk reduction, food quality improvement, and time savings (Melesse & Nachimuthu, 2017). Ethiopian farmers are

also diversified; smallholder farming dominates agriculture. There are around 14.7 million families, with approximately 60% operating on less than one hectare of land and only about 1% operating on land larger than four hectares (Isaak et al., 2020).

They are classified as follows: 1) Marginal farmers have farms that are less than 0.5 hectares in size and account for around 36% of rural households. 2) A small farmer's farm of between 0.5 and 1 hectare in size 3) Semi-medium farmers: farms ranging in size from 1 to 2 hectares 4) Medium farmers have farms between 2 and 10 hectares in size, and large farmers have farms greater than 10 hectares (Paul & wa Gĩthĩnji, 2018). ATA and MoA are now drafting an agricultural mechanization strategy based on the experiences of other nations. Until 2015, the government estimated that only 5.5% of all farmers found throughout the country had plowing machines, with only 22% solely held by smallholder farmers (Ayele, 2022). In other words, the proportion of farmers plowing machines is owned by 1.21% of all smallholder farmers (ATA annual report, 2015).

There is currently just 0.3877 kW of farm power per hectare. This farm power is derived from existing labor available from oxen at 13 million heads (87%) and 12,500 tractors (13%). The limited and scattered land holdings that make technology excessively expensive and ineffective for small and marginal farmers are a primary cause of Ethiopia's agricultural mechanization challenges (Indraningsih et al., 2021). The government has devised a mechanization strategy to increase farm electricity per hectare to 1 kW by 2025. However, the import policy only generously allows duty-free imports of machinery to licensed investors, while the vast majority of manufacturers and smallholders must pay the charge and smallholders cannot afford agricultural machinery as a result (Agricultural Mechanization Forum of Ethiopia, Dessye & Laike, 2023). Shortages and inefficient utilization of agricultural electricity limit the total area under cultivation and contribute to low crop production due to late-performed procedures (Oduma & Oluke, 2019).

The experienced farmer is active to utilize in full capacity agricultural mechanisms such as Agricultural machinery, pest, and weed control measures, seed planting, fertilizer and chemical applications, irrigation equipment, energy supply, livestock feeds, etc., to optimize production at

a reduced cost. Agricultural machinery is a device that enables other inputs to achieve the needed results and can be believed that Agricultural machinery and the system of operation generally make up the field of Agricultural mechanization (Oduma et al., 2019). The provision of agricultural machinery in the Modern Agriculture Program is to overcome drudgery and increase production. However, the utilization of agricultural machinery aid is underutilized (FACASI, 2014).

The provision of agricultural machinery in the Modern Agriculture Program is to overcome the challenges of production and increase productivity (Diriba, 2020). However, the concept on the availability and utilization of agricultural machinery and implement is not well understudied. This study aims to analyze the availability and utilization agricultural machinery and equipment and factors hindering in order to optimize the use of agricultural machinery and implement by creating the view of availability and utilization in enhancing the implementation of modern agricultural programs. The review results showed that the availability of agricultural machinery in the Modern Agricultural Program was still not optimal and it was still underutilized (Indraningsih et al., 2021).

2.8. Affordability and Availability of Agricultural Machinery

Smallholder farmers are virtually by definition resource-poor, and they frequently struggle to invest in physical assets in general, and agricultural equipment in particular (Patricia, 2021). The main case in mechanization is that agricultural machinery vendors are only located in larger towns and cities, as perceived low demand for equipment in rural areas does not usually justify the construction of distribution networks (Sims et al., 2016). Smallholders are frequently separated due to distance and poor infrastructure (particularly feeder roads). There is limited access to sources of financial credit due to the lack of availability of financial products specifically focused on farm equipment investment, the misconception of many financial institutions regarding the need for targeted financial products for equipment investment, the fundamental nature of agricultural production as a high-risk business, and the reluctance of commercial financial institutions (primarily banks) to extend credit to poor farmers with little collateral.

2.9. Experience of Other Countries in Customization of Agricultural Machinery

According to research, Ethiopia's present mechanization problem is similar to that of South and Southeast Asian countries such as Bangladesh, Thailand, Vietnam, and Sri Lanka a few decades ago (Sheahan and Barrett, 2017). Even though the socioeconomic status at the time. The main cause of the rapid expansion in the number of tractors in Asia could be attributed to government initiatives encouraging the use of locally built agricultural machinery and implementing suppliers. In contrast, the high cost and unsuitability of imported machinery remained important barriers for Sub-Saharan African (SSA) countries (Baker, 2008). Bangladesh's agriculture, which is centered on small machines like two-wheeled tractors, is one of the most automated in South Asia, even surpassing India's agriculture, which is based primarily on larger Agricultural machinery (Baudron et al., 2015).

The number of farm machines has expanded since the government approved duty-free imports of Agricultural machinery and equipment in 1995. For example, the 2WTs increased from 5,000 units in 1989 to 100,000 units in 1996. According to estimates, an average of 60,000 units was imported each year (International Development Enterprise Report, 2012). Even though smallholder farmers possess less than 0.65 hectares of land on average, which is half of Ethiopia's, the deployment of 2WTs has enabled mechanization of the scattered farmlands. Only in 2012, 69.9% of total farmed land in Bangladesh was under 2WTs (Baudron et al., 2015). Appreciating and supporting indigenous agricultural machinery manufacturers has helped Vietnam achieve a high level of mechanization. Vietnam has the most mechanized agriculture in Asia, with approximately 900,000 agricultural machines and 270,000 2WTs with engine capacities of less than 12 HP; of this, 85% are owned by smallholders (having less than one hectare of land).

This was accomplished by Vietnamese manufacturers, the majority of whom manufacture 2WTs (Tuan, 2016). This South Asian mechanization model appears equal, as even the poorest farmers have access to 2WT-based services, which are less expensive than those based on animal traction or 4WTs. Due to the inexpensive cost of 2WTs, many farmers were able to purchase them without the assistance of a formal banking institution (Baudron et al., 2015). There are numerous reasons why farmers should buy agricultural machinery when it is available. Some of the

problems include a manpower shortage for land preparation, difficulty caring for bullocks, and a lack of draft power. Farmers that use agricultural machinery can minimize labor costs, prepare land more easily and quickly, benefit from selling bullocks, and plant more efficiently (Quayum and Ali, 2012).

2.10. Tractors and Implements

In terms of agricultural technology, tractors are the most important and versatile type of equipment used by farmers wanting to mechanize some or all of their farm operations. Apart from providing an important means of transporting heavy farm inputs and produce to and from the farms, tractors are useful in coupling other motorized and non-motorized implements for the efficient and timely land preparation that is necessary for achieving high yields and minimizing postharvest losses (CIMMYT 2016). Furthermore, in Ethiopia, because of the problem of dwindling cultivable land area due to population pressure and changes in ecosystems and production landscapes from the overutilization of the arable soil, there is a need to cultivate the marginal and hilly lands to satisfy the increase in demand for food and other agricultural raw materials.

Unfortunately, human labor is not adequately equipped to grapple effectively with these changes in ecosystem and production landscapes. Having gotten experience in Ethiopia has begun importing several types of tractors in huge numbers, with several units in use (Baudron et al., 2015). However, the high cost and low income per household have remained a constraint for the adoption of new mechanized technologies, slowing the progress of agricultural mechanization (Baudron et al., 2015). According to UNIDO, research, technology adaptations, and extensions must be prioritized to transition farming from traditional to contemporary mechanization. Farmers should also have local access to the inputs they require, as well as supporting infrastructure for mechanization such as repair services, spare parts, gasoline, and lubricants (UNIDO report, 2008). Demand for machinery with less than 15 horsepower, such as 2WTs, has risen rapidly due to their lower cost when compared to 4WTs, greater maneuverability and ability to be fully utilized in systems with small landholdings, and global potential for off-farm use (Takeshima and Silver, 2016). These machines have become the primary source of mechanical power on many industrialized and developing countries' small and medium-sized

farms. Ethiopia has just begun importing agricultural machinery and implements and is working to expand its assembly and importation industries. The primary importers are Agricultural Equipment and Technical Service (AETS) and Adama Agricultural Machinery Industry (AAMI).

Implements: this range from simple hand tools to animal-drawn or tractor-mounted implements to condition seedbeds by turning the soil, burying weeds and crop residues, and bringing nutrients to the surface, all to achieve the benefits of weed control, improved soil aeration, and optimized soil fertility, temperature, and moisture. The modern implements used for these activities are such as disc plow, moldboard plow, sub-soiler, etc. In Ethiopia, 90% of tillage operations in smallholder farming are carried out using maresha, a traditional wooden plow pulled by a pair of oxen, which is not capable of inverting the soil and thus is of little use in burying weeds and crop residues. The use of the moldboard plow has been found to increase grain yield by over 50% compared to maresha and has been demonstrated to reduce required tillage frequency and bury weeds more effectively (Analysis & Scale, 2016).

Row planter: A tractor-mounted or animal-drawn implement used to sow seed in rows at regular intervals, thus helping to control and optimize seed rate and plant density. The use of row planters in Ethiopia is almost at an infant stage, and most seeds were typically sown through manual broadcasting. The optimum choice of row planter varies based on environmental conditions, particularly soil type and socioeconomic factors. Hence, further research efforts are required to identify economically and technically feasible row planters for smallholder farmers.

Harvester and thresher: In Ethiopia, most crops are typically harvested by manual uprooting, resulting in a loss of quality. After harvesting, the crop is left to air dry and then threshed on the poorly-prepared ground by animals, leading to further loss in quality and the introduction of foreign matter. Mechanizing both harvesting and threshing operations will improve the quality of products, reduce post-harvest loss, and replace manual labor. Hence, there will be an increasing need for mechanized harvesting and threshing to meet productivity and quality standards. The cost of mechanized harvesters and threshers is prohibitively high for smallholder farmers, but there is potential to provide access to post-harvest implements through rental schemes administered by cooperatives to members. Further research and technology development efforts

are required to evaluate the technical and economic feasibility of adapting mechanized harvesters and threshers in the Ethiopian small farm context.

2.11. Determinants of Agricultural Machinery Availability and Utilization

An empirical review of the literature on agricultural mechanization technology in developing countries reveals that the various factors that influence the availability and utilization of technology can be grouped into the following broad categories (1) factors related to the characteristics of producers (i.e., the farmers); (2) factors related to the characteristics and relative performance of the technology; (3) Politics and institutional factors. Education level, work history, age, gender, wealth level, farm size, plot features, labor availability, resource endowment, risk aversion, and other factors are all related to the characteristics of producers (Amare & Endalew, 2016). Enabling policies and programs, market linkages, and access to institutional support and credit were found to play a positive role in stimulating farmer investment in and adoption of sustainable technologies. A mismatch between the economies of scale of the technology and farm size is one of the most frequent obstacles to expanding small-scale access to the proper machinery (Getahun & Milkias, 2021).

Its availability and that of complementary inputs, the relative profitability of its distribution compared to substitute technologies, the period of investment recovery, local adoption patterns of the technology, the susceptibility of the innovation to failure, and the perception by people of the characteristics, complexity, and performance of the innovation are some of the factors related to the characteristics and performance of the technology and practices (Adunea & Fekadu, 2019). The institutional elements include the accessibility of markets for goods and inputs, the land tenure system, the availability of credit, the availability and quality of knowledge on technologies, the availability of markets for goods and inputs, and the availability of suitable infrastructure, extension support, etc. and the politics affects directly or indirectly all activities when it's as a source of conflict and ideal complaint (Rosen et al., 2015).

More than 50% of the food produced on a global scale comes from tiny family farms, many of which have distinct, dispersed fields and are therefore unsuitable for larger machines (Negrete, 2019). Farmers in Ethiopian nations cannot afford to buy equipment, and there is little financial

assistance available in the form of subsidies or financing plans. Due to a lack of acceptable collateral and the assumption that agriculture carries a high level of risk, the service sector is reluctant to extend credit to small-scale (Bayissa, 2015). Since farmer cooperatives are the primary beneficiaries of many centrally planned rural mechanization programs in developing nations, access to small-scale is frequently not increased as a result of insufficient support from complementary actors in the manufacturing, supply, distribution, sales, and after-sales services. The first three issues mentioned above are addressed through the creation and testing of the availability of mechanization options for small-scale farmers.

Demographic factors

The gender differences between family heads are a crucial explanatory variable when analyzing adoption-related factors. The social structure that prevailed in rural households assigned different responsibilities to the male and female household members (Deribe & Jaleta, 2019). Women are generally marginalized in rural Ethiopia and have limited access to technological information. As a result, multiple adoption studies have revealed that having a female head influences technology adoption decisions negatively. Because of the prevalent sociocultural attitudes and conventions, men are free to move about, attend various gatherings, and receive training. As a result, households led by men are more likely to use innovation than homes headed by women, which are more susceptible to being influenced by cultural norms and traditions (Elias et al., 2013). Those that are wealthier can easily afford the cost of modern farming technologies. Another factor in understanding farmers' technology utilization behavior is the age of the household head. This factor is significant because it affects farmers' access to information and their capacity to put that information to use. Older farmers might have resources and experience that would provide them with greater opportunities to experiment with new technologies. As opposed to the elder generation, younger farmers are more willing to utilize available new technologies because they have received more formal education (Malesse, 2018).

Socio-Economic factors

The household head's educational status is the most pervasive and important factor found to influence farmers' utilization of agricultural new technology. Farmers that have greater education are more likely to use new, improved technologies (Alemu, 2020). This result is

consistent with prior findings. This is because education can alter farmers' knowledge, skill, and attitude. Additionally, it improves farmers' analytical and problem-solving abilities (Malesse, 2018).

