ASSESSMENT OF AGRICULTURAL MACHINERY AND EQUIPMENT CUSTOM HIRING SERVICE IN OROMIA REGION A CASE OF DUGDA DISTRICT, EAST SHOA ZONE

ABAYNEH AWEKE AWULACHEW

A Thesis Submitted to the Department of Mechanical Engineering,

School of Mechanical, Chemical, and Materials Engineering

Presented in Partial Fulfillment of the Requirement for the Degree of Master's in Agricultural Machinery Engineering

Office of Graduate Studies

Adama Science and Technology University

March 2024

Adama, Ethiopia

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DECLARATION

First, I hereby declare that this thesis entitled "Assessment of Agricultural Machinery and Equipment Custom Hiring Service in Oromia Region A Case of Dugda District, East Shoa Zone" is my work. That is, it has not been submitted for the award of any academic degree, diploma or certificate to any other university. All sources of materials used for this thesis have been duly acknowledged through citation.

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I, the advisor of this thesis, hereby certify that I have read the revised version of the thesis entitled "Assessment of Agricultural Machinery and Equipment Custom Hiring Service in Oromia Region A Case of Dugda District, East Shoa Zone" prepared under my guidance by Abayneh Aweke Awulachew submitted in partial fulfillment of the requirements for the degree of Masters of Science in Agricultural Machinery Engineering. Therefore, I recommend the submission of a revised version of the thesis to the department following the applicable procedures.

Siraj Kedir Buse (Ph.D.)	_____	_____
Name of advisor	Signature	Date

APPROVAL PAGE OF THE THESIS

I, the advisor of the thesis entitled "Assessment of Agricultural Machinery and Equipment Custom Hiring Service in Oromia Region A Case of Dugda District, East Shoa Zone" and developed by Abayneh Aweke Awulachew here by certify that the recommendations and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

Siraj Kedir Buse (Ph.D.)	_____	_____
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We, the undersigned, members of the Board of Examiners of the thesis by Abayneh Aweke Awulachew have read and evaluated the thesis entitled "Assessment of Agricultural Machinery and Equipment Custom Hiring Service in Oromia Region A Case of Dugda District, East Shoa Zone" and examined the candidate during the open defense. This is, therefore, to certify that the thesis is accepted for partial fulfillment of the requirement of the degree of Master of Science in Agricultural Machinery Engineering.

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ACRONYMS

AAMI	Adama Agricultural Machinery Industry
AME	Agricultural machinery and Equipment
ASABE	American Society of Agricultural and Biological Engineering
ASAE	American Society of Agricultural Engineering
BB	Biliti Balewolde
BGS	Birbirsa Guda Sabole
CHS	Custom Hiring Service
CSA	Central Statistical Agency
CSAM	Centre for Sustainable Agricultural Mechanization
CSISA	Cereal Systems Initiative for South Asia
DD	Darara Dalacha
EIAR	Ethiopian Institute of Agricultural Research
ETB	Ethiopian Birr
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
FWT	Four Wheel Tractor
GDP	Gross Domestic Product
NGO	Non Govemental Organization
SPSS	Statistical Package for Social Sciences
SW	Sera Wakale
UNESCAP	United Nation Economic and Social Commission for Asia and Pacific
TVET	Technical and Vocational Education and Training
WAO	Woreda Agricultura Office
WQ	Walda Qalina
WT	Walky Tractor

ABSTRACT

A Custom hiring service was a popular method for temporary usage of agricultural machinery and equipment to accomplish farm activities. A shortage of farm power slows down the accomplishment of crucial farm tasks and eventually limits the growth of agricultural production and farm income. Therefore, this study focused on evaluating agricultural machinery and equipment custom hiring service factors related to the targeted area. A multistage study was conducted with 363 respondents from 5 kebeles and 32 cooperative and woreda agricultural office respondents using semi and structured questionnaires. ANOVA was used to evaluate factors associated with custom hiring service and logistic regression model to used recommend hiring traditional and modern hiring of farm machinery. The study found that educational status, farm size, crop type, topography, availability, hiring cost, and distance significantly influence farm machinery hiring decisions, while age, marital status, gender, and soil type negatively affect hiring services. The findings verify that male (85.1%) farmers are more engaged than female (14.9%) farmers in farming. The studied households were in the age range of 41 to 65 (56.7%) had no formal education, could be illiterate, and 26.2% had stopped attending primary school. Machinery owners are not interested in fragmented lands, as they consume more fuel due to movement between areas. Participant prefers, in terms of cost, most of the selected farmer cooperative union machinery and equipment, 61.93% farmer cooperative and 38.07% private ownership. Participant showed farm machinery and equipment like tractor training support availability of 35% and 44.4% in private and cooperative unions respectively. Custom hiring systems agricultural machinery and equipment that facilitate ways obtaining for modern farming so that extra studies would be conducted to advance the achievement of hiring as a zone and at the regional level at large.

Key words: Agricultural machinery, Cooperative union, Custom hiring, Equipment and Ownership

CHAPTER ONE

1. INTRODUCTION

Agriculture is the foundation of human survival, an important source of human food and clothing, and it contributes significantly to economic prosperity and social stability (Eng & Zhang, 2020). But until recently, all agricultural work was done manually using simple hand tools. However, machinery is one of the most crucial capital inputs in agricultural production. Equipment used by farmers to till, plant, cultivate, harvest, grind animal feed, raise irrigation water, and other tasks is referred to as agricultural machinery. These include tractors, plows, harrows, planters, chemical applicators, and different harvesting equipment like combines (Omer, 2013).

Ethiopia's economy is depended mostly on agriculture, which also provides nearly all of the country's population's means of subsistence. East Shao Zone which was found in Oromia regional state, has 12 woreda with a population of less than a million, and Dugda woreda is one of and predominantly well known for its vegetable production (CSA, 2015). Agriculture is the pillar of the district's population, and hence it provides almost the largest livelihood share of the population. The districts have a total area of 95,945 ha. Based on the general view, the current land use pattern (58.27 % of the district's land) is under cultivation (Gemeda, 2013). The major types of crops that are produced include cereals, pulses, vegetables, and fruit. Few landholders are engaged in irrigated agriculture using water from the lake Batu, groundwater, and Meki River, while others rent out their holdings to private farmers who use their own diesel generators to pump out the water from the water sources, and most of the farmers in the district are rain-dependent. From the irrigated crops produced by peasant farming, tomato and onion have accounted for 30% and 49%, respectively, in the past three years (Gemeda, 2013).

According to Deribe *et al* (2022), the status of utilization of tractors and combine harvesters in Asasa is 71.9% and 100%, in Bale (Sinana) 63% and 100%, and in Dugda 43% and 6.7%, respectively. As compared to the dugda, that of Sinana and Asasa had higher utilization of tractor and combine harvesters since the land is comfortable for mechanization and hiring services.

1.1. Background and Justification

Agricultural mechanization in Ethiopia has undergone a structural change from the state of -subsidized provision of hiring services in the 1980s, which experienced a failure in similar ways to other Asian and African countries (Brian *et al*., 2016). The farmer service provider and the private commercial farms own farmland that ranges from the lowest of 2 hectares for small-scale farmers to up to 1000 hectares for commercial farms (Deribe et al., 2022). A large-scale farming system requires the use of modern agricultural inputs, modern technology, and hired labor, contrary to family labor in small-scale farming systems. Despite these facts, little has been done, if any, to analyze whether the existing commercial farms are producing the maximum possible output given their resource bases and technology, which of course should be the first logical step to be adopted in order to improve their production and product (Kebede, 2011).

Those agricultural machinery suppliers who deliver brand-name tractors and agricultural equipment are active throughout the nation, such as Rise Engineering, Moenco, Kaleb, Hagbes, and Gedeb Engineering are some of the important companies. Some of the well-known tractor brands that business import is Messey Ferguson, Landin, Class, SAME, John Deer, and Case. The government importations and assembles tractors from Belarus and additional Chinese brands, reaching from walking tractors with 8 horse power to four-wheel tractors with 300 horse power, at the former Adama Agricultural Machinery Industry (AAMI), now known as Ethio-Engineering (Kelemu, 2015).

In Ethiopia, relatively free market operations at least permitted the involvement of the private sector; however, farm machinery and the hiring service became expensive (Yared and Bisrat, 2021). Farm machinery has a significant role to play in ensuring the timeliness of various operations. It is quite expected to use such mechanical equipment', which has a higher output capacity and reduces the number of operations to be performed, resulting in higher yields (Abiy *et al*., 2021).

Land preparation was prepared in sub-Saharan Africa by human muscle power (65%), draft animal power (25%), and engine power (10%) (Brian et al., 2016). A lack of farm power slows down the completion of crucial farm tasks and eventually limits the growth of agricultural production and farm income (Sims *et al*., 2016).

Ethiopia's economy, like that of many other sub-Saharan African nations, is based primarily on agriculture, and 80% of the population lives in rural areas, with 20% living in cities (Ayele, 2022). It has 111.5 million hectares of land, 74.5 million of which are suitable for agriculture, and 13.6 million of which are in use for production at the moment (Abiy et *al.*, 2021). However, the amount of arable land that is tilled with tractors is still quite small. The farm power smallholder farm power per hectare (ha) availability in Ethiopia is about 0.5 hp/ha, 5.4% engine-driven and; 94.6% from human and animal sources which is very low (Ayele, 2022) . Compared to Kenya and Tanzania, which have 14,000 and 21,500 tractors, respectively, Ethiopia had quite a few tractors in 2013 roughly 12,500. In Kenya and Tanzania, there were 23.9 and 26.9 tractors per 100 km^2 of arable land, respectively, whereas Ethiopia had 2.1 tractors (MOA/ATA, 2014).

The Dugda woreda is one of the east Shoa zones of Oromia regional state, and its primary source of income is agriculture. About 55,000 hectares of land under agricultural production are dependent on rainfed. From the total agricultural area, the irrigation potential for the Lake Batu catchment is estimated to be 13,300 ha. Out of these, 82% (10,880 ha) have been developed under traditional and modern small-scale mechanization (Gemeda, 2013).

Research conducted in Oromia indicates that the following categories of agricultural equipment are owned: two-wheeled (0.9%), four-wheeled (0.66%), disc ploughs (0.99%), harrows (0.33%), planters (0.33%), tie ridger (0.66), trailers (0.33%), threshers (0.9%), and motorized water pumps (9.17%) (Deribe *et al.*, 2022). The weighted mechanization index confirms that mechanically operated activities account for 12.1% of all activities in Oromia regions (Deribe et al., 2022). However, the capacity of farm machinery in the region does not meet the demands of farmers to perform agricultural activities.

It is nearly always difficult for low-income smallholder families to save up enough money to buy machinery when they are attempting to move away from subsistence farming. Alternatively, the required funds could be obtained through borrowing; however, this approach carries a higher risk, and official lending institutions such as banks are infamous for being hesitant to provide credit to this industry (Sims & Kienzle, 2015). To solve factors for farmers who do not own farm machinery, custom hire services are a well-known way to temporarily take management of those assets (Kisku & Bisht, 2022).