Institutional factors

Institutional considerations are concerned with how much influence institutions have on small-scale technological adoption. entail all services that support agricultural development, including financing, insurance, and information sharing (Deribe & Jaleta, 2019). They also consist of structures and devices that facilitate farmers' access to market opportunities and useful inputs (Baudron et al., 2019). Better roads and well-connected rural road networks are among the essential factors in the expansion and development of smallholder mechanization. One very important institutional element that distinguishes farmers' utilization status is the extension service (Davis & Franzel, 2018). Currently, the extension system handles a large portion of delivering agricultural technologies. As a result, having access to training demonstrations and other extension activities creates the framework for gathering pertinent knowledge that encourages technology adoption. In several studies, several variables have been used to assess farmers' access to extension services (Davis et al., 2018).

Access to different service providers

Access to extension services is critical for developing current agricultural production technology. Farmers can learn about new technologies through extension. Access to agricultural extension services has made automation available to small-scale farmers throughout the country (Sims et al., 2011). The amount of information available about the new technology determines its acceptance. It informs farmers about its existence as well as the appropriate use of technology, facilitating its adoption. Farmers will only use technology that they are aware of or have heard about. When farmers have access to extension services, they are more likely to accept new technology. Farmers must be confident that new agricultural technology will work on their farms if they are to adopt it. This assurance can be provided through an efficient communication system. Demonstration farms are diffusion tools that should be used to instruct young farmers who need to be familiar with new and advanced technologies (Oduma et al., 2019).

Availability of Agricultural Machinery

The proximity of machinery service providers to smallholder farmers is one of the foremost factors influencing utilization decisions. When there are nearby machinery rental stations, the hiring of mechanization grows. The closeness of tractor service providers to farmers is a significant potential driver of tractor service accessibility (Takeshima et al., 2016). The realization that a mechanization service exists is the first step toward the use of agricultural technology.

Land fragmentation

When a family's farmland, which was already modest in size, was divided among the children, it was further divided into very small pieces of land. This prevents yield from rising and instead causes poverty and food insecurity (Oduma et al., 2021). Because a large number of family members will lose their jobs because there is not enough land to support them as full-time farmers. The national survey of Ethiopia has revealed a positive correlation between yield and land fragmentation, which is an inverse link between farm size, yield, and land fragmentation (Paul & Gthnji, 2018). As a result of the smaller farm sizes' poorer yields, mechanizing farms is also challenging and ineffective for securing families' needs.

2.12. Status of Agricultural Mechanization in Ethiopia

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. The introduction of drought animal power into the smallholder farming system dates as back as a century ago. However, in recent years, the use of machinery farm technology is increasingly becoming important among smallholder farmers at the expense of drought animals and labor.

2.13. Agricultural Machinery Utilization in Ethiopia

In Ethiopia, machinery is mostly utilized for field preparation, threshing, and harvesting. Fragmented land holdings, agroecological diversity, and geography are important issues impeding the increase of agricultural machinery utilization in Ethiopia (Li Davis et al., 2023). Other obstacles to agricultural mechanization include a lack of competence, a lack of credit, a lack of regulatory backing, and a lack of tailored instruments (Bantelay et al., 2020). While some progress has been made in recent years in introducing various types of technologies to farmers, a national strategy that provides direction and unifies these efforts is required to successfully institutionalize agricultural mechanization and promote the use of tractors in farming practices. Despite Ethiopia's lengthy history of agricultural techniques, agricultural mechanization has been limited (Hailu et al., 2020). Farm power is mainly dependent on oxen draft and human muscle operating using traditional farm implements. The imbalance between food demand and actual domestic production requires an improvement in the availability and utilization of Agricultural machinery for carrying out farm operations to enhance large-scale production (Indraningsih et al., 2021).

Oxen-pulled maresha is the dominant farm implement in cereal-based systems whereas hand-hoe is the main farm implement used in agroforestry systems. The level of tractor-based agricultural machinery use is relatively better in wheat-dominated cropping systems where harvesting and threshing are done using combines (Oniya, 2021). In addition to human muscle, in most cases and particularly in cereal-based systems, oxen draft is the main source of farm power for land preparation and planting. In agroforestry systems, where hand-hoe is the dominant farm implements, human muscles are used for all farm operations. In wheat-based systems of Arsi and Bale highlands, wheat harvesting and threshing are mainly done using combine harvesters (Bayisa Debelo, 2020). Smallholder farmers in these areas are relatively better in terms of agricultural mechanization level. Machine power will also be useful to meet agricultural productivity and production goals. It is because the use of the power input into the agricultural process has a direct and significant contribution to the production, productivity, and profitability of agricultural farms. A farm machine's capacity is limited, so logically, farm size affects the number of machines and their utilization (Winarno, 2017).

From survey results of the different related researches some parts of the country, and region were using at least one or more of agricultural mechanization technologies of pre-harvest (moldboard, spike tooth harrow, and tractor), and harvest technologies (maize Sheller, wheat-teff thresher and combine harvester) while the rest were completely non-users of either of above technologies, while others were using a tractor in addition to other local and intermediate plows (Ayele, 2022). For simplicity we divided the technologies into three major categories and tried to see their utilization status; using a tractor in addition to other local and intermediate plows, using either tractor or other intermediate technologies, and using local/traditional plows (Oromia & Boka, 2022).

The survey results further revealed that pre-harvest and post-harvest technology utilization was greatly varying across the region. The common pre- and post-harvesting agricultural activity used in the country is manual. The use status of agricultural machinery technologies is greatly influenced by; educational background, family size, distance from the main market (access to technology), distance to extension service providing center, and total cultivated land (Amare & Endalew, 2016). The conceptual background illustrates how agricultural extension program that is useful to enhance farmers' knowledge and skills, on mechanization utilization as well as promote and expand improved technologies, affect the farm productivity of Ethiopian farmers (Diriba, 2020). It is a general fact that agricultural extension and advisory services play an important role in agricultural development through agricultural mechanization utilization and can contribute to improving the welfare of farmers and other people living in rural areas.

2.14. Agricultural and Socioeconomic Perspective in Ethiopia

The rate of agricultural growth in Ethiopia in turn depends on the speed with which the current existing activity production system is transformed into a knowledge-based and market activity production system (Davis & Franzel, 2018). Among the many institutional support services that need to catalyze/support the transformation process, the agricultural extension service plays a critical role, since it contributes to the development of the skill and knowledge of farmers to accept new and improved technologies and the approaches and processes with which the skill development and access to information are realized (Adela, 2022). The agricultural extension depends to a large extent on information exchange between and among farmers on the one hand,

and a broad range of other actors on the other hand (Winarno, 2017). ‘Extension, along with education and research is typically seen as both public and private services, which respond to the needs of farmers and rural people for knowledge that can help to improve their productivity, incomes, and welfare, and to manage the natural resources, sustainably; It also brings information and new technologies to the agrarian communities to improve their production, incomes, and standards of living (Davis et al., 2009).

2.15. Agricultural Activity in Wallaga Area

Wallaga Province is one of Ethiopia's key agricultural regions, where many crops were/are grown. Crops such as cereals, legumes, grains, vegetables, and fruits have been successfully grown. Maize and teff, sorghum, millet, barley, and oil seeds such as nug and sesame are the principal crops farmed in the area (Habtewold, 2018). Wallaga is also good for cultivating coffee and raising livestock. Peasants engaged in both sorts of agriculture (crop cultivation and animal rearing) at the same time. However, this does not imply that all Wallaga peasants raise the same kind of crops and animals in the same quantities or the same manner (Tolessa, 2017).

Some areas of the region may produce more crops and animals than others. The difference could be natural or man-made. Nevertheless, the different parts of Wallaga are well known and suitable for crop production there is the problem of Agricultural machinery utilization for agricultural activity, and mechanization technology utilization is less. The peasants of Wallaga are self-sufficient in times when there is a normal distribution of agricultural inputs like rainfall. This means an average peasant could help his family until the next harvest with some superfluous (Tolessa, 2017). By selling their food crops or coffee production, they can fulfill their need for cash. But there was great fear which endangered their status of self-sufficiency of farmers by encroaching/being less confident in their products because it's not enough due to the production aim of small-scale for food sufficient.

Mechanization technology in Wallaga is very minimal even though the community is farm dependent, due to that the farming activity in the area is low input and low output. Attention to small farm holder utilizing Agricultural machinery is more likely less due to the aforementioned facts. They have less insight into and knowledge about the benefit of farm equipment and its

effect on crop production in all aspects of the area. Even though mechanization technology can improve farming way, small-scale farmers not utilizing and the availability of mechanization input is also not a farmers' requirement. In many parts of the Wallaga Zone even there may be no machinery utilization for a different purpose in agricultural activity. Farm equipment utilization is observed less due to less attention from the government to deliver farm equipment and lacks of mechanization policy apply. As the data from the East Wallaga agricultural bureau shows, the number of Agricultural machinery and equipment is very few in the zone.

Agricultural activity in Wallaga province is more generally animated or labor-intensive on a small scale. However, in some locations of the Oromia region Such as the Arsi, Bale and Shewa zones there had been good progress in using agricultural machines and other mechanization inputs, especially for cereal crop production (Semahegn, 2021). Though agricultural machinery was not introduced in most regions of Ethiopia, it is not new to farmers who leave in districts Wallaga but when compared with the central and eastern parts of the region the availability, distribution, and utilization of mechanization technology is an approach to zero. Even though different mechanization technology introducing in the country such as machinery for tillage, irrigation, thresher, chemical and fertilizer applicator, and other tillage machines the traditional usage of human and animal power is well utilized. The chemical applicator which is manually operated knapsack sprayer, fertilizers, using and machines such as tractor and sheller are used by the large-scale and associated group. The tillage system, harvesting, and storing are traditional which is animal and human power-based, and hand tools are commonly used equipment. The problems are becoming serious because of the alarming rate of drought animal prices, the high demand for food crops at the local and national levels due to the scarcity of cereal crop production the controversy of sufficient and suitable arable land, and proper agroecology of the country.

2.16. Summary of Related Works and Gaps Identified

According to the referred study, Agricultural mechanization technology in Ethiopia is increasing, and a significant number of machines are introduced into the country by various agencies such as research centers, dealers, NGOs, and governments. However, it has been discovered that the country has a significant problem with agricultural production and productivity. Furthermore, it

has been discovered that knowledge of agricultural machinery technology is quite low, and agricultural work is animated, resulting in drudgery and low income. Early studies concentrated on the significance of mechanized technologies in agricultural activities and their importance for agricultural development, as well as the technology's acceptance.

From related reviewed literatures, the following conclusion and gaps were identified. Hunger and poverty have been a serious issue that reported all over the world, and major SSA country including Ethiopia are under this problem. The overall agricultural activity can be improved by the introducing the mechanization technology in to the agricultural activity at different level including small-scale farming. The previous investigations conducted on related study are mainly focused on importance of the mechanization to improve the productivity. That means limited studies have been done on the introduction of the mechanization into farming system and ways for improvement. And also, the consequences and constraints of the availability of agricultural machinery and implement were not well-defined and less or no characterization was available. The investigation effect on availability and utilization of machinery and implements as well as the problems related to the availability and utilization of agricultural equipment are not studied. As a result, a study on to them in agricultural mechanization is required. From the survey of the literature, it was recognized that no prior study has been undertaken on the availability and utilization of agricultural machinery and variables impacting it, even if there are comparable concerns with a different emphasis and research interest. Therefore, it is necessary to conduct the study to investigate the availability and utilization of agricultural machinery and factors affecting in the study area.

2.17. Conceptual Framework

A conceptual framework was developed to provide a foundation for the analysis of factors that are assumed logically to have some type of relationship, directly or indirectly, with the interest and new technology-accepting behavior of the individual farmer to increase the availability and utilization of Agricultural mechanization or Agricultural machinery technology. The conceptual framework is based on studies reported in the literature review, and such elements are expected to determine the availability and use status of machinery as well as farmers' attitudes about mechanization services, particularly for small farming activities. To simplify things, the researchers divided the components into four categories: personal considerations, resource

issues, perception/social factors, and time factors. According to the literature, the four categories of the above criteria influence directly or indirectly the availability, utilization, acceptance, or adoption decisions of farmers toward agricultural mechanization technology. This will then determine if they would purchase to boost availability for utilization or use a rental service from where it was adopted.

CHAPTER THREE

3. MATERIAL AND METHODS

3.1. Description of the Study Areas

This study was conducted in the Oromia regional state of East Wallaga Zone, which is located 328 kilometers west of the capital city of Addis Ababa. It is located at 07°02' N and 38°28' E. The area has an average yearly rainfall of 800–1200 mm and an average annual temperature of 27 °C. It features diverse agroecology and agricultural systems. The district's agroecological zones are Dega, Woyina Dega, and Kola. Guto Gida, Gida Ayana, Diga, and Sasiga woredas were purposefully chosen woredas for this investigation. Agricultural produce in the area is diversified, and the principal source of income for the rural population.