Beyond the farmer's perspective, the supply related factors that hinder the delivery of machines, domestic fabrication, provision of finance, and hiring services need to be well examined (Deribe *et al*., 2022). For small-scale farmers in particular, getting these essential agricultural hire contracts on a custom basis may prove to be more cost-effective than owning and having access to agricultural machinery services (Kadhim, 2018). Therefore, this study helps to asses custom hiring service agricultural machinery and equipment for farmers, commercial farms and farm cooperative union and the related factors during obtaining farm machinery.

In particular, assess the current status of agricultural machinery and equipment service used by the farmers and the surrounding community in the distinct, compare and contrast between farmer cooperative union and owner custom hiring service providers of agricultural machinery and equipment, and determine the factors that affect the availability of agricultural machinery and equipment under government policy during custom hiring service.

1.2. Statement of the Problem

The Ethiopian economy depends on agriculture in terms of income, employment, and the generation of export revenues. According to Ayele (2022), farm power availability of in Ethiopia is about 0.5hp per hectare, which is very low. A shortage of farm power slows down the accomplishment of crucial farm tasks and eventually limits the growth of agricultural production and farm income (Sims *et al*., 2016). Ownership of agricultural machinery services and access to them, especially for small-scale farmers, may not be the minimum cost (Kadhim, 2018). Due to a lack of financial resources and technical skills, labor shortage, and climate change farmers prefer to participate in the custom hiring of agricultural machinery.

For small-scale and cluster farm owners, one of the greatest obstacles is obtaining agricultural machinery to perform agricultural tasks; this is because agricultural machinery and equipment are expensive, and government organizational policy lacks standard custom hiring laws that would prevent disputes (Abiy *et al.,* 2021).Due to inadequate communication between the customs service provider and farmers, small farms, an absence of farm equipment, inadequate maintenance, and a shortage of spare parts, the region loses ripe crops during peak hours due to labor shortages, and a high percentage of traditional farming, which pushes young people into the city. In addition, the rate of hiring services is expensive and varies from one place to another in the same Dugda district. In addition, the study area was not clearly defined regarding the

evaluation of traditional farming and the hiring of agricultural machinery with related productivity.

1.3. Objectives of the Study

1.3.1. General objective

The general objective of this thesis work to assess agricultural machinery and equipment custom hiring service in Oromia region a case of Dugda District, East Shoa Zone

1.3.2. Specific objectives

The specific objectives of the study were:

- To assess the current status of agricultural machinery and equipment custom hiring service availability
- To conduct a comparative analysis of the custom-hiring services of farmer cooperatives union and private
- To determine the factors that affects the availability of agricultural machinery and equipment
- To come up with appropriate custom hiring service model

1.4. Significance of the Study

This research give benefit for small land holder to identify and know opportunities of getting farm machinery before crops loss, for farm machinery owner to know the potential suitability of the area for custom hiring, for establishment service providing and agricultural machinery spare part shop, for government easy to distribute farm machinery. To provide data to farmer cooperative unions to identify the potential Dugda district of mechanization to provide their service.

1.5. Scope of the Study

This study would only assess the custom hiring of agricultural machinery and equipment for farmers in the Dugda district of the east Shoa Zone to carry out agricultural tasks such as tillage, cultivation, and harvesting. The assessment considers factors for custom hiring services for agricultural machinery and equipment done structured questionnaires, interviews, and field observation. The study of this research depends on the available data in the area. While useful, the results of the survey would be viewed with attention because of possible response bias.

1.6 Limitation of the study

This study's scope was restricted to analyzing the current situation and assessing farmers' customary use of agricultural machinery and equipment for hire in the Dugda district of the east Shoa Zone. The study included only five targeted samples of kebeles. Through structured questionnaires, interviews, and field observations, the evaluation has taken into account factors that affect custom hiring services for available agricultural machinery and equipment (tractor, combine harvester, maize sheller, teff thresher, and irrigation pump) only on the selected kebeles. Evaluation takes place only for custom hiring services in private and farmer cooperatives, where farm machinery and equipment are found. This study does not cover soil test and topographic survey with equipment.

CHAPTER TWO

2.REVIEW OF LITERATURE

2.1. Agricultural Mechanization in Ethiopia

Ethiopian mechanization level has been very low compared to other countries for a long time in relation to technology. In general, the Ethiopia's history of agricultural mechanization can be separated into three main periods, beginning in the middle of the 1960s and continuing until the present.

2.1.1. Agricultural mechanization in the Empire of Haile Selase Era

The agrarian economy in Ethiopia was principally feudal. During the feudal era an agricultural surplus was extracted by a relatively small group of landlords. In 1959, the first agricultural engineering program at a university was established at Haramaia University. Simultaneously, the Jimma Agricultural Technical School was established to provide training for agricultural engineers and extension workers (Ayele, 2022) .

However, the technology that relies on horsepower for the draft is more associated with highland culture, whereas dig culture predominated in the fertile, rich South and Southern regions of the nation. Large-scale enterprises, tractor hiring services, and settlement buildings were displayed under the mechanical driven mechanization category in the mid Awash Settlement, Tendaho Estate Share Company, The Awash Valley Authority, and Setit Humera. In the Humera region in 1966, 158 farmers were utilizing 229 tractors, and the region was expanding quickly. There were reportedly more than 400 tractors imported from 8 different countries at the time, 19 distinct models from 12 manufacturers. Blocks of land between 400 and 1000 hectares were given to individuals. A 70-year lease was arranged for about 7000 hectares (Kelemu, 2015).

2.1.2. Agricultural mechanization of the Derge Era

According to the land announcement of 1975 recognizing the importance of large-scale mechanization, the Derge established big mechanized farms then called "state farms", by removing private farms and establishing new ones. The study focused mainly on five state farms of differing agro-ecology, two research centers, two machinery hiring organizations and machinery importers as indicated below: Agricultural Equipment and Technical Service, Enterprise, the Awassa State Farm, the Adele State Farm, the Dedesa State Farm, the Upper Birr State Farm and the Ziway Horticultural Farm (Kelemu, 2015)

The Ministry of State Farms through the Agricultural Equipment and Technical Service Corporation was responsible for importing, distributing and after sales maintenance of the agricultural machinery and implements at the different state farms. The Derg established the farms within a short span of time, mainly with ZT, IMT tractors, E512 combines and Landin imported from the former East European countries, and locally assembled NTAP tractors (Goda, 1998). Initially, about 448 farms of different sizes with a total area of 131,000 hectares came under the State farms' management and out of which about 47,000 hectares were irrigated (Kelemu, 2015). Some farmers had been using the machine for nearly 40 years, beginning about the same time that the Agricultural Mechanization Service Corporation (AMSC) was established and began offering farmers hiring services for mechanization (Deribe *et al*., 2022).

The Ministry established eight rural technology centers at Kombolcha, Assela, Sodo, Mekele, Bako, Jimma, Bahirdar, and Harar. These centers were established with the objective of promoting rural development through increasing agricultural productivity, rural energy and small-scale rural industries. Besides, 25 rural technology hiring stations and 170 farmers' technical service stations were established at service cooperatives in the country. Farmers reported some income of 5000-7000 birr in three months by hiring the maize sheller around Kombolcha, while some farmers around Bako earned 10,000 birrs during the same period (Desta, 1998). It was believed that large-scale state and cooperative farms would increase productivity and boost overall economic growth (Berhanu, 2016).

2.1.3. Agricultural mechanization in present Era

Nowadays, most rural technology promotion institutes have become regional mechanization research centers, therefore there are still not many agricultural mechanization training institutions. A Regional Agricultural Mechanization Research Center has been established in Oromia, Amhara, Tigray, Afar, and Somalia Region. During the Derge, there was just one Agricultural Mechanization Research Center, which was housed within the Ethiopian Institute of Agricultural Research (EIAR). There are four Agricultural Mechanization Centers in Oromia (Assela, Bako, Jimma and Fedis). The hand tool and draught animal power mechanization has continued throughout this period in the highlands and the country's southwest, much like it did in the previous one (Kelemu, 2015). The growing need for mechanization by smallholder farmers resurfaced as a policy priority in 2013, and a national mechanization strategy was introduced in 2014. The goal of the approach is to decrease animal power by 50%, increase

smallholders' access to mechanization by 30%, and increase mechanical power utilization from 0.13 kW/ha to 1 kW/ha (MOA and ATA,2014).

There are two divisions called pre harvest and post-harvest divisions at each center. Additionally, they offer hiring services, training for farmers, manufacturers, and dealers, and participate in technology expansion. The main mechanization supply chain actors in terms of repair and maintenance are found in numbers 37, mostly in Addis Ababa and Oromia; customs hire service providers (66% in Oromia; 26% in Amhara); and mechanization training service providers in numbers (2) in Oromia at Adama and Shashamne (Ayele, 2022).

2.2. Agricultural Machinery

Agricultural machinery is a significant element and essential for agricultural growth in crop production, animal production, conservation of the natural area, and irrigation in modern agriculture in several nations. The key aims of using agricultural machinery are to decrease the problems of farm operations and to make the most of production. Farm machinery is any equipment that agriculturalists use to till, plant, cultivate, harvest, grind animal feed, lift irrigation water and others. These include tractors, plows, harrows, planters, chemical applicators, and different harvesting equipment like combines (Omer, 2013).

Despite the fact that agricultural machinery can have significant advantages and has been the subject of numerous development projects in developing nations, access to agricultural machinery by smallholders is still extremely limited in many of these nations, especially in sub-Saharan Africa. For instance, hoe agriculture still predominates in vast swaths of Africa, and few people have access to oxen and tractors for agricultural field operations (Hatibu, 2013)

2.3. Acquiring Agricultural Machinery

When the machinery and equipment are acquired, and the recipient or its representative takes possession of the items and has control over them. Despite the fact that the majority of farmers own their equipment (individual or joint ownership), hiring, renting, and leasing options are still widely used (Edwards, 2009). Your decision regarding acquiring farm equipment would be based on your responses to the following requests; How much would it cost? What further options exist? for you to hire the machine's services? What are the expected costs? How much cash would you need? Can you afford it? Can capital be used more profitably? What is the

income tax? What is your own tax situation? Do you possess the skills, equipment, and manpower necessary to run and maintain the machine? Are the newest technologies? For the farm manager, choosing the optimum acquisition strategy for machinery poses a challenging financial decision. The acquisition includes facilitation of agricultural machinery acquisition, developing demo areas, developing and improving custom hiring and leasing systems for agricultural machinery, capacity building on research and development, and reformation of regulations. Facilitation of agricultural machinery procurement is carried out by providing financial credit from government banks and providing assistance for purchase of agricultural machinery(CSAM-UNESCAP, 2013).

2.3.1 Individual ownership of agricultural machinery

The most common way to gain long-term control over agricultural machinery services is through ownership. Owning a machine gives you control over how it is used and how well it performs, as well as responsibility for fixed and variable cost. You must also provide the manpower to operate the machine, which is the least expensive choice in the long run, especially for high-use equipment (Edwards and Hanna, 2009).