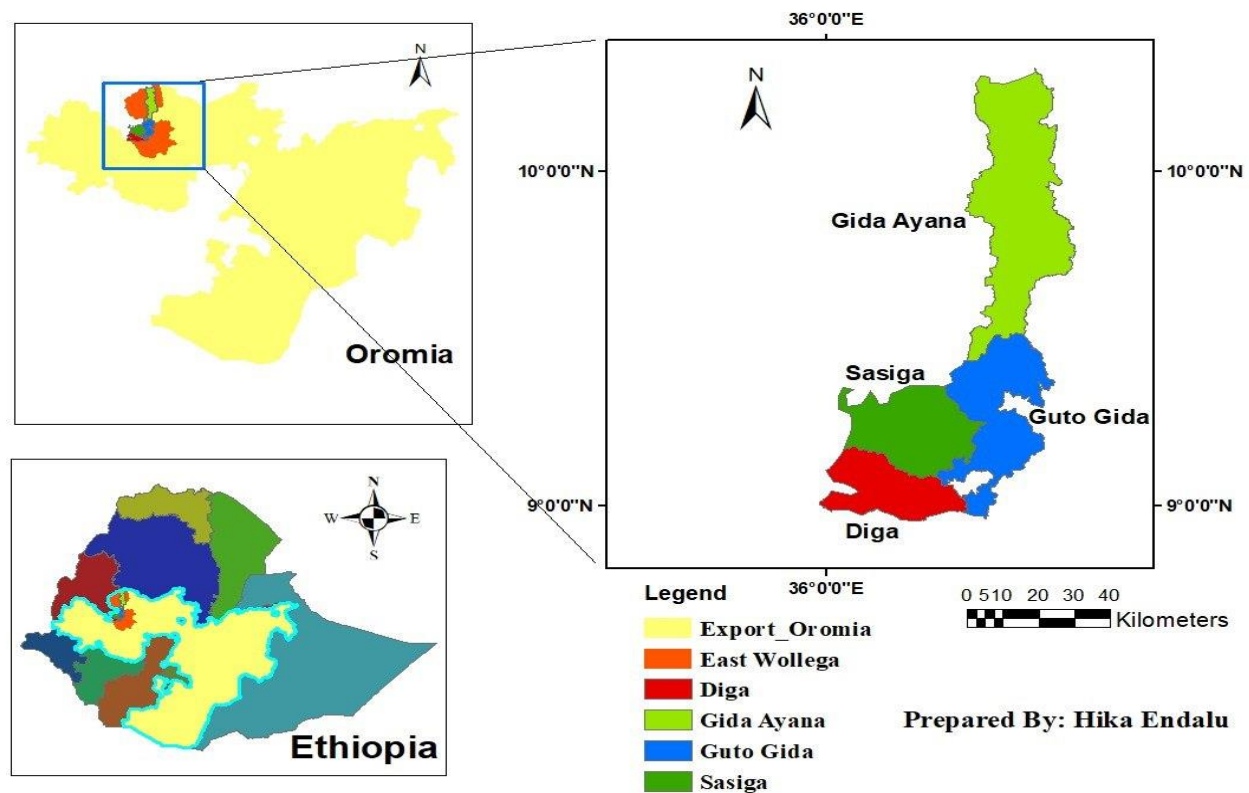


Figure 3 1. The Map of the study area

Research Methodology

In this research study, integrated or mixed research methodologies were used, with both quantitative and qualitative data collection and analysis used to investigate machinery availability, utilization, and factors influencing farmers' use of mechanized technology. This

research was carried out by reviewing scientific literature, conducting surveys, and gathering information on agricultural mechanization technology, machinery utilization, and factors influencing mechanization availability in the East Wallaga zone of the Oromia region. A survey on the general status of mechanized technology use was conducted in four woredas of the East Wallaga Zone, Oromia region. A structured questionnaire was utilized to collect primary data from chosen respondent farmers about several parameters linked to mechanized technology utilization and distribution. The structured questionnaire for the survey was designed to extract information in categories such as personal traits, resource considerations, perception and social variables, and supply and time constraints. Personal factors included age, education level, gender, farming experience, and household size; resource factors included farm size, rented land size, income, labor cost, and access to the credit or exchange system; perception and social factors included perception, knowledge of mechanization services, neighbor persuasion, institutional factors, and physical observation of current and existing activities performed by mechanization technology and records, institutional factors included road infrastructure, credit facility, introduce appropriate machinery, farmers encouragement, etc.

3.2. Research Design

Descriptive statistics were used for this study to assess the availability and utilization of machinery and implements in the targeted areas, as well as the current state of Agricultural machinery and the factors impeding the availability, utilization, and diffusion of agricultural machinery. This strategy required collecting and analyzing data from groups in a specific area that were typical of the entire population. The research used both primary and secondary data sources. Documents were used to collect relevant secondary data. On four Woredas in the East Wallaga zone, a survey on the general availability and use status of Agricultural machinery and implements was conducted. Primary data were collected through a structured questionnaire on selected respondents regarding availability, utilization, and factors affecting agricultural machinery.

3.3. Sources of Data and Methods of Data Collection

3.3.1. Types and Sources of Data

Primary and secondary sources were used to acquire qualitative and quantitative data. Respondents, and key informants (individuals with relevant knowledge and information about the past and present status of machinery utilization) were the primary sources of qualitative and quantitative data. To collect the necessary primary data from various primary sources, research procedures such as household surveys using semi-structured questionnaires with both open-ended and closed-ended questions were administered to sample respondents. Similarly, data were gathered from a sample of respondents via an interview schedule. Which were gathered for this study to be completed successfully. Structured questionnaires and key informants were used to acquire primary data from the selected sample respondents. Secondary data were gathered from the internet, offices, linked professions, and literature, as well as document reading and note-taking from the appropriate primary sources, which contain original, raw, and unprocessed data. Documents were used to acquire pertinent secondary data.

A) Primary data source: Observation, sample respondent, farmer, office (by interview), development agents (DAs), Agricultural machinery user of area.

B) Secondary data source: internet, offices (documented file), related sectors, and literature, through document reading and note taking.

3.3.2. Data Collection Methods

Data were collected using survey methods such as field observation, interviews, and document examination. The structured questionnaire included several questions aimed at extracting meaningful information from the research area's interviewed families as well as the zonal and woreda agriculture bureaus. Furthermore, a structured and semi-structured questionnaire was developed to capture both qualitative and quantitative data. Enumerators have been informed about the goal of the study, the reason for collecting information from individual respondents, and the procedure they must follow to ensure the anonymity and confidentiality of the interview. Enumerators were also instructed to collect data with care and to treat interviewees with respect. The survey's structured questionnaire was meant to elicit information in four categories: personal factors, resource factors, perception elements, and social aspects. Personal factors included age, education level, gender, farming experience, and household size; resource factors included farm

size, rented land size, income, off-farm income, labor cost, and perception; and social factors included perception, interest, knowledge of mechanization services, neighbor persuasion, institutional factors, fee opinion, work quality, profit orientation, supply, and distance from the center.

3.4. Sampling Techniques and Sample Size

➤ Sampling Design

Four woredas and twelve sample kebeles were chosen. Purposive and random sampling was used to pick sample farmers from the kebele. The basic sampling units were zone selections from the four Wallaga zones, then East Wallaga was chosen using purposive sampling based on the presence of agricultural machinery. Secondly, four Woredas, (Guto Gida, Sasiga, Diga, and Gidda Ayana) were chosen by the purposive sampling from the east Wallaga zone. In the third sampling unit, three kebeles were chosen from each woreda also by Purposive and random sampling, based on farmers' knowledge and responses to agricultural machinery. The selection of respondents in the kebele was chosen both randomly and purposively; purposive is used here to identify the machine owner since they are small in number.

Purposive sampling is selected consulting experts to specifically use area where information of mechanization there, to identify owner of machinery, based on the history of the machinery in the area, and depending on the peace problem in the study area the purposive is required to select safe area to collect data in a safe way. The sample size was calculated using the standard sampling approach employed in numerous surveys. As a result, the following formula was used to compute the sample size for this investigation, which is the most commonly used standard in both qualitative and quantitative data gathering from unknown populations (Ali, 2014), and related to this study. This formula is used because as understudied from the reviewed reference and cited material it's better for my research behavior and type as its survey from unknown population.

$$n = [Z^2 p (1-p)]/d^2 \dots\dots\dots (1)$$

Were:

n = the to-be-determined sample size

Z = the standard normal deviation, which is set to 1.96 and corresponds to the 95% confidence interval.

p = the estimated proportion of a population, which equals 50% or (0.5).

d = 5% or (0.05) the amount of sampling error between the sample and the population

So, to compute sample size;

$$n = \frac{(1.96)^2 \times 0.5 \times (1-0.5)}{(0.05)^2}$$

$$n = 384$$

Then adding 10 % of the non-response rate, we get; $n = 384(1+0.1) = 422$

At the district level, a proportional sampling technique will be employed to calculate the sample size. The required sample sizes at the kebele level will equally be allocated to each kebele.

$$\text{No of respondent at kebele} = \frac{\text{Total no of respondents}}{\text{Total no of kebele}} \dots\dots\dots (2)$$

$$\text{No of the respondent at each kebeles} = \frac{422}{12} = 35.16 \quad \text{we take } 35$$

$$\text{No of the respondent at woreda} = \text{No of kebeles} \times \text{No of respondents at kebeles} \dots\dots\dots (3)$$

Table 3.1. Sample size distribution in the study area.

Sample Weradas from	No of the selected	No of respondents in	Total No of
East Wallaga	kebeles in the woreda	each kebele	respondents
Guto Gida	3	35	105
Diga	3	35	105
Sasiga	3	35	105
Gida kiramu	3	35	105
Total	12	35	420

Finally, the required sample sizes were allocated to those selected kebeles as indicated in Figure 3.2 below.

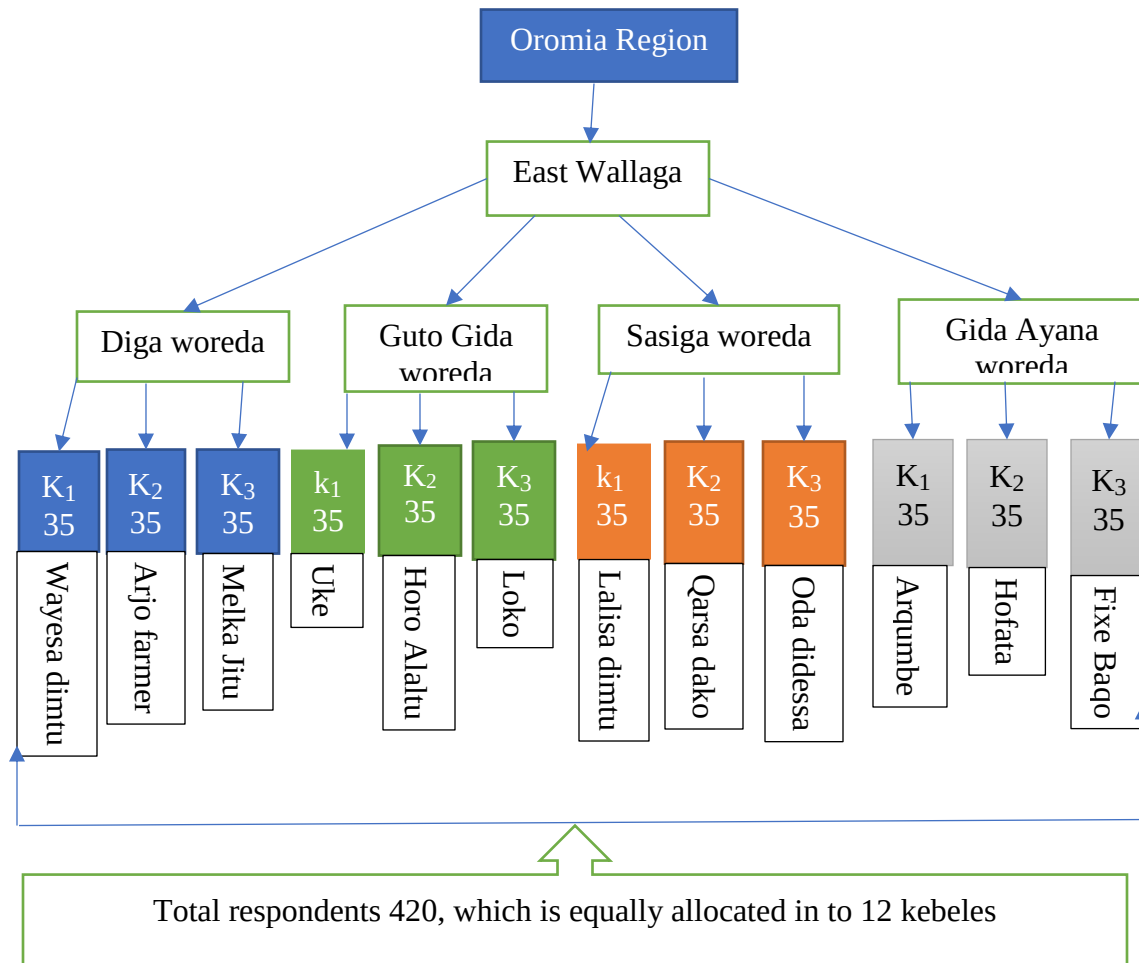


Figure 3. 2. Schematic presentations of equal and proportional allocations of sample size

3.5. Data Analysis

A detailed questionnaire was devised to elicit information from the zone and woreda agricultural bureaus, agricultural agents, and farmers via one-on-one interviews and surveys. MS Excel 2016 was used for data coding and entry while SPSS (Statistical Software Package for Social Sciences) version 29 was used for data analysis for descriptive statistics.

CHAPTER FOUR

4. RESULT AND DISCUSSION

4.1. Social and Demographic Characteristics of Sample Households

The sample respondents were composed of both male-headed and female-headed households as well as experts from a total of 380 selected kebeles from four woredas in the East Wallaga zone. The calculated sample size was 420 but 40 samples are rejected due to unqualified, unreturned, and incomplete response so 380 sample were 360 are farmer and 20 of them are experts. The socioeconomic characteristics directly or indirectly influence the mechanization technology availability and utilization was studied. Background profile data values of social and demographic characteristics such as age, education, family size, farming experience, land size, and number of economically active household members were analyzed using descriptive analysis. These features are found to be important in terms of clearly showing the diverse backgrounds of the respondents and their effect on agricultural machinery technology as well as socioeconomic aspects.

Table 4.1. Respondent's age description

Age intervals(N=360)				
Age	18 - 25	26 - 35	36 - 45	>45
Frequency	0	15	186	159

According to the response of the interviewee, ages between 36 and 45 (N = 186) have a high frequency, followed by ages above 45 (N = 159). 85% (N = 306) of the respondents were male, while the female respondents accounted for 15 % (N = 54). Thus, the majority of the sampled farmers were middle-aged, (57% less than 45) which could have a positive effect on agricultural production. According to the response of interviewee, the mean age of the respondents was 45 with standard deviation, minimum and maximum age of 8.48, 27 and 65 respectively.

Educational level is assumed to increase recognition, of the ability to access and process information related to agricultural new technologies. Education creates positive attitudes toward the utilization of different advanced technologies and the risks related to utilization of it.

Table 4.2 Sex and educational status of respondents (N = 380)

	Illiterate	Adult education	Grade 1-5	Grade5- 10	Level	Diploma	Degree
Male	82	33	180	53	0	0	18
Female	0	0	8	4	0	0	2
Total	82	33	188	57	0	0	20

Out of the interviewed households' 21.6 % were illiterate, 8.6 % were categorized as literate and could read and write, 49.5 % were primary (first cycle) educated, as well about 10 % and 5% were above grade five and grade ten complete respectively. The degree holders of the respondents are those from the office at zone, woreda, and DAs which are a total of 5%. Education creates positive attitudes toward the utilization of agricultural machinery and taking risks related to technologies, however, there are no certified farmers and a minimum number of people above the primary education in the study area, there is no negative effect shown on the availability and utilization of Agricultural machinery regarding the educational level as 60% of agricultural technology users are illiterate and less than grade five.

There was a wide range of farming experience in the study area, varying from 5 to 35 years. Farmers who have more experience in farming are supposed to have better skills and knowledge because experienced farmers have a better engagement with farming than non-experienced ones. The average farming experience of the interviewed households was 24 years.

Table 4.3. The farmer's farming experience (year)

	Experience (year)				
	5 - 10	11 - 15	16 - 20	21 -25	> 25
No of respondents	10	72	171	95	12
%	2.8	20	47.5	26.4	3.3

Table 4.3 revealed that 2.8% of the farmers were within the range of 5-10 years of farming experience whereas 20%, 47.5%, and 26.4% were within the range of 11-15, 16-20, and 21-25 years farming of experience respectively. 3.3% of the respondents have more experience which

accounts for more than 25 years of farming experience. Therefore, in the study area, the majority of the farmers have better farming experience. Experienced farmers along with long duration in the farming are more likely to produce and get better income from production through long period, which enables them to purchase Agricultural machinery than non-experienced farmers. Although the only machine or implement is not the case for success in agricultural activity, the farming method, types of crops with agroecology, utilized technology, and likes are also important things developed through the experience.

The land is one of the most crucial inputs for the rural community, whose livelihood depends on farming. On top of owning land, its size is one of the determinant factors for agricultural machinery utilization (Koroso, 2016). The study reveals that all the respondents in the study area were owners of the land although the size of the holding varies greatly from household to household.

Table 4.4. Farmland possession of farmers (hectare)

Land size (ha)	Nº of respondents	%	Land size (ha)	Nº of respondents	%
0.4	4	1.1	3.0	10	2.8
0.5	30	8.3	3.2	9	2.5
0.6	12	3.3	3.4	9	2.5
0.8	26	7.2	3.5	6	1.7
1.0	22	6.1	3.8	6	1.7
1.3	28	7.8	4.0	7	1.9
1.4	32	8.9	4.4	5	1.4
1.5	24	6.7	4.7	5	1.4
1.7	14	3.9	5.0	3	0.8
1.8	18	5	6.0	2	0.6
2.0	22	6.1	7.0	1	0.3
2.3	19	5.3	8.0	1	0.3
2.4	20	5.6	9.0	1	0.3
2.5	13	3.6	Total	360	100.0
2.7	11	3.1			
Summary:		Mean	2.00 ha		
		Std. Dev.	1.18 ha		
		Minimum	0.4 ha		
		Maximum	9.0 ha		

The study reveals that all the respondents in the study area were owners of the land although the size of the holding varies greatly from household to household and among respondents who utilize machinery are those operating more than 1.5 ha of non-fragmented land. Table 4.4 shows that the mean value of land holding size was two hectares with the minimum and maximum observed holdings per household of 0.4 and 9 hectares, respectively with standard deviation of 1.18 hectares. The majority of land holdings about 62% (N=222) of the total respondents possess small portions of land measuring less than two hectares, and fragmented in to different areas, which mostly forces farmers not to take any risk by applying new farming technologies. Aside from the small amount of land held in the study area, the proportion of fragmented land was extremely high due to the owner's use of it for various purposes such as crop production, livestock, and infertility, which has negative implications for modern Agricultural mechanization in the study area. This means that the respondents' land holdings are modest, which has a detrimental impact on the amount of utilization of agricultural machinery and modern technologies.

4.2 Availability of Agricultural Machinery and Implements in the Study Area

An improvement in farm human capital through agricultural mechanization is important for enhancing farm productivity (Oduma et al., 2019). Availability of machinery is the basic tool that should be insured to rural farmers in order to increase productivity and income from agriculture (Eskeziaw et al., 2021). The agricultural machinery found in the area are tractors irrigation pumps, maize shellers, groundnut shellers, and implements such as moldboard (ARDU and BBM), disc plows, are found in the zone, though they are not in the required amount. The two-wheel tractor was found in Diga and Guto Gida woreda but it's not utilized due to its less productivity or not effective, less quality and durability, non-maintainability, and spare parts in both woreda, as data from respondents, 67 distributed 2WTs in Diga and 2 in Guto Gida, during 2005 which is from METEC was out of service due to the listed reasons, and due to the lack of skill and awareness of the operation, injuries up to death happen on the one person, according to the information from Diga's agricultural office. The 45 mold bold was presented in Diga by the Bako mechanization center and was not utilized due to lack of operating power as its weight is heavy for oxen and donkeys which is the power source of the farming system in the area (source: Diga woreda agricultural office). Based on this, know days, walking tractors and mold bold are

not utilized in the study area as a result farmers do not prefer to purchase and no one is supplied. As a result, farm power availability is always insufficient for performing farm operations that are difficult to undertake without mechanical help. One of the significant issues with farm power in the zone is a lack of the appropriate types of Agricultural machinery, hence mechanization utilization stays low.

To promote Agricultural machinery availability and utilization among small farmers in the country as well as in the area, agricultural machinery-hiring schemes have been established and primarily managed by farmer organizations (Maker, 2017). In the study area, Agricultural machinery is distributed in two ways. That is through the MoA, and individuals through cash payments. The ways by which through the MoA is that numbers and types of machinery decided by the MoA and bureau, communicating with the company and telling the zone to accept and distribute the machinery, and the zone organizes the requirements from the woreda and agreements of the payment end users had at the woreda and distributes to the woreda as per available and requirements then after completing the 30 percent payment and 70 percent as bank credit, the machinery is given to the end users.

The second way is that individuals buy after completely paying cash, even though the process is also through the woreda and zone. The owner has to be licensed and allowed to buy the machinery by the zone, and after completely paying cash, the owner goes to the company and receives the machinery. However, the user and respondents revealed that the process is so tiresome, which is completing the process from a bank and agricultural office may take many days since no office and banks work only on this issue. Because there are no brokers or providers that run the issue by supporting owners, the circulating of all the steps in the process is taken place by servants, and after all the steps are completed they go to the company and take the machine by their transportation, which is an additional cost to the user, due to the absence of brokers and agents that can supply the required machinery at the area even at a short distance. Therefore this is the other problem raised by the respondents and users in addition to the unaffordability and high rate increment of the machine cost in both ways.

In this study, available does not mean that it's enough because the availability and distribution of agricultural machinery and implements do not take place well in the study area, due to the distribution determinant factors such as capital and resources of the end users in addition to the hindering factors such as topography and road infrastructures. To solve the problem of availability and distribution with demand and supply, the government and institution or organization working on the developments of agricultural mechanization have to incorporate with a company of different machinery and implements to distribute lower or discounted cost with a long-term credit facility and work to access the providers and brokers and introduce the appropriate equipment suitable for the different situation of farm activity and affordable for small-scale farms. The general response of the respondents in all areas on the question asked to identify the presence of agricultural equipment in the study area is as Table 4.5 and 4.6 blow which responded as available and not available to indicate the presence or not the presence of equipment in the study area by respondents.

Table 4. 5. The status of the availability of implements in the study area

Implements	Availability	Tractor operated		Animal operated		Manual	
		Nº of responden ts	%	Nº of responden ts	%	Nº of responden ts	%
Maize	Available	286	75.3	0	0	290	77
sheller	Not available	94	24.7	0	0	90	23
Ground nut	Available	214	56	0	0	192	50.5
sheller	Not available	166	44	0	0	188	49.5
Moldboard	Available	82	21.6	94	24.7	0	0
	Not available	298	78.4	286	75.3	0	0
BBM	Available	0	0	94	24.7	0	0
	Not available	380	100	286	75.3	0	0
Disc plow	Available	380	100	0	0	0	0
	Not available	0	0	0	0	0	0
Ti-rigger	Available	200	52.6	0	0	0	0
	Not available	180	47.4	0	0	0	0

Soil crusher	Available	288	75.8	0	0	0	0
	Not available	92	24.2	0	0	0	0

As the table above indicates, the majority of respondents know the machinery and implement, and they mean available not utilizing, rather it is to show the equipment adopted in the area. Therefore from this idea of the respondents, in the study area, no work on the adoption was required, rather the appropriateness of machinery and utilization conditions were not achieved to as required.

According to the acquired data, the availability of Agricultural machinery varies in the woreda of the zone and from kebele to kebele within the woreda. Diga is one woreda of East Wallaga zone, with 21 farmer's kebele which 13 of them are kola and 8 of them are dega with the main product of maize, ground nut, sorghum, millet, teff, etc. respectively as the data from Diga woreda. The practice, distribution, and utilization of machinery are only in those 8 words because of the suitability, agroecology, and the crop produced in the area. In the rest of the kebeles, even though the lifestyle is similar to others it's not as well suitable to use machinery due to the production being in small amounts with the fragmented lands for only family use such as teff, millet, sorghum, and maize. Mechanization level can be measured by the machinery (tractor and combine harvester) availability in an area.

There is a big variation in the mechanization utilization in different parts of the Oromia region. In many parts of Oromia, such as Arsi, Bale, and Shawa, agricultural mechanization was introduced during the Derg regime, as there are highly appropriate conditions for cereal crop production. But in some parts of Oromia, particularly Wallaga Zones, cereal crop mechanization has been introduced within the last ten years, even if not in all parts of Wallaga. Of the four Wallaga zones, East Wallaga is the highest user of agricultural machinery, such as tractors, combines, and irrigation pumps. As shown in Table 4.6, there were about 343 registered agricultural machinery in the study area and out of which tractors accounted for 99% (N=340), while combine harvesters accounted for 1% (N=3). Those machinery are owned by different bodies such as farmers associations, youth groups, PLC, investors, and farmers unions, and the three combined are found two in Guto Gida and one in Gida Ayana, owned by investors.

Table 4.6. Tractors and combine harvesters in the study area

Machinery	Quantity(Nº)	Brand	Horsepower(hp)	
			75hp	120hp
Tractors	42	Natfaa	34	8
	21	John Deere	21	
	5	WYito		5
	78	Horsus	72	6
	7	New Holland		7
	56	Massey Ferguson	35	21
	98	Velarus	98	
	27	Turbo	27	
	6	Agro track		6
Combine- harvester	2	John deer		2
	1	New Holland		1

Source: East Wallaga Agriculture Bureau (2023).

Table 4.7 above shows the currently available machinery (tractors and combines) in the study area. From the available machinery in the study area, the number of 75hp tractors is much higher than the number of 120hp tractors, and there is no other higher-hp tractor in the area. Even though the interest there in the area is 95 horsepower, the supply limits them to 75 horsepower, and the other horsepower supplied is 120 horsepower, which is not preferred due to its cost and is not appropriate for farmers. The majority of the machinery (70%) including higher-power machinery (120 hp) are owned by different bodies, such as PLCs, investors and institutions, and the rest are owned by; unions, cooperative farmers groups, and youth groups and high capital farmers.

Then, to see the availability, distribution, and functional status of machinery in woredas, a survey resulted in the number of agricultural machinery and implements in each woreda; in the Diga woreda: 21 four-wheel tractors, 67 two-wheel tractors, 179 irrigation pumps, 9 maize shellers,

and above 75% of groundnut producers using their own manually operated shellers, 45ARDU mold bold, (Diga woreda agriculture office). From the available machines, it's owned by farmers, a cooperative group of farmers, and a youth group (locally, Interpirayisi Micro Xixiq (IMX)). The 2WTs, which are not functional and are known to be completely disposed of, were distributed to farmers by METEC during 2004–2005, but only farmers saw what walking tractors meant and did not give service as due to the lack of efficiency and operation skill as the study area experts and farmers respondents especially Diga woreda. Even though the interest of farmers is high (more than 80% of respondents), the availability of agricultural machinery and implements in the study area is very low, and farmers are using those machines by renting, keeping the rotations or turns, which is time postponement or delay, and the majority of farmers are using traditional tools because many machines are not enough and unappropriated to utilize yet. The genera response on the availability and non-availability of the machinery in study area responded as Table 4.5 and it's to identify the presence and adoptability of machine in the area.

Table 4.7. Response on the Availability status of machinery

Types of machine	Status of machine	N^o of respondent	%
4WTs	Available	355	93
	Not available	25	7
2WTs	Available	82	21.6
	Not available	298	78.4
Irrigation pump	Available	365	96
	Not available	15	4
Combiner	Available	78	20.5
	Not available	302	79.5

In the Table 4.5 above, even the number of the respondents saying available is high, it's not mean that the availability and utilization is high. Because the respondent say available, to indicate as the machine adopted in the area, even its number is minimum as showed in Table 4.7 and not appropriate to all.

In a similar manner, according to the acquired data from the survey and observation taken, the number of Agricultural machinery and equipment in the Guto Gida district, which is owned by farmers, PLC, cooperating farmers, and the Youth Group (Interpirayisi Micro Xixiq (IMX)), is 101 four-wheel tractors, 240 irrigation pumps, 52 shellers, 22 potato and groundnut diggers, 29 soil crushers, 528 maize row planters, and a combiner. According to the data from the survey, the district farmers, DAs, and agricultural office data show that in the study area, the tractor-attached moldboard is only utilized by Wallaga University in Guto Gida, and it's not utilized by other bodies participating in agricultural activity because there is no available tractor attached for farmers, and the animal-operated moldboard is not utilized due to the weight beyond the operating power source.