2.3.2. Joint ownership of agricultural machinery

Joint ownership allows you to share the responsibility for investment, repairs, and labor with someone else, and reduce ownership costs per hectare. The parties must approve of each other's work habits and care of the machine, develop a system for scheduling use of the machine, and agree on responsibility for labor and repairs(Edward, 2009). Most important, a written agreement should be developed with details of how the co-ownership would be dissolved in case of disagreement, termination of farming by one party, or death of one party, and with a method for determining the machine's value at the time of dissolution (Edwards and Hanna, 2009).

Two or more farmers working together to share their labor and use of equipment can reduce their investments in machinery and still have access to a complete system. Exchanging work may be particularly attractive to young farmers starting their operations with an older neighbor, when one needs machinery and the other needs labor.

2.3.3. Custom hire of agricultural machinery

Acquiring temporary management of agricultural machinery, especially for harvesting and applying fertilizer and pesticides, is common through custom hiring. A neighbor, a nearby

provider, or a company that specializes in custom farming and handles all manner of field operations may all offer custom. The use of farm machines on a custom hire basis could help accelerate the mechanization process in agriculture (Khan and Rehman, 2019).

Custom hiring centers are the other actors to reach out to agriculture service provision entrepreneurs to explore potential customers. Most of the custom hiring centers focuses on larger farm machinery, so one with a power tiller and combination could reach custom hiring and reference their client whom they don't serve (Brian et al., 2016).

2.3.4. Rental of agricultural machinery

The temporary use of a machine is covered by a rental agreement. In most cases, fees are determined by the number of hours, days, weeks, months, or seasons used, with a minimum fee applied even if actual usage is less than that specified in the contract. Terms of rental contracts vary from those of custom hiring in the following ways: There isn't a supplied operator. You would likely be in responsibility of paying for all operating expenses throughout the life of any term contracts, and you are in control of the machine's operation and routine maintenance. Since you run the machine, you have control over the work's quality, and you can use it whenever you wish for the duration of the rental (Williams, 2011).

2.3.5. Leasing of agricultural machinery

Leasing is one of the best methods for updating the agricultural equipment that is currently on the market. Leasing gives the lessee greater chances to access more borrowed funds, reduce taxation, and a variety of other things, while also enabling the company to renew its fleet of agricultural machines (Kiritsa et al., 2021).

The most typical length of a lease is 3 to 5 years. The purchase of agricultural machinery through leasing does not give the property right, which is retained by the lessor until the entire amount is paid. Compared to the purchase, the lessee has more available funds. Leasing companies for commercial property, agricultural lenders, and equipment dealers frequently offer leases on farm equipment (Williams, 2011).

2.4. Factor of Custom Hiring Service of Agricultural Machinery and Equipment

2.4.1. Custom hiring provider

Another party approaching agricultural service providers to investigate possible clients is custom hiring centers. Customer, whom they don't serve, for example, as the majority of them specializes; larger agricultural equipment (CSISA, 2021) .

The main factors that influence the profitability of a machinery hire service include the size of the capital invested, type of selected machinery, the business volume that generate incomes the price that is charged to the customers for the services rendered and the expenditure or operational costs. Machines should work enough hectares in a season to cover the costs of operation as well as generating an income surplus to cover loan serving and other obligations. A farmer can temporarily obtain responsibility over farm machinery through the custom hire service center without having to invest a large sum of money (Kadaraiah et al., 2022).

2.4.2. State government and its program

Farm mechanization is a crucial tool for the agricultural sector's development, and the government supports it through a number of programs. Agricultural service providers should constantly be proactive in utilizing any kind of incentive, whether it's a direct subsidy on machinery purchases, a tax break on farm machinery or equipment imports, or an interest refund on a loan (CSISA, 2021).

The recently amended import policy further has given a tax incentive for farmers and farmer cooperatives during 2019. The old custom practice was allowing for keeping machines in stock for only about 4–6 months but the current procedure has improved the limitations. The tax exception resulted in a reduction of the import and value-added taxes that accrue up to 35% of the sales value of the machine. Furthermore, spare parts are still subject to taxes unless imported altogether with the machine. For the manufacturing of small-medium machinery, the time-to-time rising price of raw materials makes the price of good quality products expensive(Yared and Bisrat, 2021).

For returning migrants and workers who are willing but lack the financial means to start a business, banks and other financial organizations offer loans for the purchase of machinery(CSAM-UNESCAP, 2013).

2.4.3. Farm size holding

Tractors can be crucial for increasing the total area that huge farms cultivate in a society where there are together large and small farmers. For large farms, hired labor accounts for a significant amount of costs production (Diao et al., 2016). The land owned by households is estimated at 1.25 hectare as Ethiopia (Deribe *et al*., 2022). The amount of land a household has directly correlates with the kind of agricultural machinery and equipment that they own (Sarkar, 2020).

The practice of mechanized agriculture in Ethiopia is estimated at 0.7% for land preparation while it is less than 0.8% for crops thresher machines (Yigezu, 2021). Specifically, tractor ploughing received the largest acceptance for which utilization accounts for 17% followed by combine harvesting with a rate of 12% (Deribe *et al*., 2022).

2.4.4. Agricultural machinery maintenance and spare part

The economic life of the old machinery was taken into consideration while deciding whether to replace it with new. Costs associated with upkeep and repairs are directly related to economic life. Amounts incurred in the ownership and maintenance of farm equipment account for 35–50% of total output costs. The maintenance manager needs to be knowledgeable about key performance measures in order to be effective. Measures of productivity, quality and cost, on-time delivery, quality of working life, innovation, and profitability is frequently employed in the maintenance role to evaluate the system's and a subsystem's performance. To guarantee that the appropriate parts would be available when needed, spare part management is a must for all types of companies. As a result, there are working capital constraints and high carrying expenses (Sims & Heney, 2017)

A proactive approach to reliability places a high importance on asset condition knowledge for organizations. The quantity of inventory needed is mostly determined by utilization, therefore the fewer parts we utilize, the fewer we must have in stock (Anthony Kelly, 2006).

Farm machinery skills training is also affected by training methods, training environment, and farmers' personal characteristics (Brinia and Papavasileiou, 2015) and (Landini et al., 2017). As a kind of agricultural skills training, agricultural machinery maintenance training is conducive to the maintenance of agricultural machinery equipment and normal operation.

CHAPTER THREE

3.MATERIALS AND METHODS

3.1. Study Area Descriptions

Dugda Woreda is located in East Shewa Zone of Oromia Regional State in Ethiopia. Geographically the Woreda is located between 80 01'N to 80 10'N latitude and 38 031'E to 38 057'E longitude(Woreda Agricultural Office, 2014). The annual rainfall and average temperature in the in the woreda can be estimated to vary between 700 mm to 800 mm and 15^0c to 28^0c respectively(Gemeda, 2013).

The Woreda has 36 rural Kebele Administrations and 3 small town kebeles (in Meki). The capital town of the district is Meki which is located 134km from Addis Ababa and 88km west of Adama before reaching Batu town, along the same main asphalt road. The boundaries of the woreda are Bora woreda in the North and North West, Arsi zone in the East, Adami Tulu Jido Kombolcha Woreda in the South and Gurage zone in the West (WAO, 2014). The Woreda ranges in elevation from 1600 to 2020 meters above sea level. The woreda's physical features consist of 2.86% mountains and 97.14% flat terrain. The woreda is mostly composed of two types of soil: sandy loam (59%) and clay loam (41%) (WAO, 2014).

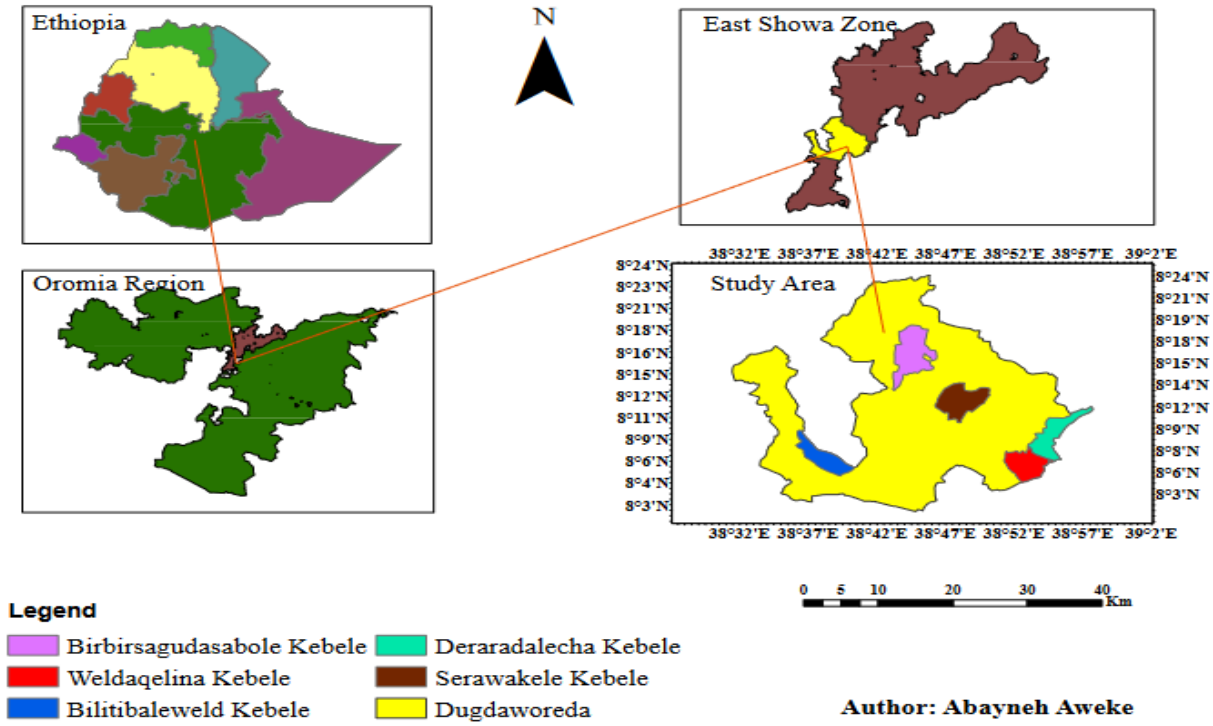


Figure 3.1: Map of study area description

3.2. Research Design and approach

Descriptive design (cross-sectional design) study conducts to assess custom hiring service of farm machinery the target areas as well as to assess the existing obtaining system and the factors deterring the getting of agricultural machinery service.

The survey was designed with multistage unit sampling; in the first stage, the Dugda district was selected from the east Shoa zone, and in the second stage, representative Kebeles were selected from 36 rural Kebeles and three towns. Using simple random sampling and purposive sampling, five kebeles were chosen from this set based on the crop produce and farm machinery and equipment they had. Primary data is collected through a structured questionnaire on selected respondent growers concerning mostly different factors aimed at getting machinery service such as; time, cost, family size, farm size, crop type, soil type, topography, availability of farm machinery, availability of maintenance and repair services, farm machinery training center and spare part accessibility. The physical reflection was also made on the recent actions executed by farm machinery and equipment records, which targets the woreda agricultural office.

The study designs; generally, an inductive procedure that uses to evaluate different factors deterring acquisition of agricultural machinery Dugda district.