In Gida Ayana, about 150 four-wheel tractors with primary tillage implement, 250 maize shellers, and 140 irrigation pumps are owned by farmers. In the Sasiga district, there are also 18 tractors, 90 shellers, and 175 irrigation pumps that are utilized by the majority of the farmers in the area. Even though the available machines do not fit the interests of the farmer, many jobs are delayed due to the lack of Agricultural machinery and implement. According to the study and district information, respondents in the Gida Ayana, Diga, Guto Gida, and Sasiga districts indicated a delay in agricultural operation due to a lack of Agricultural machinery and equipment. However, based on their understanding of the role of Agricultural machinery, a small number of respondents claimed that there was no delay in farm operations due to a lack of Agricultural machinery and equipment.

The delayed response of the operation is high in districts with more technical users, as it is understood from the respondents who are machinery users. From the understanding of farmers, as there is delay and no delay, the response shows that there is a high delay response in the areas where there is high utilization and availability of machinery and technology, as they understand the advantage of Agricultural machinery in agricultural activity, which shows that the interest, demand, and preference of the machinery in agricultural activity increase as the adoption and awareness of technology increase. Generally based on the current situation the availability of the machinery and implements in the study area is summarized as Figure 4.1 below indicates.

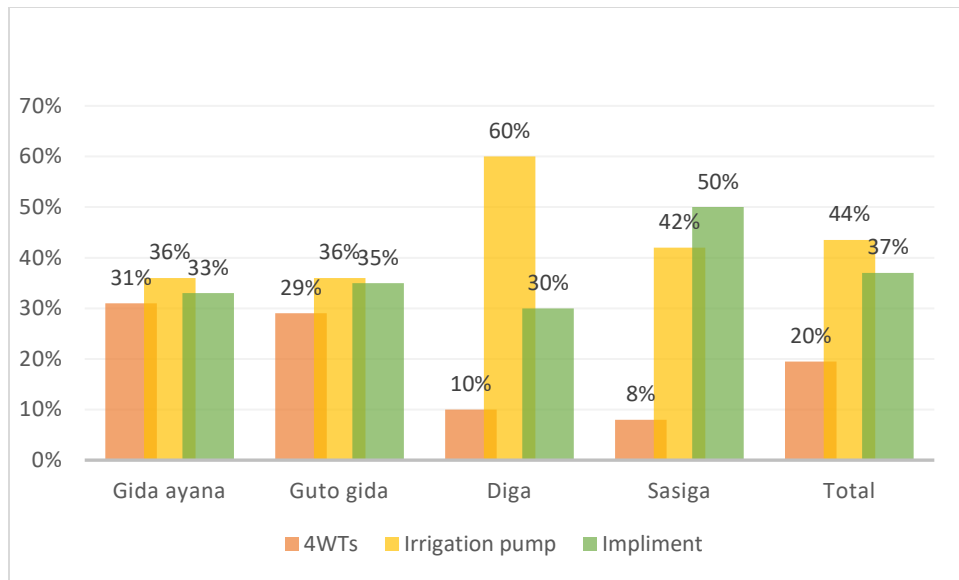


Figure 4.1. Summary of the availability of machinery and Implement in the study area.

Each percentage denotes the machine's availability relative to the entire amount of machinery in the study districts, and the overall percentage acts as a whole. As previously mentioned, the distribution varies depending on which districts are suitable for the presence of owners and stakeholder groups. For this reason, the percentage of equipment is higher in some woredas and lower in others. The irrigation pump is the most readily available and used piece of equipment in the study area.

4.3. Utilization of Agricultural Machinery in the Target Area

The utilization interest in the available machinery in the area is as high (85%) as indicated by the respondents both owners and non-owners from the study area. However they did not train on the recent technology, 30% of the farmers in the study area have an awareness of mechanization from the Didessa farm state which is during the Derg regime, and nowadays they are operators and technicians for machinery utilized in that area. The survey revealed that due to non-availability, about 40% of farmers in the study area used the least modern technology in addition to other local and intermediate implements, and were no respondents who were only using either tractor or other intermediate technologies for agricultural activities. While the rest 60% of the farmers were purely using local/traditional tools and systems in the agricultural activity starting from primary tillage to harvest and threshing, due to the lack of affordable machinery and

implements as the capacity of farmers demand and the non-availability of appropriate machines to meet the farmers' needs due to the farm size, agroecology, and capital.

The result further revealed that pre-harvest technology utilization was greatly varying across districts and there is no harvest and post-harvest technology available in all parts of the study area except the maize sheller. Next to the irrigation pump from the total number of machinery in the area four-wheel tractor is utilized. Generally as it can be revealed from the respondents and data from the experts the technology utilization of the study area summarize as 42% (N=145) were user and 58% (N=215) are non-user of the agricultural machinery and implements when see the total user and non-user in the study area. Over all the agricultural machinery utilization status of the targeted woredas is summarized in Figure 4.2 below.

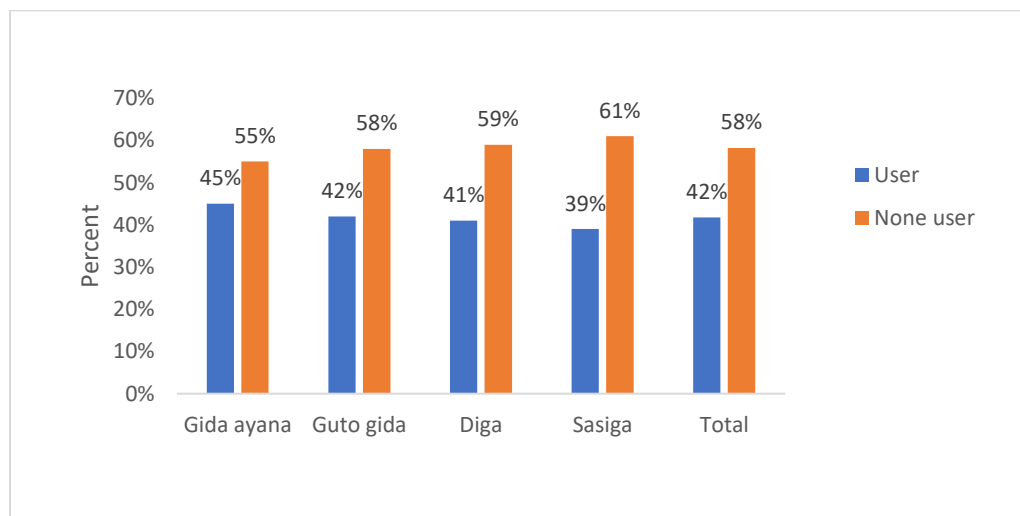


Figure 4.2. Agricultural machinery utilization status of the targeted woreda

Gida Ayana was found to be the highest technology/tractor user's woreda of the zone where both the primary and secondary technologies of farming are used, followed by Guto Gida districts where 42% of total respondents were users of available Agricultural machinery. The other highest mechanization technology users were found in the Diga district where 41% of the total respondents were available technologies users, especially irrigation pumps. As all in the study area, all agricultural machinery the high number utilizing is irrigation pump (table 4.5) when compared with other machinery, even if it's not as required. From the survey and harvested data result, the less amount of the respondents in the study area (42% from Figure 4.2) were using the

technology of primary tillage and sheller which is tractor attached, or manually operated sheller and the rest (58%) are the users of a traditional system of farming activity in addition to threshing and shelling which is putting the maize in the sack or covering it with chaff and beating with the stick. In the study areas, the application of the mechanization technology is majorly for primary tillage which is also only for plowing and preparing seed beds.

Even though the walking tractor (power tiller) is the technology appropriate for the small-scale and fragmented land operation and they know, neither farmers nor the private are utilizing the study area. From the point of view, there is the attitude that the power tiller is ineffective for the area from respondents, due to the understanding from the low-quality product was distributed during 2005 G.C from METEC and which was discomfited and rejected without use as a result of, low quality, low power, non-maintainability, absence of spare parts (as Diga woreda office). The combine harvester is also used in Guto Gida and Gida Ayana only by investors and private companies (PLC). For threshing and harvesting other crops there is no technology available in the area as the goal of production and productivity of the land with the types of crop determines the utilization of the mechanization. As the gathered data shows the least technology user kebeles are in Sasiga, Diga, Guto Gida, and Gida Ayana respectively as it's understood from the respondents and office data.

The use status of pre- to post-harvest technologies was greatly influenced or determined by land fragmentation, highly productive crops in the area, family size, distance from the main sector (access to technology), service-providing center, capital/cost unaffordability, topography, and total cultivated land size. The technology users were those producing maize and ground nuts at large since it is the most highly productive crop of the area and is used for both market and local use. According to the responses of respondent farmers in targeted districts, it was discovered that in parts of East Wallaga districts, appropriateness and cost were the most important factors in agricultural machinery use. The farm-land condition of the area requires a high power or hp of at 90Hp in many parts of the area but the available between 75 and 120hp is not enough power to fit the work and the high power is expensive beyond the farmer's capacity. Districts are full of low and medium-income farmers, which is difficult and inappropriate for currently available machinery in the areas, the required use of BBM and mold board is also impossible because the

available implements are not suitable due to the weight of available implements being beyond the capacity of the power source which is animal (oxen & donkey). The machinery utilization status of the study area is not similar in all woreda based on the availability/distribution of machines, capital, agroecology, etc.

4.4. Operations Performed by the Machinery in the Study Area

Plowing, harrowing, seed planting, shelling, harvesting, transporting, and spraying chemicals are the most prevalent operations undertaken by agricultural machinery users in the targeted districts. Threshing and harvesting were not frequent practices in the study locations. When compared to other targeted districts, farmers in Gida Ayana and Guto Gida have acquired a positive attitude toward the use of agricultural technology and prefer Agricultural machinery to the traditional farming system. Among the four targeted districts, Guto Gida and Gida Ayana were the first to use a corn planter with a tractor. Users of functional Agricultural machinery in the four targeted districts reported several benefits, including reduced time compared to the previous traditional farming system, increased productivity, reduced labor during farming activities, generated income for those who rent the machine or for owners from rental service, and avoiding carousel during peak farm operation times when many labors are required simultaneously. Tillage (particularly primary), shelling, transporting, and harrowing are the overall operations done by machinery in the research area, according to data from respondents.

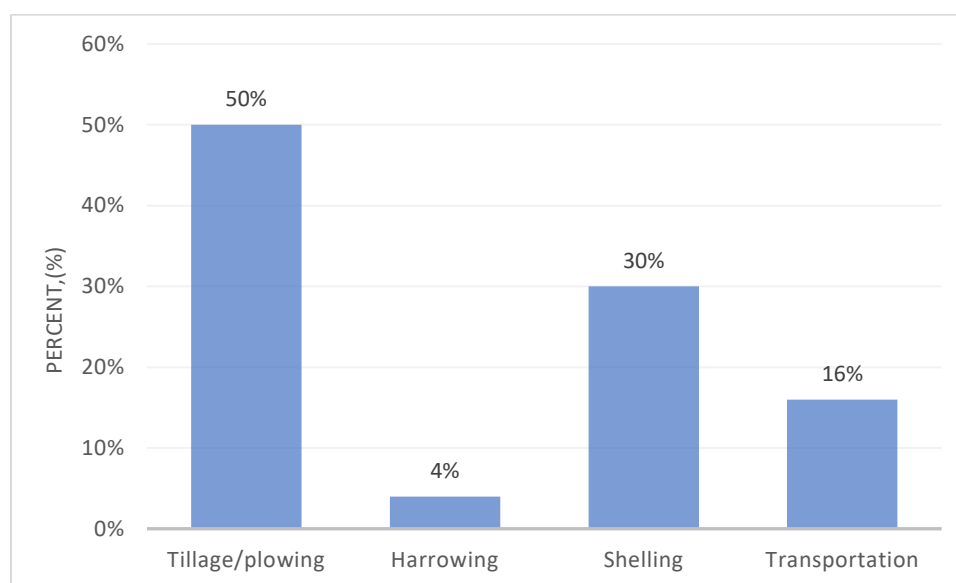


Figure 4.3. Percentage of different operations performed by machinery and implements

Form the genera activity of the tractors in the study area, as shown on Figure 4.3 the 50% is tillage operation, 4% harrowing, 30% shelling of maize and groundnut and 16% for transportation of crop and materials by the cart attached. However, the operation requires high labor, with limited time and spadework such as seeding, weeding, harvesting, and cultivation there is no availability of machinery and implements for such an operation in the study area. The technology also increases the size of the land to be operated/product area with less human power, less fatigue and drudgery, and high quality, whereas traditional activities require many laborers and animals to complete the process, as the user respondents say that a tractor can operate 7 hectors per day with a single operator and by the anima or tradition one hector requires 7 days. Through ownership or renting service it was indicated that utilizing Agricultural machinery had several benefits, including greater productivity and labour independence.

4.5. Availability of Machinery for the Rental Service

Farmers have been using both implements and Agricultural machinery (tractors, combine harvesters, and other equipment's) by renting from machinery and implement owners during normal and peak operation periods (Koroso, 2016). However, the owners of farm power give priority to themselves during any operation period. According to the findings of this study, farmers and groups with Agricultural machinery provided rental services to other farmers in the targeted districts. The minimum and maximum number of farmers that rented one tractor was determined to be 100 to 150 for plowing and 200 to 250 for shelling the maize, respectively during operation time or peak season as users responded in Gida Ayana, Guto Gida, and Diga. The owner of the machinery and implement in the study area so few percent (Table4.8).