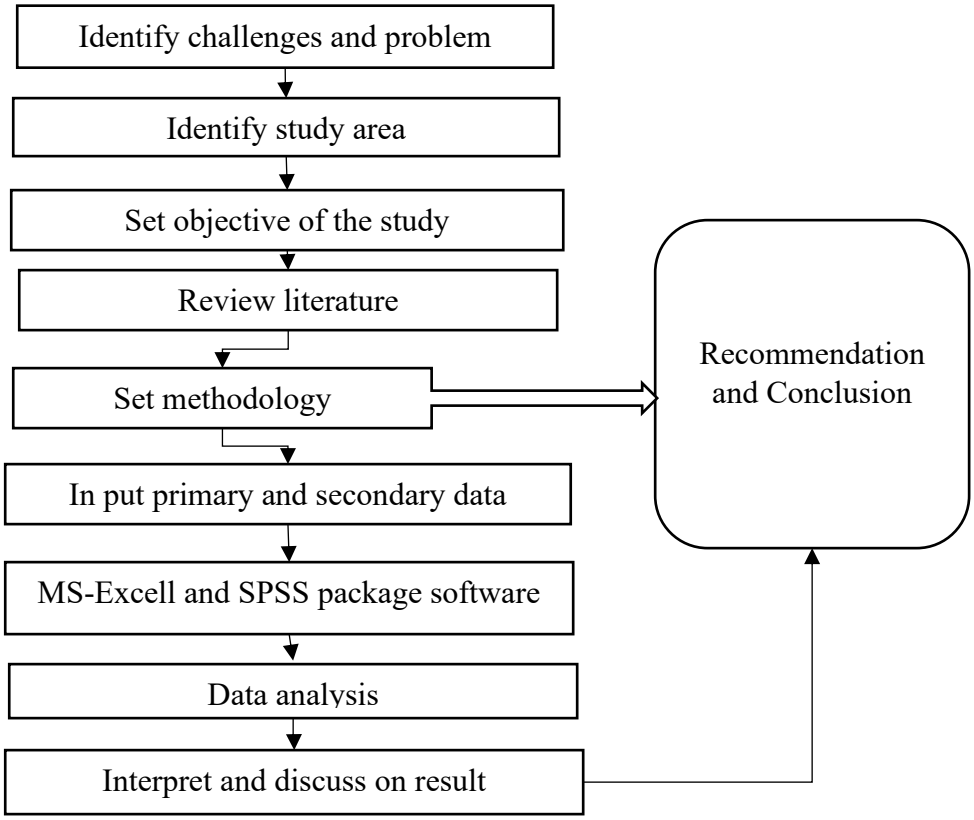


Figure 3.2: Flow chart diagram of the study

3.2.1. Sample size determination techniques

In this research sample size was determined by means of a single population proportion formulation for known a population as suggested (Yamane ,1967).

$$n=\frac{N}{1+N(e)^2} \quad \text{..... 3.1}$$

According to Noordzig et al. (2010), the selected households' size in Dugda kebeles was stratified into male and female-headed households by Equation (3.2.).

$$ni = \frac{\text{Number of house hold in each kebeles}}{N} x\ n \text{----------3.2}$$

Where:

n = is the sample size to be determined

Z= (α/2), the standard normal deviation set at 1.96, which corresponds with the 95% confidence interval.

e = level of precision considered (e = 5%) or proportion of sampling error between the sample and the population.

For the study, accordingly, to obtain the required sample size at the standard normal deviation set at the critical value of the Z-test from the Z-distribution table: $Z_{\alpha/2} = 1.96$, which corresponds with a 95% confidence interval (Montgomery, 2012).

n_i = Number of sample households from each kebeles.

The equation (3.1) is used to compute the needed sample size; that is, the sample size(n) for a known population.

$$n=\frac{3868}{1+3868(0.05)^2}=\frac{3868}{10.67} \quad =362.5$$

The value n is taken as =363

At the woreda level, a proportionate sampling procedure was employed to compute the sample size based on the number of kebeles using custom-hired service agricultural machinery and equipment. In addition, sample size kebeles were selected based on crop produce with in cluster and without cluster, distance, availability of water, tractor usage, road and land comfort for plowing. The essential sample proportions at the kebele level would be proportional to each kebele. Which was shown below in the Dugda district diagram division based on different factors in Table 3.1.

Table 3.1: Sampling distribution of Dudda district kebeles

Targeted study site district	Names of sampled kebeles	No of households		Total Targeted population	Sample households		Total sampled house holds
		Male	Female		MHH	FHH	Total sample taken
Dugda	Derara Dalacha	824	160	984	77	15	92
	Walda Qalina	835	145	980	78	14	92
	Sera	484	88	572	46	8	54

	Wakale						
	Biliti Balwolda	361	57	418	34	5	39
	Birbirsa Guda sabole	786	128	914	74	12	86
Total sample households		N= 3868			n=363		

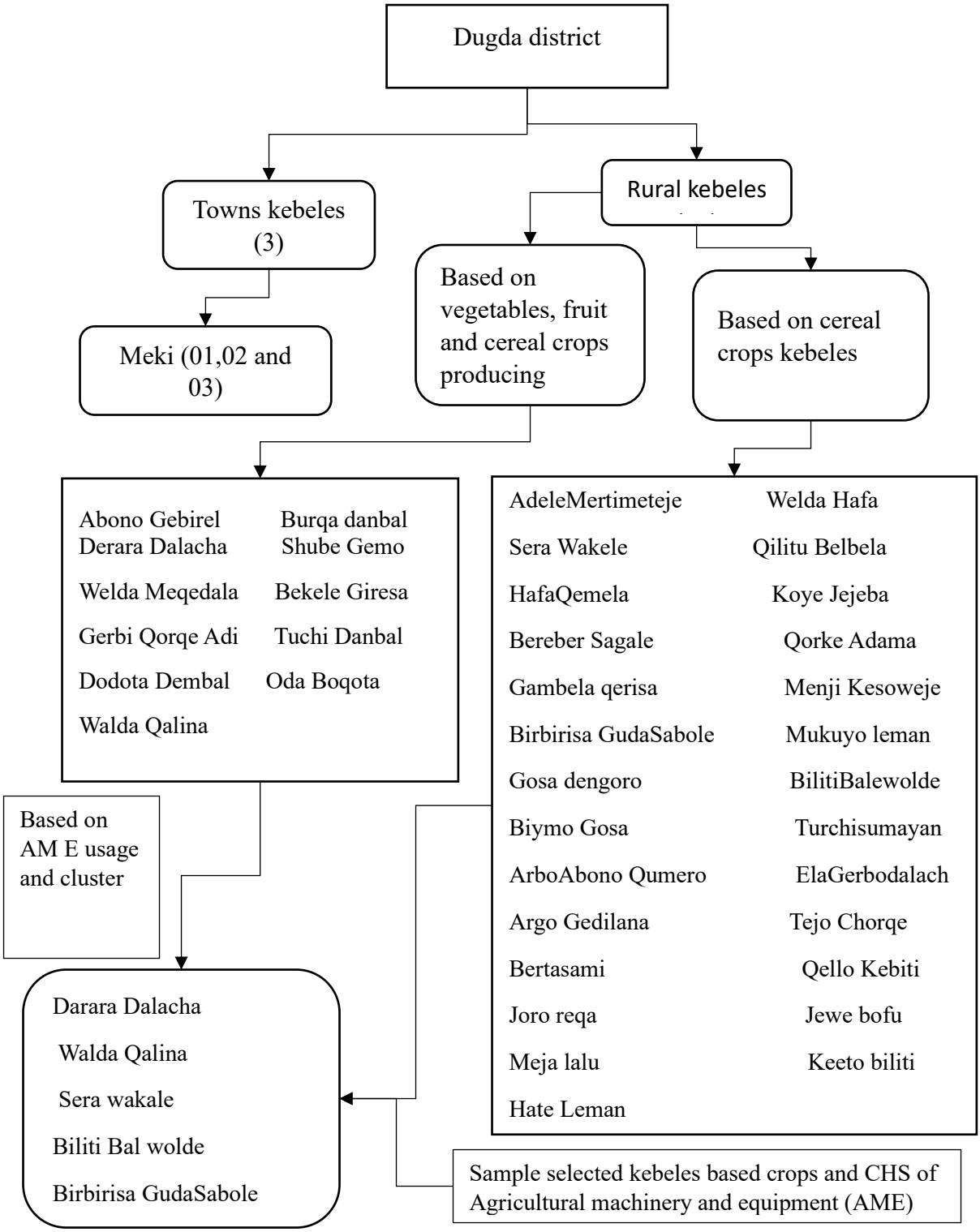
Notes: MHH = Male-Household Head, FHH = Female-Household Head. Source: Annual Report of Dugda district office (2022/23) and census result (2022/23).

3.2.2. Sampling technique

The research employed a multistage sampling technique. The primary sampling elements were from Oromia regional state, and the East Shoa zone was selected based on the potential of crop harvest, water, and farm machinery users. Secondly, Dugda district was selected by a simple random sampling technique based on the existence of farm machinery and equipment, customs hiring service users, and the comfortability of the land. That means, access to custom hiring service for tractors, thresher, harrowing and ridgers from private owner and Meki Batu, Bora Denbal farmer cooperative union service. Finally,Dugda district out of 36 rural kebeles, five rural kebeles namely Derara Dalacha,Walda Qalina, Sera Wakale, Biliti Bealewold, and Birbirsa Guda Sabole were nominated by purposive sampling technique based on the use of custom hiring of combine harvester, tractor , equipment (disc plough, disc harrow, and ridger),combine harvester , engine operated (thresher and sheller), and engine operated water pump. From this kebeles Walda Qalina highly practices cluster farming in which they harvest maize, and Derara Dalacha kebele also uses clusters to harvest wheat, vegetables, and fruits. Special papaya was highly produced by clusters in Walda Qalina kebele up to 100ha. The remaining three kebeles were wheat, teff and maize. The farm size and topography of the land were very comfortable for tractor and combine harvesters.

The selected kebeles get custom hiring service from private and farmer cooperative union from in Meki town namely Meki Batu Fruit and Vegetable Growers Cooperative Union Ltd (limited),

Bora Denbal Farmers' Cooperative Union all service providers for farmers Ltd and farmer private ownership agricultural machinery and equipment.