Table4.8. Machine and implement ownership condition

Machine & implement	Condition	Frequency	Percent
Machinery	Owning	56	15.6
	Non owning	304	84.4
Implements	Owning	203	56.4
	Non owning	157	43.6

The study result shows in the Table 4.8 the owner of the machinery and implement in the study area whether by group or investors from the total respondents 15.6% are only owing machinery and 56.4% are owner of the implement (either manual or tractor operated), however 84.4% and 43.6% are non-owner of machinery and implement respectively (Table 4.8). The machinery's unavailability and non-functionality limit the rental service in the area, Farmers in Guto Gida, Gida Ayana, Diga, and Sasiga districts have initiated and demanded the use of tractors and shellers by renting them while ploughing, harvesting, and transporting. However, at the time the farmers gave the rental service the problems with timely non-availability of machines occurred in the area. This is due to many factors such as a mismatch of demand and supply, and even available machinery cannot be delivered to all areas due to the problems of road infrastructure in the districts. During work, tillage, and threshing, the majority of working tractors and implements were rented to farmers who did not have them for various agricultural practices such as ploughing, threshing, harvesting, and transporting.

Because there were no maintenance and spare part services or technical specialists in their area, machinery owners spent the most money on maintenance, spare parts, and mechanics. As a result, they take the mechanic and spare parts from Addis Ababa, which is so far distance from the company that purchased the machine, which is expensive, takes more time, and disrupts their rental service, resulting in a drop in rental income as well as the delaying of work to be performed by the machine for the owner and renters. Due to these factors and the scarcity of the machine for rental service, the cost or payment for rent is high or ineffective for many interested farmers. No individuals or groups are working on the renting of machines; only the owner of the machinery rents after they finish their activity, which causes work delays as time passes.

The farmers who rented pay service charges depending on the time of operation, i.e., they pay the maximum amount during peak times and the normal payment during normal operation periods. The payment for plowing one hectare of land by tractor is 2500–5500 birr and 30–60 birr for shelling one quintal of maize following the peak time and demand, as respondents in Gida Ayana and Guto Gida say and which is expansive and hinders many low-income farmers from using it. To alleviate these issues, farmers require capacity-building training in operation,

repair, and maintenance, as well as spare parts and maintenance center should be availed at around.

There are also factors affecting the utilization of rental services like farm size, farm income, and, lack of roads to rotate in areas, and capital. As a result, the tractor operates up to 7 hectares of land per day and the majority of land possession in the area is less than a hectare with more fragmented for different purposes which are unappropriated to rent machines. However walking tractors appropriate for such conditions, neither of the respondents, farmers or private, in the study area have a walking tractor (power tillers). The result shows that the farmers in the study area do not have the initial capacity to buy Agricultural machinery (tractors) and they have no chance of a return on their assets, because the income they gain from the farm is so low (4 to 10 quintal crops, farmers report), not enough to purchase the machine and there is no institution or organization supply credit support at the area as the respondents indicated. Hence, they are more likely to rent farm power when they want machines for the operation from owners either groups, individuals, or private owners, which depends on the will of the owners.

4.6. Goal of Crop Production in the Study Area

The main motive of smallholders' production is fulfilling their subsistence requirements. It is believed that limited input availability and precarious environmental conditions determine the production decisions of smallholders. Smallholders' resource utilization is generally considered to be very poor. Production efficiency may vary from farmer to farmer because of various factors. Analyzing resource use efficiency is a basis for implementing agricultural policy which helps improve smallholders' productivity. The majority of farmers in each targeted woreda grow the crop for their consumption; fewer grow it for both food and sale; and the few crops that a small producer grows are only grown for the market (including maize, soybeans, sesame, and ground nuts). The majority of crops produced by the farmers of the areas are maize, teff, sorghum, millet, wheat, soya beans, ground nut, sesame, and likes produced by both users of Agricultural machinery and non-users in all areas for different purposes.

Small amounts of crops were produced for markets due to the study area's low utilization of Agricultural machinery and other modern technology, and there is no available machinery for

such products, particularly because they are produced in small quantities on fragmented land based on the requirements and product goal. Therefore, the major crop produced, and the size of the operated land size can determine the type of technology the society uses in the particular area for crop production. In most cases where many diverse crops are available, machinery is rarely used, while in areas where specialized crops are available, machinery can be used in most cases. As the majority of the land size of the individual farmer is low and the production goal is to feed a family, diverse crops are produced by a farmer by fragmenting the land into different purposes as per the requirement of the crop for home purposes which results, in the unsuitability to utilize machinery. However, the utilization of the irrigation pump is possible in all conditions rather farmers produce once a year by rain-fed the availability of the technology is low due to farmer's lack of capital and no support from other bodies.

Most farmers across all districts claimed to be working their property, but a small number of farmers in other districts claimed to have been given farmland under contract with permission. According to the responses of the farmers who responded in the targeted districts, most of the farmers had families between 4 and 10 members and between 0.4 and 9 hectares of land, which suggests that there is variability and that high output is unsuitable. Besides other constraints in increasing production and productivity, the problem of infestation by wildlife and a lack of land were named major constrained. The results in the study area show that for the majority of farmers, 55% (N = 209) of production aim is for food, 25% (N = 95) for the market, and 20% (N = 76) is for both market and food as the consideration of the production goal in the study area.

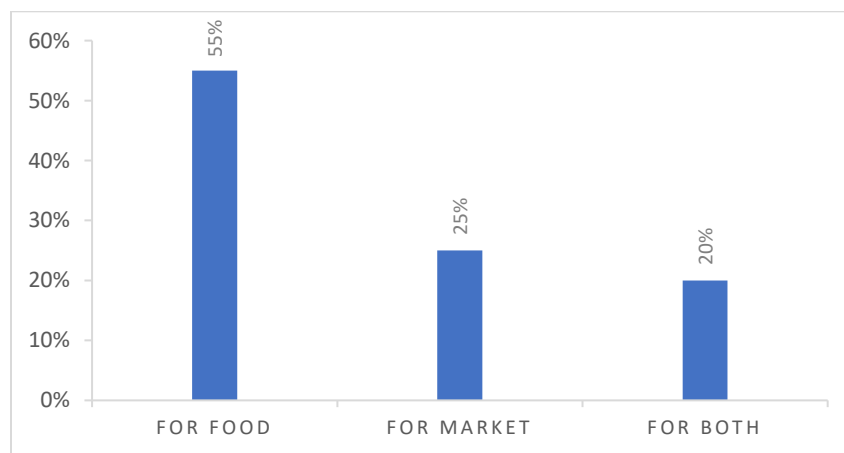


Figure 4.4. Percentage of the purpose of crop production

4.7. Current Condition of Agricultural Machinery in the Study Area

Farmers in the east Wallaga zone reported that their farm activities were frequently laborious and that traditional equipment was used due to a shortage of agricultural machinery and other key agricultural implements. However, agricultural machinery like tractors, irrigation pumps, and shellers is used by farmers in limited quantities, and many of the available machines are inoperable. The main causes of machinery non-functionality in all districts were inadequate systems in governmental and non-governmental mechanization institutions to support users, a lack of operating skills, part failures within a short period, and a lack of spare parts and maintenance services.

In the study, by considering total Agricultural machinery in all targeted districts, due to lack of maintenance and non-maintainability of the damaged parts, many of them are out of function, and the implements such as animal-drawn BBM and ARDU mold board are not used because the weight of the implement is above the capacity of the animals (donkeys and oxen) the farmers used for the activity as the power source, as indicated from the data of the East Wallaga zone and woreda agricultural office. From the survey and data acquired, the number of functional Agricultural machinery was 98, 17, 15, and 180 four-wheel tractors in Guto Gida, Diga, Sasiga, and Gida Ayana woreda, respectively, while the number of non-functional machines was 7, 6, 10, and 15, respectively. The functional implements were 43, 25, 10, and 200, respectively, in the Guto Gida, Diga, Sasiga, and Gida Ayana, whereas the number of nonfunctional is 34, 68, 15, and 35, respectively.

The combine harvester is only there in Guto Gida and is functional. The primary causes of the non-operational agricultural machinery in all areas were: inadequate mechanisms in governmental and non-governmental mechanization institutions to support the users; lack of required maintenance for the disabled machines due to the unavailability of spare parts; lack of operating skills or lack of enough training given for the user; failures of parts of machinery within a short period; non-maintainability of components; absence of spare parts; and lack of maintenance services. Based on these, the existing status of the machinery in the area is categorized as functional and nonfunctional, with nonfunctional sub-categorized as maintainable and not maintainable based on its current situation, as Figure 4.5 below indicates.

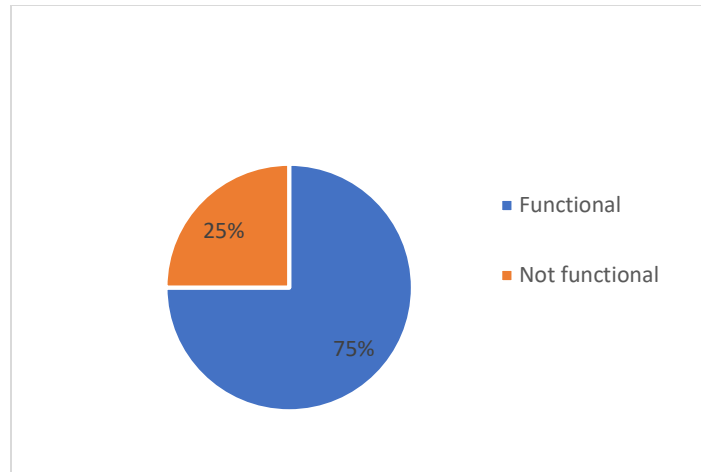


Figure 4.5. Functionality and no functionality of the machinery in the study area

Generally, by considering the total Agricultural machinery in all four targeted districts, the average total of functional and non-functional machinery and implements from the total available in the targeted area is 75% and 25%, respectively, as per the data gathered from the target area agricultural bureau and survey.

4.8. Farmer's Perception and Interests on the Agricultural Machinery.

By posing various questions concerning farmers' views and attitudes, it was determined whether a relationship existed between farmers' impressions of various traits and their desire in using agricultural mechanization. Perception is the process by which persons observe, visualize, interpret, and organize sensations to produce a meaningful experience of the world. In other words, a person is confronted with a situation or stimuli and interprets the stimuli into something meaningful to him or her based on prior experiences. However, what an individual interprets or perceives may be different from reality.

Perception is also interlinked with the results of personal, social, and technical factors. In the study area, the perceptions of sample respondents were assessed in terms of the importance of technology associated with the use of Agricultural machinery. Based on the survey conducted, the findings revealed that out of the total sample of respondents, 97% of them agreed with the importance of agricultural machinery. Out of the sample respondents of technology users, about 99% of them responded that utilizing technology increased yield, work quality, reduced labour,

and saved time. Even though they are not utilizing it due to different factors non machinery users have also agreed, on the importance of agricultural machinery in agricultural activity by 90.9% of non-users and they are also interested full (85%) to utilized technology, if they got appropriate machinery with factors such as small and fragmented land, low cost and there available road infrastructure to rotate in the rural.

From the response of the respondents and collected information it can be understood that almost all respondents of non-users (more than 85%) have an interest to use agricultural mechanization technologies. Farmers were enthusiastic about adopting farm equipment and agricultural new technology, and they were interested in agricultural mechanization in all of the targeted areas. However, owing to the lack of Agricultural machinery, the availability of agricultural mechanization technology services was insufficient, and there is a delay in giving responses to the purchase and demand interest in addition to the social and demographic factors hindering. Although farmers were interested in using the machinery and implementing it if they could acquire a rental service, the availability of machinery for rental was insufficient to rotate and work in all sections of the district due to the lack of road infrastructure in many places.

A small number of farmers were also not interested in buying mechanization input, due to different factors, some owing to lack of awareness, small farm-land size, and fragmentation, Agroecology, cost ineffectiveness/increasing by high rate, less land productivity, and goal of production. Considering the information gathered in the selected districts, due to any of the above problems and related issues, there were different attitudes of farmers towards Agricultural machinery, such as not interested respondents, interested respondents, and highly interested respondents. Generally, According to the study results revealed in the targeted areas, the average percentage shows that 15% (N = 57) were not interested in Agricultural machinery, 50% (N = 195) were interested, and 35% (N = 133) were highly interested.

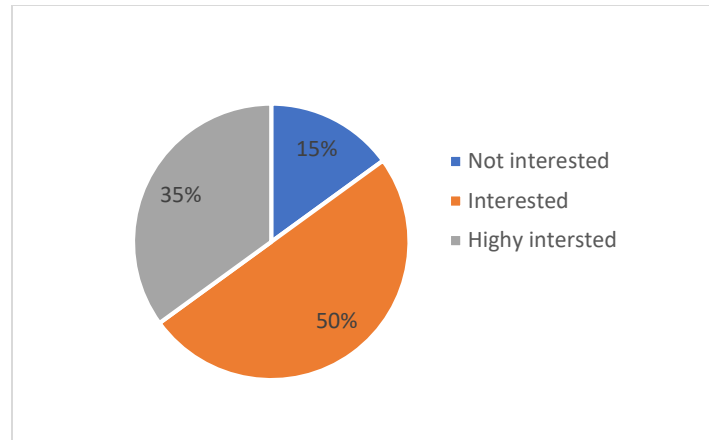


Figure 4.6. The farmer's interest in the study area in agricultural machinery

All stakeholders and government sectors should be in charge of encouraging farmer interest in mechanization technology and supporting farming operations by encouraging farmers, extension work, and advertising new technology to increase the productivity of agricultural activity in the country. As the key stakeholder, the government should be responsible for aiding enterprises, enabling financing alternatives, and increasing understanding of agricultural mechanization and Agricultural machinery availability. On the other hand, the corporation and institution must accept responsibility for allowing the supply of mechanization inputs, equipment, and maintenance services to farmers at the shortest possible distance.

4.9. Agricultural Machinery Utilization Vs Traditional Farming System

The utilization of Agricultural machinery vs traditional farming system was evaluated. According to the findings of the interview and survey, the days for ploughing one hectare of land with animals were over 7 days, and using the tractor, 7 to 8 hectares of land could be plowed per day. In the traditional system, a minimum of seven people are required with seven pairs of oxen, whereas when using machinery, only the operator accomplishes this. This demonstrates that using agricultural technology reduces the number of days, labor, and resources required to plow. The study found that mechanized farming saved more resources in agriculture than traditional farming. The study indicates that using machinery or technology reduced the time of operation by more than three times with high quality.

One quintal of crop or corn needed to be threshed or shelled over 5–6 hours, requiring the labour of 4-6 persons. While it took 2.5 hours to thresh one quintal of produce using a thresher when it was manually operated and 30-40 minutes when it was tractor-operated, which also depended on the speed and efficiency of labor to feed the sheller, as the number of laborers increased, output increased. For instance, a tractor-operated sheller can produce up to 350–450 quintals per day by effectively using 10–12 laborers. This specifies that labor and time were decreased when using machinery in agricultural activity. In the traditional threshing system, the number of laborers needed to thresh one quintal of the crop was six, while it took three workers on average to thresh one quintal of crop using a thresher. This shows that utilizing a thresher to thresh crops reduced the need for labour and other resources.

4.10. Conventional Harvesting and Threshing Prevailing in the Study Area.

Farmers in the study area practice different methods of harvesting and threshing crops. Separate rapid surveys conducted identified animal trampling and stick beating in the localities and this method is commonly used in all parts of the Wallaga zones.

➤ Animal trampling

A crew of animals is allowed to treadle on the millet or teff stalk spread on the threshing ground, often coated with a thin layer of cattle dung. The amount produced and labours required depend on the type of crop to be threshed because the properties of grain are different. According to participant farmers, this method takes on average ten people a day to produce one quintal of the output of teff grain, and five to seven people can produce up to eight quintals of soybean grain. Threshing soybeans with oxen is less burdensome and safer from a seed-purpose point of view. Nonetheless, it causes huge losses due to mixing with dung and urine and the amount is eaten by livestock when they thresh the crop. Sometimes the absence of sufficient livestock and labour for trampling forces prolongs the threshing period, thereby increasing loss due to shattering, pests, and rotting of grains. If threshing animals are not available, the farmers will thresh by stick beating little by little, thereby exaggerating the loss. If animals are available, the labour needed will also be exaggerated.



Figure 4.7. Traditional teff trashing by Animal

➤ **Beating by stick**

Beating entails hammering crop panicles with a wooden stick on the ground, which is then coated with a thin layer of animal dung. Maize farmers beat the maize taken from the stalk and peeled by placing it in a sack or jute bag or covering it with chaff and beating it with the sick. The rationale for wrapping or putting in jute is to limit the blowout of seed when pounding. Other producers thresh soybeans by placing the entire plant inside jute sacks and using a strong stick to knock open the pods, which are normally already dry. This task is more labor-intensive than others and causes grain damage. In a survey, farmers presumed that with this method of threshing, 10–12 people are required for 8-hour days. However, farmers claimed that it threshes more grain from the same quantity of soya bean, is speedier than other conventional methods, and is cleaner than animal trampling. Most threshing jobs take several days, so they assist each other by forming a small farmers' group, which is called a local daado or dabo on their farms. In return for help threshing, they offered payment to each other in the form of a day's worth of food or liquor. In this operation, participants are mostly male youth, as it demands more energy, and females are more mandated for indoor work.

4.11. Factors Hindering the Availability and Utilization of Agricultural Machinery

The purpose of this study was to identify the variables influencing the accessibility, use, and distribution of agricultural machinery in the study area, such as capital, distance from the center, topography, income from farm or product, government consideration, farmer perception, land

size, and product aim. The technology needs adoption and diffusion to make it available and utilized in the community, increasing the knowledge and skills of the users. From the results of the survey and interview held with agricultural sectors and farmers, a group of district experts, zonal, regional, and federal key informants, private technology multipliers, and importers' accessibility to technology, awareness of the presence and advantage of technology, lack of liaising bodies among technology sources, users, and other stakeholders, lack of appropriate technologies to different situations like agro-ecology, topography, and different soil types, and last but not least, a focus from policy-makers on agricultural mechanization technologies were mentioned as the most determinant factors for availability and utilization of the technologies by diffusing.

The strategy and policy of the development there also influence the utilization and productivity of the technology because it is proclaimed from MOA to region, zone, woreda, and kebele, which does not consider the technology's fit with the area or the farmer's perception and interest. From the results of descriptive and inferential statistics from structured questionnaires, we can observe that the amount of cultivated land and land given (owned) by PA per household significantly affects the technology use status of the household. Generally, during the study, the survey and respondent states revealed that the major factors hindering the availability and utilization of agricultural machinery in the study area were discussed as follows:

❖ Factors Hindering Availability of Agricultural Machinery

The accessibility to different services

Extension, promotion, and advice have a direct influence through the provision of information and training on the available agricultural technology. The research center, Institute of agricultural mechanization, and agricultural machinery and implement providers are important sources of information on agricultural innovations including encouraging and advising farmers and supplying adopted technologies. The availability of these technology centers initiates the farmer's machinery and availability by initiating those who have the capital to purchase and adopt new technology. The survey result indicates that the sample respondents had not contacted any of those experts because they are not available there. Credit service is one of the economic variables that influence the availability of agricultural machinery technologies. Outcomes from

this study showed that farmers face difficulties to get credit facilities through formal channels. Access to credit services enables the farmer with liquid assets to purchase different inputs and machinery due to that machinery becoming available in the area. In the study area, there is no access to credit from microfinance, NGOs, and different agricultural development agencies the only chance is through bank credit which is a process full as revealed by respondents.

- **Lack of capital**

Smallholder farmers are virtually resource-poor by definition, and they frequently struggle to invest in physical assets in general and Agricultural machinery in particular. As the respondents reported, low own-starting capital or purchase capital was the major hindrance that hampered the existing agricultural machinery not being available in the study area. This shows that farmers make this technology available on their own unless external support is introduced and backed up.

- **Lack of Government/institution consideration**

The other reason that inhibited the availability of agricultural machinery in the study area stated by respondents is there was no consideration given to the area by the government or NGOs regarding the development of agricultural technology/machinery. Training and extension, as well as research and development (R&D), support services, infrastructure development, etc. in developing countries, the government must undertake because the private sector is not yet developed enough. However, government institutions are usually also very weak and largely ineffective and inefficient in the mechanization technology in the study area, and as the area far from the center mechanization center was so important but there is no yet. Also, there are no Agricultural development supporters and advisory activities are critical to the success of any mechanization and the promotion of new sustainable agricultural production technology in the farming system.

- **Cost of machinery and implement**

In many areas, farmers cannot afford to purchase equipment, and financial support through subsidies or financing schemes is limited. The financial services sector shies away from providing credit to smallholders because of a lack of eligible collateral and a perception of the high risk involved with agriculture. As reported by the sample respondents, the machinery and other mechanization inputs are expensive and increasing (from 1.6 to 2.7 million difference in one year), cost of the tractor to the respondent and agricultural bureau data; which, affecting their availability, even though the local farmers can't purchase them. This result indicates that

minimizing farm machinery Cost influences the mechanization of the conventional agricultural system and the appreciation of the use of farming technology by small-scale farmers. The respondents said that one way to lower the cost of agricultural machinery was for the government to import the farm machinery and implements that the group purchased. This response was given in response to the question of how to develop mechanization technology.

- **Brokers**

As the influence of brokers is high in the availability of farm machinery and implements, by making the supply process easier and quicker, the absence of brokers in the area affects the availability of machinery and implements. As the area is far from the center and agricultural machinery suppliers are only found in the larger towns and cities, as the perceived low demand in rural areas for equipment does not always justify the establishment of distribution networks the availability of the complimentary actors involved with manufacturing, supply, distribution and after-sales service not there in the study area. Therefore, from this idea of respondents, it was understudied that the presence of brokers would influence farmers' decisions to use mechanization services.

Table 4.9. Descriptive statistics for factors affecting the availability of machinery.

Variable	N	Mean	SE Mean	Std. Dev
Lack of different services	380	0.72	0.02	0.45
Lack of capital	380	0.63	0.02	0.48
Cost unaffordability	380	0.69	0.02	0.46
Lack of Government consideration	380	0.48	0.03	0.50
Absence of brokers	380	0.67	0.02	0.47

In the study are as the respondent's results and Table 4.10 revealed that the availability of machinery is highly affected by the government considers as it's possible to understand from standard and farmers or end users have no capital to facilitate appropriate

mechanization technology, and the lack of capital is secondly affected as shown also from standard deviations of the following to the cost of machinery and lack of brokers.

❖ **Factors Hindering Utilization of Agricultural Technology**

Farmers in Ethiopia have been embracing and implementing many agricultural technologies; nonetheless, technology utilization is not yet at its peak. As a result, it is necessary to continue to promote agricultural new technologies by developing them to address farmer problems and needs. Farmers' use of new agricultural technology is influenced by a variety of factors that vary by area (Sims et al., 2016). In the study area, it was possible to identify the major reasons why farmers did not utilize agricultural technology or Agricultural machinery. The sample respondents had different reasons for not utilizing the existing technology in the country.

➤ **Land size and fragmentation**

The great problem in mechanization of small-scale farm is the mismatch between the economies of scale of machines and farm size. More of the food produced originates from small family farms (Diriba, 2020) and many of these consist of separate and dispersed fields and are thus poorly suited for larger machinery. The amount of cultivated land per household significantly affects the technology use status of the household. The total land size and its continuity or fragmentations affect the utilization of even available machinery by the rental service. Large farm-land ownership utilizes the machinery and technology of those who hold small and fragmented farmland.

➤ **Productivity; Level of farm income per year.**

The level of annual income should be greater than the expenditure for farm inputs consisting of farm power and implements. Better output encourages farmers to invest in agricultural inputs, including the purchase of small machines or using available hire services. An adequate income could be used as funding to purchase or rent the mechanization services. Higher-income farm households are more likely than lower-income ones to use equipment and implements for farming tasks.

➤ **Service Providers**

The services for rental utilization are significantly influenced by the local service providers' accessibility. The use of rental services is impacted by the lack of machinery service providers in the farmers' immediate area. Mechanization services will be easier to acquire if there are more Agricultural machinery service providers in the area.

➤ **Family size**

Agriculture is a labor-intensive industry that needs access to family and/or hired labor. A larger family can provide more labor than a smaller one. The number of economically active labour forces in the family was discovered to have a negative relationship with agricultural machinery utilization, especially when small-scale and fragmented land is handled since it is unsuited for machinery. Households with a higher proportion of economically active labour force members are less likely to hire machinery, according to the data, because extra labour is used for fieldwork.

➤ **Topography**

The utilization of Agricultural machinery requires a flat and straight area. The efficiency and productivity of the machinery are also higher in straight topography than in the up and down areas (Li et al., 2023). Therefore the undulating of the area affects the utilization of Agricultural machinery. Generally, the utilization of the agricultural machinery and mechanization technology in the study area is hindered by discussed major factors, and their value given is analyzed as shown in table 4.10 which shows the similarity of the degree to influence as standard deviations more related.

Table 4.10. Descriptive statistics for factors affecting the utilization of machinery.

Factors	N	Mean	Std. Error of Mean	Std. Deviation
Land size	380	0.02	0.47	0.37
Productivity	380	0.02	0.47	0.46
Absence of provider	380	0.02	0.47	0.48
Topography	380	0.02	0.47	0.45
Family size	380	0.02	0.47	0.46
Goa of production	380	0.66	0.02	0.47

As the evaluated response of respondent indicates (Table 4.10) above the degree by which factors affect the utilization of agricultural technology was vary. The factors with high std. deviation were significantly affect the utilization of mechanization technology in the study area. From the Table 4.10 seen that the absence of provider affect by 0.48 Std. deviation rather than other factor as respondents response.

4.12. The Problems Identified and Need Policy Intervention

The result revealed that training, awareness creation, and supply/availability of the technology were almost nil. More than 20% of the respondents answered that they do not know the presence of agricultural mechanization research/producing organizations. Therefore, awareness creation on available technologies, producers, and importers and about the importance and advantages of modern and intermediate agricultural mechanization technologies is a crucial action to be taken by concerned bodies. There is no formal procedure to recommend agricultural mechanization technologies like other agricultural technologies.

In the agricultural technology utilization process of the country, there is a formal procedure for technology release. But it is learned that, in agricultural mechanization technologies there is no such system; technologies are being recommended and released by the researcher or any other body and this has several negative impacts/problems on the technology transfer and generation processes. To begin with, there is no farmer participation or collaboration with stakeholders in the technology release process, and the technology will not reach the intended end users regularly. Although research and mechanization institutions make many advertisements, even if farmers are interested and the technology is applicable, it is not available to them. On the other side, there is a significant danger of publishing or endorsing technology that is useless, incomplete, or unproven. That is, allowing such usage causes difficulty when someone studies or seeks to investigate particular issues in a single location that are not authorized and are less significant in all places.

The other problem is that the machinery that is provided by the government sectors is not perception-based and is proposed and planned based on the farmer's interest and the condition of the area; rather, it is simply decided that the number, amount, and type of machinery for the zone

are determined by the upper body, regardless of whether the machine is effective or not in the area. After that, the zone facilitates woredas and farmers who can pay 30% and 70% as credit and can buy by group or individually. The other is that many times the agricultural sectors, research centers, and mechanization centers show and advertise improved and effective technology, but the supply and delivery of such technology are not available. There are no different organizations, institutions, or projects working on mechanization that support the farmers by facilitating alternative ways of supplying Agricultural machinery and implements through a credit facility, discount, or free support, except for the credit from the MoA through the zone, which is only based on the availability of machines rather than interest.