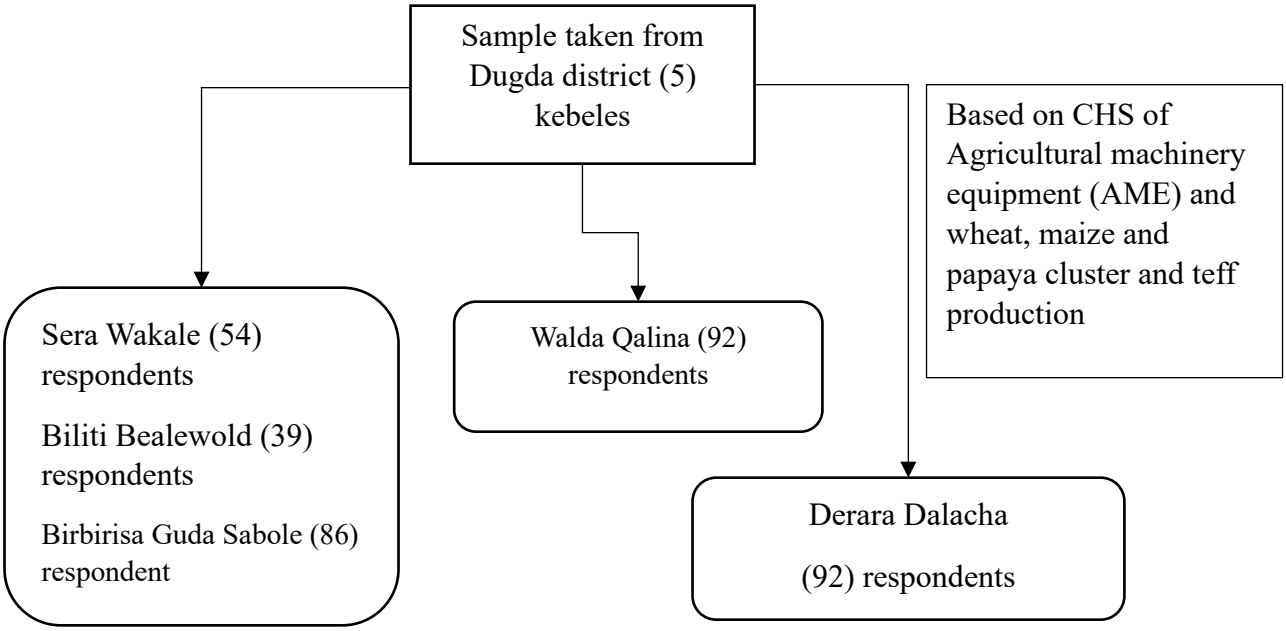


Figure 1.3: Follow chart demonstrations of sampling technique

3.2.3. Specification of model to assess effect of agricultural machinery hiring service

To find the variables most likely to affect agricultural machinery custom hire services for crop production in the study area, a linear regression model was employed. Moreover, the model has to identify the influence on production in the form of input and output relations of the use of agricultural machinery, including tractors, combine harvesters, walking tractors, maize shellers, threshers, and irrigation pumps and implement like disc plough, disc harrow, rigder). The study determined the following 16 important independent variables: the head of the household's age, gender, marital status, educational status, family size, land size, crop type, soil type, topography, distance from service provider, time, hiring expense, support for training, availability maintenance and repair, availability of spare parts, and agricultural machinery. We selected the linear regression model, because the dependent variable is continuous and the model is best determining a cause-and-effect relationship between the parameters without put and computationally easier to estimate.

Whenever the dependent variables have dummy values, the LOGIT and PROBIT models are utilized. These models use the probability distribution to convert interrupted variables into continuous one (Gujarati, 1995). The key distinction between the models, which are fairly close in most applications, is that the logistic distribution has somewhat thicker tails. Because of the logit model's relative mathematical simplicity, numerous scholars frequently employ it. When examining the choice between two options, one of the most popular methods is the logistic regression model.

The association between variables and the choices made by farmers to use machinery for agricultural services was determined using a binary logistic model. Farmers base their selections for hire on the perceived beneficial level of technology. The logistic regression model form for the binary preference problem could be presented as follows, in accordance with

$$ln\frac{pi}{1-pi} = \beta o\sum_{j=1}^{k}\beta jXij \text{..} 3.3$$

Here is the model specification used in the analysis as: $Y=f\,(X_1, X_2, X_3, X_4, X_5, X_6, X_7\ldots X_n)$

where Yi, =hiring service for the i^{th} home, is the dependent variable.

Xij =independent variables in the study

The options for farmers to use farm machinery services are yes (1 and no, respectively). Since P_i is considered to be the probability that the decision to employ services for agricultural machinery would be made, $1-P_i$ represents the probability that the choice not to engage services for agricultural machinery would be made.

$$P[Y=1] = P_i \text{ and } P[Y=0] = 1-P_i$$

The ratio Pi/1-Pi is known as the odds ratio in favor of hiring farm machinery service. The logistic model transforms the dependent into a logit variable and then uses the maximum house hold prediction. The following is the formulation of the practical mathematical model for estimations.:

$$P_i = prob(y_j=1) = \frac{1}{1+e^{-(\beta o+\beta 1Xi+\beta 2X2i+\cdots\ldots\ldots+\beta kXki)}} = \frac{e^{(\beta o+\beta 1Xi+\beta 2X2i+\cdots\ldots\ldots+\beta kXki)}}{1+e^{(\beta o+\beta 1Xi+\beta 2X2i+\cdots\ldots\ldots+\beta kXki)}} \ldots\ldots 3.4$$

Based on the empirical model presented in Equation (3.3), the effect of explanatory variables on farmers to hire farm machinery services could be expressed through the following linear relationship: The regression probability is:

$$ln\frac{pi}{1-pi} = L= \beta_0 + \beta_1X_1+ \beta_2X_2+ \beta_3X_3 + \ldots+ \beta_{16}X_{16}$$

Hence, for estimation purpose, variable Y is defined in this study as:

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \ldots. + \beta_{16} X_{16} + \varepsilon_0$

Where: βo=intercepts/constant

$\beta_1, \beta_2, \beta_3 ' \ldots, \beta_{16}$ =Coefficients

$X_1, X_2.X_4, X_7, X_8, X_9,$ =dummy input variables which determine dependent variable.

$X_3, X_4, X_5, X_6, X_{10}, X_{11}, X_{12}, X_{13}, X_{14}, X_{15}, X_{16}$= Continuous input variables which determine dependent variable.

X_1=Age of house hold head (year)

X_2=Marital status (0=unmarried,1=married)

X_3=Gender of house hold head(0=male,1=female)

X_4 =Family Size (number)

X_5=Educational status (0=illiterate ,1=educated)

X_6=Land size (hectares)

X_7=Crop type

X_8=Soil type (0=sandy loam,1=clay loam)

X_9=Topography (0=sloppy land, 1=flat land)

X_{10}=Distance of from service provider (kilo meters)

X_{11}=Training support (0=unavailable,1=available)

X_{12}=Availability of maintenance and repairs(0=unavailable,1=available)

X_{13}=Availability of spare parts (0=unavailable,1=available)

X_{14}=Agricultural machinery ((0=unavailable,1=available)

X_{15} = time (0=no,1=yes)

X_{16}=cost of hiring (0=cheap,1=expensive) and ε_0 = error term

Since practically all of the farmers in the study district answered "yes" and because some characteristics, were challenging to assess, some of the factors that were outlined in the conceptual framework are not included in the model. Regarding the respondents' perceptions of the hiring rate of farm machinery services, no significant difference was found. Even though the "hiring rate" was a significant variable, the regression analysis did not include it as none of the respondents thought it was low.

Variables and Linear regression model specification

Age of house hold head (X_1): It was hypothesized that the hiring decision for machinery services was inversely correlated with the farmer's age. Due to their observations and experiences, older farmers have collected more farming knowledge. They could therefore find it challenging to give up their old habits in favor of new technologies.

Marital status (X_2)**:** respondent of hypothesized marital status should not be a factor in the hiring of agricultural machinery job. In most countries, it is illegal and considered discriminatory to make employment decisions based on marital status.

Gender of house hold head (X_3): Respondent's gender. The most popular methods of reducing labor constraints for female families are hiring labor and using animal drafts, regardless of the site or kind of household. Due to the time constraints of having to divide their time between household duties and field preparation, female farmers are more likely than male farmers to hire tractor services. For homes headed by women, it was therefore positively hypothesized.

Family Size (X_4): Bigger families have enough workers to hand harvest cereal crops. Therefore, one would anticipate that having a larger family would reduce the likelihood that a farmer would employ farm machinery. Therefore, it was hypothesized that smaller family households are more likely to employ farm machinery, which increases output.

Educational status (X_5): A farmer's capacity to gather, process, and apply information relevant to the choice of employing a mechanized service was thought to be enhanced by their educational background. Because it lowers one's capacity for thought, comprehension, and focus, illiteracy is a major obstacle to the acceptance of new technologies that could enhance one's standard of living (Ayandiji A and Olofinsao O.T. 2015). Education was therefore considered a positive hypothesis to raise the likelihood of using the machinery hiring services.

Farm size (X6): It was hypothesized that as a farmer's crops area increases, he/she is more likely to use an agricultural machinery to ensure that farm operations are completed on time so that production is more likely to increase than small farm size.

Crop type (X_7): It was hypothesized different crops require different types of equipment for efficient ploughing, harvesting and handling. Like, walking tractors, tractors, a combine

harvester, maize sheller, thresher and irrigation pump is commonly used for grain crops like wheat and corn.

Soil type (X_8): Soil type can indeed have an effect on the hiring of farm machinery, which soil type influences the hiring of agricultural machinery. Farmers renting machinery need to ensure that the equipment they hire is suitable for their specific soil conditions. For example, if a farmer is working with heavy clay soils, they would need machinery that can effectively penetrate and work the soil without excessive compaction.

Topography (X_9): The quantity of crop production per hectare is determined by field conditions for farm operation. Therefore, the level farm may slopy or flat but flatland was comfortable to use farm machinery than slopy farm. So flat farm has hypothesized positive effect hiring machinery.

Distance of from service provider (X_{10}): The distance from the service provider can have an impact on the hiring of farm machinery. Farmers should weight these considerations when deciding whether to hire machinery from a service provider located at a greater distance.

Training support (X_{11}): Crucial to ensure safe and efficient operation, maximize productivity, and minimize the risk of damage or accidents. It can be provided through a combination of methods, including on-site training sessions, manuals or instructional videos, hands-on practice, and periodic refresher courses.

Availability of maintenance and repairs (X_{12}): The availability of maintenance and repair services for farm machinery is essential for ensuring the smooth operation of agricultural equipment. It is crucial for farmers to establish relationships with reliable service providers who have a good reputation for quality service, prompt response times, and expertise in farm machinery.

Availability of spare parts (X13): When it comes to hiring a service that requires spare parts, there are several factors that can influence the availability of those spare parts.

Availability of Agricultural machinery (X_{14}): The availability of agricultural machinery can have an impact on hiring service providers for agricultural equipment. Type and complexity of machinery, geographic location and seasonal demands. Availailty was therefore considered a positive hypothesis to raise the likelihood of using the machinery hiring services

Time of plough and harvest (X_{15}): Availability of service providers can be influenced by seasonal demands. During peak farming seasons, such as planting or harvesting, service providers may be in high demand, potentially leading to longer wait times or limited availability.

Cost of hiring (X_{16}): The cost of hiring farm machinery can vary depending on several factors. Here are some key factors that can influence the cost: type of machinery, duration of hire, seasonal demand, size and condition of machinery and additional service.

3.4. Production cost determination

Economic parameters analysis was calculated by using equations below (Pishgar-komleh *et al*., 2012).

Total production value = crop yield (kg ha^{-1}) × price ($\$100^{-1}$ kg^{-1}) ……...….3.5

Net return = total production value ($\$ ha^{-1}$) - total production cost ($\$ ha^{-1}$) ……3.6

$$\text{Crops productivity} = \frac{\text{Crop yield(\$kg/ha)}}{\text{Total production cost ((\$kg/ ha)}} \text{……....3.7}$$

3.5. Methods of data collection

The survey study of farmer households, medium farmers, and farm cooperatives, which was done by interviewing a sample of randomly chosen farm owners, is the main source of data for the study. Samples were collected through advance field visits and contacts with interested parties such as tractor operators, farm machinery owners, cooperative unions, farm machinery customers, Kebeles development agents, and word officers.

The main objectives of the research were connected with the structured approach that would be used to record the data. The survey parameters included information about the soil type, crop type, farm size, topography, time, cost, training and support of farm machinery, availability of maintenance repair services and, farm machinery uses in various farm operations. Farmers' level of awareness and farm machinery demand are major constraints that delay getting agricultural machinery service.

Additionally, a formal and qualitative survey of machinery owners, providers of machinery, and agricultural machinery hire services used to gather supply-side data. To collect data on current policy benefits and gaps, supply characteristics, and necessary interference in the machinery supply system, different questionnaires were developed for each category of machinery and service suppliers.

3.3.1. Questionnaire

It contains socio-demographic characteristics data and critical factors related to the use of custom hiring of farm machinery. The researcher designed the questionnaires for assessing the present status of the rental service of farm machinery and equipment. Two types of questionnaires were prepared for the samples. One of these was the questionnaires which consisted of identical questions and was prepared and distributed to the house hold farmers in order to gain information that was analyzed, patterns found and comparisons made. The other questionnaires were distributed to experts who were selected from cooperative union management staff, woreda office agricultural supervisor, and development agent committees.

In general, the questions revolved around the policies and strategies for implementation of custom hiring services, ways of service delivery from farmer cooperative unions, challenges, opportunities, strengths, and threats of custom hiring services (CHS) of farm machinery in crop production.

3.3.2. Interview

The semi-structured questionnaires were prepared and pretested after collecting reliable quantitative and qualitative data. Moreover, different interview guides were used for key informants for in-depth and triangulated data sources. For validity, adequacy, and reliability, the researcher himself and the enumerators conducted a face-to-face interview with all key stakeholders i.e., experts and top administration staff who were selected from the woreda, and farmer cooperative unions by searching for their answers to unfold problems. The interview was prepared in English, and Afan Oromo the researcher, used the local language for key informants' discussion and probing. Moreover, the sampling of stakeholders for this study followed a mix of purposive and stratified sampling procedures to ensure adequate coverage of stakeholders at different administrative levels as illustrated in Table 3.2.

Table 3.2: Purposive and stratified sampling distribution of key informants

Classified system	Target group	Number of Key Informant Interviewees
Dugda Woreda office	Agricultural manager (1)	12
	Mechanization Supervisor (1)	
	Target kebeles supervisor and development agent (10)	
Meki Batu Fruit and Vegetable Growers Cooperative Union Ltd	Cooperative union manager (1)	3
	Operator (2)	
Bora Denbal farmers' cooperative union all service providers for farmers ltd	Cooperative union manager (1)	3
	Operators (2)	
Farm machinery owner	Owner and operator	14
Total key informant interviewees		32

Note: = Number of key informant interviewees in the target group using purposive and stratified sampling technique.

3.3.3. Observation

The researcher used direct observations from land preparation to harvesting of crop activities. Necessary direct observations were recorded in a field notebook and captured relevant data. This method helps the researcher better understand the real dealings and connections as well as the triangulation of contradictory and differences in results from questionnaires, and interviews. The explanations have mainly been achieved by observing the current standing of the crop production farmers scheme in the Dugda target area. Furthermore, the researcher used this method to prove the reliability of the data collected by employing other methods of data collection.

3.4. Method of data processing

The data required for the investigation included both primary and secondary data. Primary data was collected from a selected sample of respondents (farmer union managers, customs hiring service private owners; farm machinery owners, brokers, operators, mechanics and small farm

holders). Data include the types and numbers of agricultural machinery as well as the costs of customs hire services in the kebeles with structured questionnaires as key informants.

Secondary data were collected from a variety of published books, journals, reports, manuals, unpublished materials, websites, policy documents, and other relevant sources.

The data concerning the assessment of the customary hiring of agricultural machinery service in Dugda Woreda at the study area was collected through a structured interview, questionnaire, document review from woreda, field observation, literature review and focus group discussion, as well as direct contact with the Ministry of Agriculture mechanization directorate, Oromia mechanization directorate, Zone, and Dugda woreda district agricultural officers.

3.5. Method data analysis

The data obtained was analyzed using an analysis tool in a computer package. SPSS was used for the data entry and coding would be used for the analysis. ANOVA was used with a 5% Least significance difference to analyze the data.

CHAPTER FOUR

4. RESULT AND DISCUSSION

4.1. Current status and practice of custom hiring service of agricultural machinery

Description of Respondents Results

The study area was consists of 363 randomly selected sample sizes from five kebeles in Dugda district, namely Biliti Bealwolde, Darara Dalacha,Biribirsa Guda Sabole,Sera Wakale, and Walda Qalina. From all kebeles, 74 (20.5%) respondents have hired tractor plowing and harrowing services, and 64 (17.7%) respondents have hired combine harvesting operations. In addition, the irrigation pump, maize sheller, and teff thresher had 19 (5.3%), 16 (4.5%), and 8 (2.3%), respectively. From which, 36.2% hired both tractor (ploughing and harrowing) and combine harvester services; however, 13.5% hired none of the services. Other tractor hiring services, such as planting and spraying, are not available in the woreda. There were a large number of farmers who hired tractor rather than combine harvester services. It showed that the uptake of tractor and combine harvesting is much more accepted.

Table 4.1. Custom hiring service of agricultural machinery

Characteristics	Frequency	Percentage
CHS of agricultural machinery		
Tractor ploughing and Harrowing	74	20.5
Irrigation pump for watering	19	5.3
Sheller for maize shelling	16	4.5
Thresher for teff threshing	8	2.3
combine harvester for harvesting	64	17.7
Both combiner and tractor user	131	36.2
No hire	49	13.5

4.1.1 Socio-economic background of farmers

A selected sample of respondents from farmer households was interviewed to find out their background related to sex, age, educational background, marital status, family size, farm size, and experience in crop production. And also, the availability of machinery and equipment, the cost of hiring, the farm machinery training support, the availability of maintenance and repair services, and the availability of spare parts. These features are important in terms of clearly

showing the diverse backgrounds of the respondents and their effects on farm machinery and equipment's field practices among the farmers, as well as socio-economic and demographic aspects of livelihoods. Thus, the sampled targeted district of kebeles.

Gender, marital status, family size and age structure

According to the response of interviewee, the mean age of the respondents was 43.5 with standard deviation, minimum and maximum age of 7.17, 22 and 65 respectively. Ages between 23 and 40 (N=90) has followed by age between 41 and 65 high frequencies (N=134). 85.1% (N=309) of the respondents were male while the female respondents were accounted 14.9 %(N=54). Thus, majority of the sampled farmers were middle aged, which could result in a positive effect on custom hiring of agricultural machinery and equipment.

Table 4.2. House hold age descriptive statistics

	Number	Minimum	Maximum	Mean	STD
House hold age(year)	363	22	65	43.7	7.17

Indeed, an attempt was made to assess the educational level of the respondents. The level of education of our household farmers is indicated in Table 4.3, accordingly, 56.7% (N =206) of respondents were illiterate, 26.2% (N = 95) of respondents were in primary school, 14.6% (N = 53) of the respondents could go to high school and preparatory, and 2.5% (N = 9) of respondents were at TVET College and University.

Hence, as the survey data show, the majority of the respondents of the member households had no formal education or primary school; out of these majorities, 56.7 percent of them could were illiterate, and 26.2% had stopped attending primary school. This indicates that the customs hiring service for machinery farmer households was challenged in understanding the written contract agreement. Therefore, they were unable to execute their responsibilities properly and demand their rights as per the written contractual agreement, and they were also unable to create other job opportunities for family members due to a lack of knowledge and skill.

Concerning the marital status of respondents as indicated in Table 4.3, 68.9% (N = 250) of the respondents were married,4.7% (N = 17) were widowed, and 8% (N = 29) were divorced, while single respondents were comparable to married very few, 18.5% (N = 67), and considered younger.

Table 4.3. Socio-demographic characteristics of respondents

Variable	Category	Number	Percent (%)
Sex	Male	309	85.1
	Female	54	14.9
Marital Status	Unmarried	67	18.5
	Married	250	68.9
	Divorced	29	8
	Widowed	17	4.7
Education background	Illiterates	206	56.7
	Primary School	95	26.2
	High school and preparatory	53	14.6
	TVET College and University	9	2.5
Family size	≤ 2	51	14
	3-5	140	38.6
	≥5	172	47.4

As shown in Table 4.3; households' family size distribution in the category of less than or equal to 2 was 14% (N = 51), family size between 3 and 5 was 38.6% (N = 140) with the highest frequency, and family size greater than or equal to 5 was 47.4% (N = 172). Generally, the study data in Table 4.1 showed that the majority of the respondents were high; their family sizes were mainly 3 to 5 and greater than or equal to 5. This revealed that most of the household's family members participated in seasonal jobs and daily labor, such as manual planting, harvesting, and manual weeding, as well as manual chemical and fertilizer application. However difficult it is to engage all children in farm activities, their ages and education time have one factor.

4.1.2. Farm size and distribution

One of the most significant inputs for rural communities whose livelihood depends on farming is land. Owning land in such a rural place is now essential for survival. Along with land ownership, one of the determining variables for the use of agricultural machinery, i.e., tractor, combiner harvester, engine-operated thresher, sheller, and irrigation pump, is the size of the

farm. Despite minor differences in the size of the holdings from household to household, the survey found that most of respondent in the study area had land.

Table 4.4 shows the mean value of land holding size was 2.58 hectare with the minimum and maximum observed holdings per house hold of 0.5 and 5 hectares respectively. According respondent survey indicted in Table 4.4, land holding capacity of household farmers between ≤ 0.5 hectares accounts for 34.9% (N = 122) of farmers among respondents, followed by 1–1.5 hectares (30.9%; N = 109), 2–3 hectares (21.8%), and > 3 hectares (8.1%; N = 29) of land, and 5.6% (N = 20) of land remaining is no own land property. From this data, we concluded that most farmers own land between ≤ 0.5 and 1-1.5 hectares of land. As indicated for less than half hectares, it is difficult to get agricultural machinery like combine harvesters and tractors. Since the price of hiring increased. This forces farmers to use farm machinery that requires cluster farming methods, which are costly to use.

Thus, access to agricultural machinery and equipment is made easy and enables participants in the crop production mechanization cluster to boost productivity and their way of life.