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

This research work presents the availability and utilization of agricultural machinery in the Oromia region of the East Wallaga zone with four targeted Woredas such as Guto Gida, Diga, Sasiga, and Gida Ayana. Hence, the availability, and utilization of machinery and implement as well factors affecting the mechanization technology in the study area were evaluated and analyzed by the descriptive statistical method. Other social and demographic characteristics such as age, education, and farm experience have also found to have positive effect on availability and utilization of agricultural machinery and implements. The non-owner of machinery and implement in the study area utilize by renting from owners, but the availability of equipment for rental service affected by different factors such as un-availability, non-functionality and road infrastructures to rotate in rural area.

There is no supply service or providers work only on the rental service and during the peak operation time as the demand greater than supply the cost for rent increase from 2500birr to 4500birr for plow one hector of land and 35birr to 60birr to shell on quintal of maize. To alleviate the problems happen during operation, the availability problem due to lack of maintenance, lack of spare parts and mechanics issues, farmers require capacity-building training in operation, repair, and maintenance, as well as spare parts and maintenance center should be availed at around. In machinery user Woreda, farm equipment serves a variety of purposes for farmers and effectively encourages them to employ various agricultural technologies.

The study implies the findings for farmers and stakeholders in order to improve and solve the problem of unavailability of machinery and implements especially for rental service, better to incorporate and encourage to work on rental service, providing machinery by group. The factors that affect availability are Lack of credit access, lack of capital, cost unaffordability, lack of government consideration, and Absence of brokers, whereas topography, land size, goal of production, productivity, absence of service provider are affect utilization of Agricultural machinery. To further optimizing the availability and utilization of agricultural machinery in encouraging the implementation of the Modern Agriculture Program, the policies that should be carried out are (1) the determination of prospective farmers and prospective locations should be

carried out appropriately so that the assistance of machinery is under the needs of farmers and local conditions, (2) the Government full facilitate training to improve the ability of farmers management to operate agricultural machinery, (3) the Government should facilitate workshops and complete spare parts to overcome equipment damage, and introduce appropriate machinery and equipment, (4) it is necessary to take appropriate and firm sanctions for owners and stake holders who do not use agricultural machinery and technology properly.

5.2. Recommendation

The research area's situation reflects that of many locations in Ethiopia that the worse conditions there in many zones of the regions. While reliance on traditional farming is clear, as many young people migrate to cities, the potential to produce will be limited. The country must feed its rapidly rising population. As a result, more food is necessary, and mechanization should be prioritized above conventional farming to produce more food. Based on the evaluation of the availability and utilization of agricultural machinery in East Wallaga Zone, Oromia Regional State, the following recommendations are wished-for:

1. Improve Access to Agricultural Machinery:

Establish machinery rental schemes or cooperatives to facilitate access to machinery for small-scale farmers who cannot afford to purchase their equipment.

Collaborate with financial institutions to develop affordable and accessible financing options for farmers to acquire machinery.

Strengthen existing agricultural machinery distribution networks and explore the establishment of additional sales and service centers in the region.

2. Enhance Farmer Training and Capacity Building:

Develop and implement training programs to improve farmers' knowledge and skills in operating, maintaining, and repairing agricultural machinery. Provide training on proper agronomic practices, including optimal timing and techniques for machinery use, to maximize productivity and minimize environmental impact. Collaborate with agricultural extension services and local institutions to organize workshops and demonstrations on machinery utilization and best practices.

3. Strengthen Institutional Support:

Improve coordination and collaboration among government agencies, agricultural extension services, machinery manufacturers, and suppliers to ensure efficient support systems for farmers.

Establish maintenance and repair centers in the region to provide timely and reliable servicing of machinery, reducing downtime and increasing machinery utilization.

Allocate adequate resources and budget for the procurement and maintenance of agricultural machinery in the region.

4. Promote Mechanization Adoption:

Raise awareness among farmers about the benefits of agricultural mechanization through targeted information campaigns and demonstration plots.

Conduct cost-benefit analyses and share success stories to showcase the economic advantages and long-term benefits of using agricultural machinery.

Encourage the formation of farmer cooperatives or machinery user groups to collectively invest in machinery and share the costs and benefits.

Establish the mechanization center for the remote area from the center and organize the separated or independent sector at the zone and woreda level.

5. Policy and Regulatory Support:

Review existing policies and regulations related to agricultural machinery importation, taxation, and subsidies to ensure they are conducive to the availability and utilization of machinery.

Develop and implement supportive policies and incentives, such as tax breaks or subsidies, to promote the adoption and utilization of modern and efficient machinery.

Establish monitoring and evaluation mechanisms to assess the effectiveness of policy interventions and make necessary adjustments based on feedback and outcomes.

These recommendations aim to address the identified challenges and promote the availability and utilization of agricultural machinery in the East Wallaga Zone, ultimately contributing to improved agricultural productivity, efficiency, and livelihoods of farmers in the region.

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APPENDIX QUESTIONNAIRE

Objective: The main goal of this questionnaire interview is to gather information about agricultural machinery in the East Wallaga Zone. The interview will be a key source of information for a study done for academic purposes. As a result, I respectfully ask that you provide me with your honest response to the questions listed below in the structured interview/questionnaire. I want to guarantee that the responders' responses are completely private and safe. Please accept my sincere gratitude for your understanding and cooperation. It was translated to local language. (This purposive description stands for all pages).

Appendix 1. Questionnaire for Sampled Respondents

Section 1: Background Profile

Please indicate your response by circling the appropriate choice or providing accurate information in the given space for each items.

1. Identification: _____
2. Name of Woreda: _____ Kebele: _____
3. Sex: 1) Male 2) Female
4. Age in years: 1) 18-22 2) 23-35 3) 35-45 4) Above 45
5. Education level: 1) Illiterate 2) Adult Education 3) Primary School 4) Secondary School
 5) Certificate/Level 6) Diploma 7) B.Sc.
If other, specify: _____
6. Farming experience (Years): 1) <10 years 2) 10-20 years 3) >= 20 years

Section 2: Resource Profile of the Respondents

1. Do you have your own land? 1) No 2) Yes
2. What is the size of your farm land in hectare? _____
3. Did you rent-out/share-cropping land? 1) No 2) Yes
4. Do you have Agricultural machinery and equipment? 1) No 2) Yes
5. Is there training given for you and your family based on agricultural mechanization? 1) No 2) Yes
6. Have you used Agricultural machinery in your farming activity? 1) No 2) Yes

7. Is the lack of mechanization affecting your farm activity? 1) No 2) Yes
8. Do you have alternatives in using agricultural mechanization technology? 1) No 2) Yes
9. For what purpose you produce crop? 1) For food 2) For sale 3) Both
10. Is the main source of your household income and livelihood base is agriculture? 1) No 2) Yes

Section 3: Social Interaction and Perception of Respondents

1. Do you know what agricultural mechanization mean and its importance? 1) No 2) Yes
2. Do you think that mechanization is important in agricultural activity? 1) No 2) Yes
3. How do you rate the utilization of Agricultural machinery technology in your area? 1) Very poor 2) Poor 3) Good 4) Very good
4. If there is available agricultural machinery in your area, do you want it for your farming practice? 1) No 2) Yes
5. What are key operations carried out with the agricultural machinery in your area? 1) Primary tillage 3) Harrowing 4) threshing/shelling 5) transportation
6. Do operations ever get delayed due to the unavailability of the machinery? 1) No 2) Yes
7. Is there agricultural machinery for rent in your area? 1) No 2) Yes
8. Is there any farmer in your village using any of Agricultural machinery? 1) No 2) Yes
9. Is the supply & availability of mechanization input is well here 1) No 2) Yes
10. Is the way of Agricultural machinery & equipment delivers & supply only through credit facility? 1) No 2) Yes
11. What factors are affecting utilization of agricultural machinery? 1) Topography 2) Land size 3) Access to server 4) Land productivity 5) Goal of product 6) Other
12. Is there distribution of different mechanization inputs by government? 1) No 2) Yes
13. What factors affecting the availability of Agricultural machinery? 1) Lack of government consideration 2) lack of capital 3) cost unaffordable 4) Absence of brokers 5) If other?
14. Is the mechanization more valuable than traditional farming system? 1) No 2) Yes
15. Are the farmers who utilized the agricultural machinery profiting? 1) No 2) Yes
16. Is the agricultural mechanization is an important technology and needed? 1) No 2) Yes
17. Is agricultural mechanization utilization means using only tractors and combines? 1) No 2) Yes

18. Agricultural activity needs, technical, training, and technology support. 1) No 2) Yes
19. Are the government facilitating and encouraging farmers to mechanize their farm? 1) No 2) Yes
20. Is there distribution of Agricultural machinery and equipment by government and none government sectors?
1) No 2) Yes
21. Is the machinery spare part facility available in the village/area? 0. No 1. Yes
22. Do you prefer mechanization as compared to your previous trend of traditional farming?
1) No 2) Yes
23. How much time to carry out one hectare of land plowing with tractor? (in hrs or days)

24. How much time and labour to carry out one hectare of land plowing with labour and animal? (hrs or days) _____
25. How many laborers and time required to thresh one quintal of crop with thresher?

26. How many laborers and time required to thresh one quintal of crop with labour?

27. How much money do you asked for one hectare of land plowing with tractor?

28. How much money do you asked for one kuntal of crop shelling by sheller?

Appendix 2. Questioner for Bako Agricultural Mechanization Centre

Section 1: Closed-ended Items

1. What is your main focus area in agricultural mechanization? 1) Maintenance and assembly 2) Extension/advertising & promotion 3) Test and practice 4) Technology adoption
2. Do you have any activity conducting with farmers on agricultural mechanization? 1) No for now 2) Yes
3. Is there any opportunity for the farmers facilitated by your center to use different farm machineries? 1) No 2) Yes
4. Do you think that farmers are willing and interested in using mechanization? 1) Not all 2) yes
5. How do you see the status of agricultural mechanization in this area? 1) Very poor 2) Poor 3) Good 4) Very Good
6. Do you test, verify and modify machineries and implements suitability for the area? 1) No 2) Yes
7. Is the Agricultural machinery and equipment are available in your center and at other firms in this area? 1) No 2) Yes
8. Are the farmers utilizing the available mechanization input? 1) No 2) Yes
9. Is the development of mechanization increasing in this center and in the society? 1) No 2) Yes
10. What factors are affecting the Agricultural mechanization in this area? 1) Absence of providers and Government system 2) cost of input 3) Topography 4) capital
11. Is the center supply and distribute the Agricultural machinery and equipment for farmers? 1) No 2) Yes

Section 2: Open-ended Items

Instruction: Please respond to the following questions by providing relevant information.

1. How do you explain the existing status of availability and utilization of the Agricultural machinery in this area?
2. What types of agricultural machinery are recommended for this area?

3. What factors are hindering the availability and utilization of mechanization technology in this area and what is the best way forward to overcome the problem?

Appendix 3. Questioner for Targeted Woreda Agricultural Bureau

Section 1: Closed-ended Items

1. Are the agricultural machineries available in your woreda? 1) No 2) Yes
2. How is the participation of farmers in mechanizing the agricultural activity? 1) Very poor 2) Poor 3) Good 4) Very good
3. Is there any opportunity for the farmers to use different Agricultural machinery in your woreda? 1) No 2) Yes
4. Is the farmer utilizing the available mechanization input in your woreda? 1) No 2) Yes
5. Utilization of Agricultural mechanization in this area is affected by 1) Farmers attitude 2) Topography 3) Soil type 4) Cost ineffective
6. How do you encourage and support farmers to use Agricultural machinery? 1) By training 2) Extension system 3) By development agent workers 4) Supplying the mechanization input
7. How do you encourage farmers who are utilizing mechanized technology?
1) No specific support 2) By giving rent 3) By cooperating
8. How do you see the interests of farmers in Agricultural mechanization? 1) Very poor 2) Poor 3) Good 4) Very good
9. How is the level of the availability and utilization of agricultural machinery in the woreda?
1) Very poor 2) Poor 3) Good 4) Very good
10. The relationship between agricultural sector and the farmers and supporters is 1) Very weak 2) Weak 3) Good 4) Very good
11. Is the problem of developing agricultural mechanization related with 1) Land size 2) Farmer interest 3) Lack of knowledge and awareness

Section 2: Open-ended Items

Instruction: Please replay to the following questions by providing relevant information.

1. How do you state the mechanization status of this woreda and different opportunities there?
2. How is the interest of farmers in the utilization of mechanization technology? Have you ever asked about the problems in the community regarding the use of mechanization?

3. What are the factors hindering the availability, distribution and utilization of mechanization and what are the recommendable solutions?

Appendix 4. Questioner for East Wallaga Zone Agricultural Bureau

Section 1: Closed-ended Items

1. What is the level of agricultural mechanization in the East Wallaga zone?
1) Very poor 2) Poor 3) Good 4) Very good
2. How is the availability and distribution of agricultural machinery in this zone?
1) Very poor 2) Poor 3) Good 4) Very good
3. How is the availability of mechanization input in your zone?
1) Very low 2) Low 3) Good 4) Very good
4. Utilization of Agricultural machinery in this zone is affected by
1) Farmers attitude 2) Soil type and topography 3) Mismanagement 4) Land size
5. Do you know how many machinery are currently functioning?
1) No 2) Yes
6. What are the factors hindering the utilization of mechanization technology?
1) Cost ineffective 2) Lack of the awareness 3) Mismanagement 4) Farmers perception
7. Is the adoption of agricultural machinery needed in this zone?
1) Not needed 2) Needed 3) strongly needed

Section 2: Open-ended Items

Instruction: Please respond to the following questions by providing relevant information.

1. What are the main factors hindering the availability and utilization of agricultural mechanization in east Wallaga?
2. What are the solution set and options you have to solve the problems of availability and utilization of mechanization in this zone?
3. What are the total number of Agricultural machinery in this zone and distributed by your sector?
4. As the expert, what is your opinion in order to increase the agricultural mechanization utilization in the East wallaga?