Table 4.4. Farm land size in hectares

Land holding in (ha)	Frequency	%	Land distribution (ha)	Frequency	%	Summary	
≤ 0.5	122	34.9	≤ 0.5	173	47.66	Min	0.5
1-1.5	109	30.9	1-1.5	99	27.27	Max	5
2-3	78	21.8	> 3	23	23	Mean	2.58
> 3	29	8.1	Others	68	68	STD	1.12
No own land	20	5.6		-	-	SE mean	0.49
Total	358	98.6	Total	363	100	-	-
System	5	1.4	-	-	-	-	-
Total	363	100.0	100	-	-	-	-

Note, Max= maximum, = minimum, SE= standard error

Paman *et al* (2014) considered that machinery type, land condition, and operation distance were important factors affecting the supply of agricultural machinery services. In the target area, most

of the farm lands of the householder were not found at the same place, which makes it difficult to apply custom hiring services, according to the respondent of the survey in Figure 4.1. As it got from the respondent, equal or less than 0.5 hectares were 47.7% (N = 173), 0.5 to 1 hectare were 27.3 % (N = 99), 1 to 2 hectares were 6.3% (N = 23), and others were 18.7% (N = 68). As we see from the study, equal or less than 0.5 to 1 hectares had a higher land size distribution in the targeted kebeles, reaching 75%. The proportion of fragmented lands was very high, which has negative implication for modern farm mechanization in the study area. This implies it needs much more application of cluster farms to create a good condition to apply farm machinery and equipment. However, the farmer is participating in cluster farming, especially in maize and wheat in the targeted areas of Wald Qalina, Derara Dalacha, and Birbirsa Guda Sabole, respectively, but needs much more practice in Sera wakale and Bilit bealwolde. This system is particularly effective for growing wheat and maize, as well as for mechanized farming.

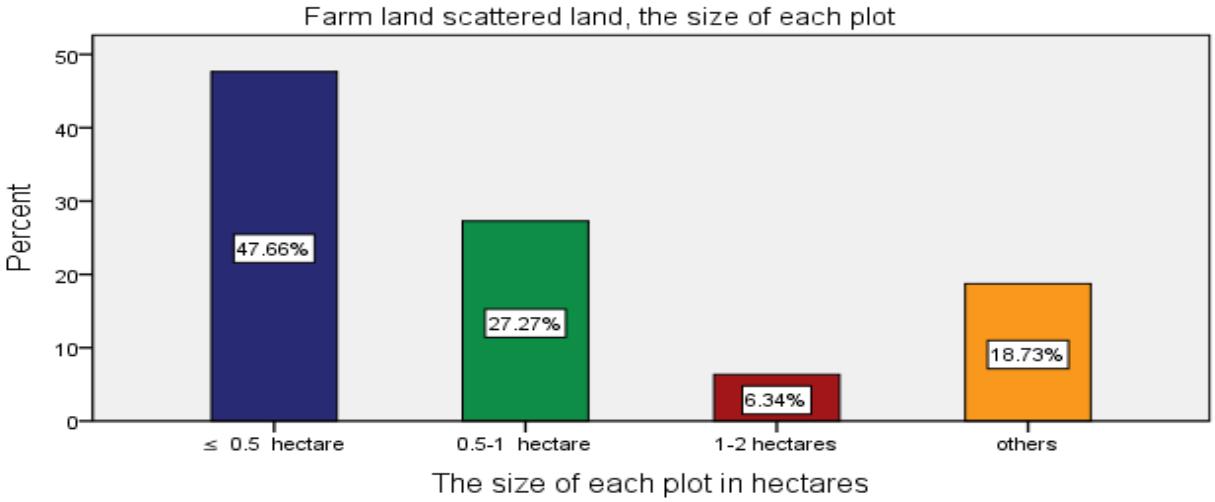


Figure 4.1.Farm size and scattered

As the results show in Table 4.5, households' topography settlement of the land distribution in the category of the targeted sampled kebeles, such as in BB flat land coverage was 87.2% (N = 34) and slopy land was 12.8% (N = 5), DD flat land was 93.5% (N = 86) and slopy land was 6.5% (N = 6) coverage, SW flat land was 85.2% (N = 46) and slopy land was 14.8% (N = 8) coverage, WQ flat land was 95.7% (N = 88) and slopy land was 4.3% (N = 4) and BGS flat land was 85.9% (N = 73) and slopy land was 14.1% (N = 12) coverage with frequency and percent, respectively.

Generally, from the targeted kebeles household settlement results of 90.3% flat land and 9.7% slopy land, the survey data showed that the majority of the land was covered with flat, which

was comfortable for farm machinery use. All stakeholder groups should take responsibility for increasing farmer interest in agricultural machinery and equipment supporting farming operations. The government, as the primary stakeholder, was responsible for assisting infrastructure like roads and facilitating financial options. On the other hand, the company has responsibility for enabling the delivery of spare parts and maintenance service centers near the farmers' homes.

Table 4.5. Topography of the land

Kebeles * Topography settlement of the land Crosstabulation				
Kebeles		Topography of the land		Total
		flat land	Slopy land	
Biliti Bealewold	Numbers	34	5	39
	Precent	87.2%	12.8%	100.0%
Darara Dalacha	Numbers	86	6	92
	Precent	93.5%	6.5%	100.0%
Sera Wakale	Number	46	8	54
	Precent	85.2%	14.8%	100.0%
Walda Qalina	Numbers	88	4	92
	Precent	95.7%	4.3%	100.0%
Birbirsa Guda Sabole	Numbers	73	12	85
	Precent	85.9%	14.1%	100.0%
	Numbers	327	35	362
	% of total	90.3%	9.7%	100.0%

4.1.3. Crop type

The types of crops produced in the target area are mostly wheat, teff, and maize; in addition, papaya and vegetables (red onion, chills, and tomatoes) are also produced, as interviewed by households' farmers indicated in Figure 4.2. According to the responses of respondent farmers in the targeted kebeles in BB, 28% wheat, 16% teff, 42% maize, 4% fruit, and 10% (red onion, chills, and tomatoes); in DD, 39.3% wheat, 17.9% teff, 30.8 maize, 1.6% papaya, and 10.3% (red onion, chills, and tomatoes); in SW, 36.8% wheat, 26.5% teff, 32.4% maize, 1.5% papaya, and 2.9%; and in WQ, 20.20.5% wheat, 14.5% teff, 44.4% maize, 14.5% papaya, and 6% (red onion, chills and tomatoes). As it was observed from the data of the respondent, wheat and maize produced more of all four kebeles, and papaya produced much more papaya in WQ. Thus, wheat, teff, and maize are produced in all designated areas that are suitable for tractor and combine

harvester use for plowing and harvesting. However, there are few tractors available, and no combine harvester is available.

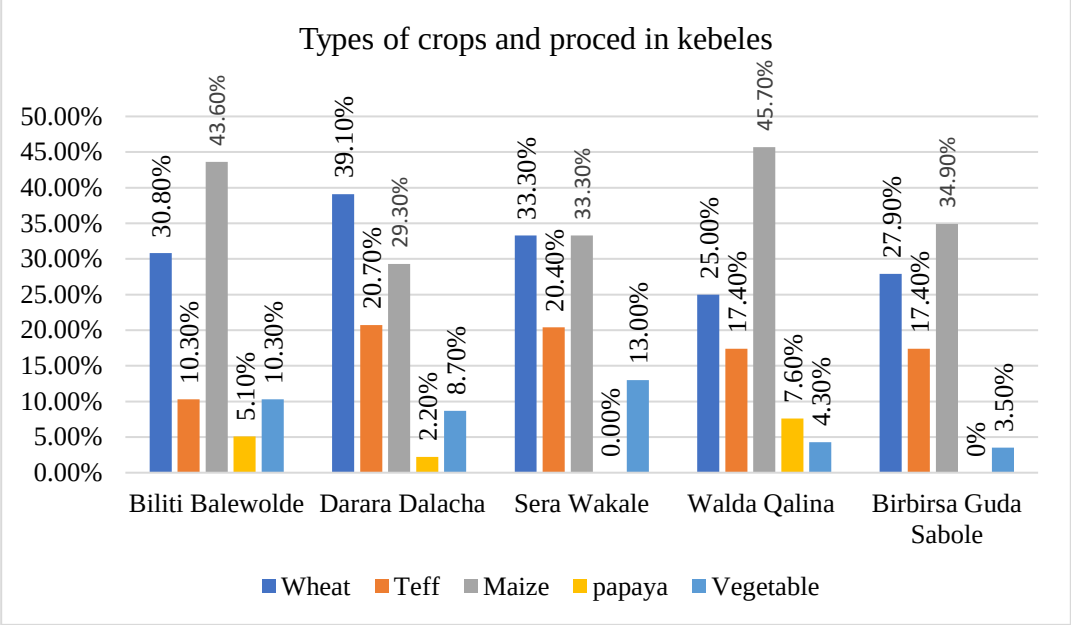


Figure 4.2. Crop type and crop produce in the targeted kebeles

According to the replies of respondent farmers in targeted districts of Kebeles. The majority of farmers in districts indicated that they were farmed on their lands, while other farmers were given farms by contract with agreement. Farmers were also given the opportunity to educate their family members. Crops produced in this area in general: 33% of respondent farmers in all targeted areas grow the crop for food (own consumption), 41% for market, 16.5% selected seed enterprise supply, 5.7% industrial raw material supply, and just 3.4% others. A small amount of crop was produced for 5.7% of the industrial raw material supply because of less farm machinery usage in the study area. In the bar chart below, agricultural output in the targeted districts was presented (Figure 4.3).

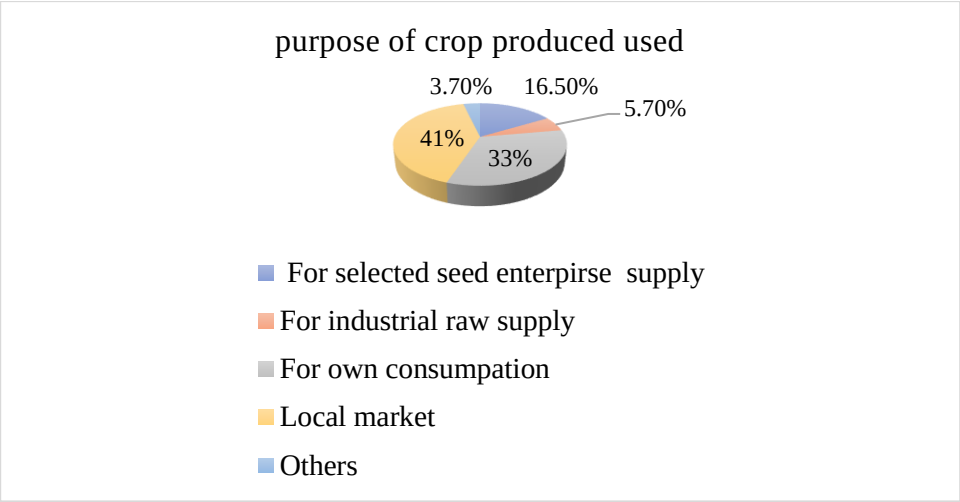


Figure 4.3. Percentage of purpose of crop production

4.1.4. Summary of Variables Used in the Model

The variables used in logistic regression model to determine the influencing factors for hiring farm machinery services are summarized here. To draw some picture about the distribution and level of inputs, the percentage, mean and range of input variables are summarized in the table as follows:

Table 4.6: Summary of variables used in the model

Variables	Min	Max	Mean	St. Deviation	% frequency With Dummy=0	% frequency with Dummy=1
independent variable						
Age of house hold head(year)	22	65	43.5	7.17		
Family Size (ha)	1	10	5.5	1.5		
Farm size	0.5	6	2.75	0.95		
Distance of from service provider(km)	3	25	14	3.667		
Educational Status (0=illiteriate,1=literate)					56.7	43.3
Topography (0=sloppy land, 1=flat land)					9.7	90.3

Gender of house hold head(0=female,1=male)		14.9	85.1
Marital status (0= single,1=married)		18.5	68.9

4.1.5. Summary of econometric model result

The study's econometric findings are shown in this section. The logistic analysis was conducted using the SPSS software. Table 4.6 reports the findings of the econometric model for farmers' decisions to use agricultural machinery services. Model table is for hiring service related to tractor plowing and harrowing, whereas model Two is for hiring decisions related to combine harvesters. Model three is used for employment decisions related to maize shellers and teff threshers, whereas model four is used for hiring decisions related to irrigation pumps.

The low value of log likelihood and the high value of the omnibus test show that the models did fairly well overall ($p<0.00$). In total, the models accurately forecast 83.2%, 86.1%, 85.2%, and 85.5% of the cases. The association between independent and dependent variables was examined using the Chi-square test at a 95% confidence level ($p<0.05$). The null hypothesis was rejected and the alternate hypothesis was accepted if the determined p was less than 0.05, and vice versa. The combined effect of the independent variables deviates from zero, according to the log likelihood x2 statistics ($p = 0.000$). Therefore, we choose the alternative hypothesis and reject the null hypothesis.

The Hosmer-Lemeshow test's x^2 value shows that there is a strong overall fit between the model's expected and actual numbers of respondents who hired farm machinery services.

In terms of goodness-of-fit, the tractor, combine harvester, maize sheller, teff thresher, and irrigation pump models have Nagelkerke R Square (R2) values of 0.88, 0.85, 0.825, and 0.85 respectively.

Table 4.7. Results of Logistic Regression Model Analysis

Custom hiring service of tractor for ploughing and harrowing

Variables	Coefficient	S.E.	Wald	Sig.	Exp(B)
Age of house hold head	3.456	1.85	2.542	0.251	15.623
Marital status	0.19	0.15	1.256	0.179	1.786
Gender of house hold head	3.164	1.92	3.012	0.085	4.781
Family Size	-1.245	3.451	3.063	0.080	6.545
Educational status	2.347	1.086	4.670	0.031*	10.451
Farm size	2.224	2.482	0.803	0.025*	1.249
Crop type	-1.428	0.721	6.233	0.042*	4.895
Soil type	0.589	0.634	5.237	0.541	13.258
Topography farm land	3.52	1.252	2.141	0.023*	12.465
Availability of tractor	2.147	1.026	4.210	0.039*	15.214
Distance of from CHS	-2.124	0.583	5.147	0.045*	0.221
Time of plough	3.443	1.98	2.462	0.010*	14.140
Cost of hiring plough	2.121	1.425	4.211	0.018*	7.589
Intercept	-8.512	5.235	1.789	0.316	0.000

*Significant at 5% level. -2 Log likelihood=49.576, omnibus tests of Model coefficients (chi-square, df, sig) =5.448,8,0.000) Hosmer and Lemeshow Test=.709, Nagelkerke R square=0.88, percentage of correct predictions=83.2%

Custom hiring service of combine harvester for harvesting wheat

Variables	Coefficient	S.E.	Wald	Sig.	Exp(B)
Age of house hold head	-1.712	3.22	0.327	0.421	0.324
Marital status	-2.19	0.234	2.416	0.079	3.722
Gender of house hold head	5.351	2.821	4.523	0.067	7.884
Family Size	0.725	0.463	1.470	0.220	3.183
Educational status	2.052	1.742	2.561	0.045**	6.535
Farm size	1.125	0.922	0.712	0.032**	5.224
Crop type	2.412	1.720	4.242	0.044**	6.784
Soil type	0.951	0.538	1.534	0.0742	10.201
Availability of combiner	1.589	2.564	3.081	0.021**	13.141
Topography the farm land	4.312	1.471	2.345	0.043**	7.315
Distance of from CHS	-2.124	0.583	5.147	0.048**	0.487
Time of plough	3.154	2.562	3.210	0.035**	11.121
Cost of hiring plough	2.256	1.841	2.675	0.049**	9.451

*Significant at 5% level. -2 Log likelihood=43.312, omnibus tests of Model coefficients (chi-square, df, sig) =4.59,8,0.000) Hosmer and Lemeshow Test=.692, Nagelkerke R square=0.85, percentage of correct predictions=86.1%

Interpretation of results of the logistic regression model

In relation to employing tractor plowing and harrowing services, Table 4.7's results indicate that eight of the thirteen selected factors were statistically significant at the 0.05 level. The study identified several significant factors that influence tractor hiring decisions. These factors include the gender of the household head (0.024), educational status (0.031), farm size (0.025), crop type (0.042), topography of the farm land (0.023), distance from CHS (0.045), availability of tractor (0.039), time of hiring service (0.01), and cost of hiring service (0.018). In a comparable manner, eight of the thirteen variables that were chosen were statistically relevant when employing a combine harvester. These are gender of house hold (0.047), education status (0.045), farm size (0.032), crop type (0.044), topography of the farm (0.043), availability of combiner (0.021), cost of hiring service (0.049) and distance (0.048) with harvesting and weather-related uncertainties.

Among shown above (Table 4.7), the of marital status, family size and gender in the household was found to have a negative relationship with tractor hiring service. It was found that to be significant at the 5 percent level. The finding indicated that households with the marital status, family size and soil type in significant hire tractor services for carrying out field operations.

The existent of family size of the household exhibits statistical significance ($p<0.05$) to make tractor hiring decisions and is consistent with the hypothesis. Family size household with higher number a negative relationship with tractor hiring decisions engage in employment opportunities. However, the result showed that this variable is statistically insignificant for making combine harvesting hiring decision.

Educational status of farmers was to be significant ($P<0.05$) at 0.031 positively effect to tractor hiring service. The result of the logistic regression is in line with the hypothesized assumption that literate higher wants than illiterate hired tractor that is why they have knowledge about service and purpose.

The significance level of farm land size was found to be positively associated with the custom hire of tractor ploughing and harrowing services. The model predicted that size of land affect since in the total farm land size increase hiring tractor ploughing of the household service increases.

Even if statistically significant and has correlation to combine harvesting decisions, the result suggested that women households are likely to hire the service. Moreover, the model predicted that households headed by women are dominant to make tractor hiring decision. In both model's, level of education has got a positive sign and significant to make hiring decision. Although higher education level was postulated to have a positive influence on hiring decision.

Table 4.8. Custom hiring service maize sheller and teff thresher harvesting

Variables	Coefficient	S.E.	Wald	Sig.	Exp(B)
Age of house hold head	0.725	0.463	1.470	0.220	3.183
Marital status	-4.512	6.235	1.156	0.512	1.214
Gender of house hold head	-1.712	3.22	0.327	0.421	0.324
Family Size	-2.19	0.234	2.416	0.149	3.724
Educational status	2.052	1.742	2.561	0.045***	6.535
Farm size	1.125	0.922	0.712	0.032***	5.224
Crop type	5.351	2.821	4.523	0.031***	7.884
Topography the farm land	2.412	1.720	4.241	0.144	7.784
Distance of from CHS	-2.124	0.583	5.147	0.048***	0.487
Time of harvest	3.154	2.562	3.210	0.035***	11.121
Cost of hiring	2.256	1.841	2.675	0.049***	9.451

*Significant at 5% level. -2 Log likelihood=39.451, omnibus tests of Model coefficients (chi-square, df, sig) =5.448,8,0.000) Hosmer and Lemeshow Test=.689, Nagelkerke R square=0.825, percentage of correct predictions=85.2%.

Custom hiring service irrigation pump

Variables	Coefficient	S.E.	Wald	Sig.	Exp(B)
Age of house hold head	2.412	1.720	4.241	0.144	7.784
Marital status	-1.512	2.235	1.051	0.0812	3.214
Gender of house hold head	0.725	0.463	1.470	0.220	3.183
Family Size	-2.19	0.234	2.416	0.089	3.724
Educational status	3.252	1.841	2.675	0.045***	8.253
Farm size	1.125	0.922	0.712	0.032***	5.224
Crop type	2.052	1.742	2.561	0.041***	6.535
Topography the farm land	-1.712	3.22	0.327	0.520	0.72
Cost of hiring	5.351	2.821	4.523	0.037***	7.884

*Significant at 5% level. -2 Log likelihood=37.251, omnibus tests of Model coefficients (chi-square, df, sig) =5.145,8,0.000) Hosmer and Lemeshow Test=.698, Nagelkerke R square=0.84, percentage of correct predictions=85.5%.

In relation to employing tractor maize sheller and teff thresher harvesting services, Table 4.8 's results indicate that six of the eleven selected factors were statistically significant at the 0.05 level. The study identified several significant factors that influence maize sheller and teff thresher hiring service. These factors include the educational status of the household head (0.045), farm size (0.032), crop type (0.031), distance from CHS (0.048), time of hiring service (0.035), and cost of hiring service (0.049). In a comparable manner, four of the nine variables that were chosen were statistically relevant when employing an irrigation pump hiring services. These are education status (0.045), farm size (0.032), crop type (0.041), and cost of hiring service (0.049) with watering and weather-related uncertainties.

Among shown above (Table 4.8), the of age of house hold, family size, marital status, gender in the household and farm topography were found to have a negative relationship with maize and teff thresher hiring service. This stated in above do for irrigation pump hiring service. Therefore, the finding indicated there in significant and no correlation hire of maize sheller and thresher services for carrying out harvesting operations. However, the result showed that this variable is statistically insignificant for making threshing hiring decision.

4.1.6. Current status agricultural machinery and Equipment

Farmers from targeted districts of sampled kebeles were interested in custom hiring farm machinery such as four-wheel tractor (4WT), walking tractor (WT), and combine harvester and

equipment such as mold bold plough, disc plough, and disc harrow, as well as small machinery such as engine-operated (thresher machine, sheller machine) and engine-operated irrigation pump. However, in the targeted districts are farm machinery tractor (John Deere, class New Holland, YTO, Case, Landin), and wheat combine harvester get, such as the Class, New Holland, come from Shashemane, Addis Ababa, Bale, and Gedeb Asasa. In addition, the district had farm machinery and equipment found in two farmer cooperative unions and individual private farmers in Dugda district. Such a cooperative union was called Meki Batu Fruit and Vegetable Growers' Cooperative Union Ltd. and Bora Denbal Farmers' Cooperative Union Ltd. Both cooperatives provide the following agricultural machinery and equipment: customs hiring service, agricultural input supply, fertilizer, seeds, and different chemicals with credit and cash for farmers. This service helps farmers reduce poverty and sustain their economies. The Figure 4.4 below shows the customs hiring service provider for the target district of Dugda in Kebeles BB, DD, WQ, SW, and BGS Kebeles. The diagram shows the division of farm machinery and equipment.

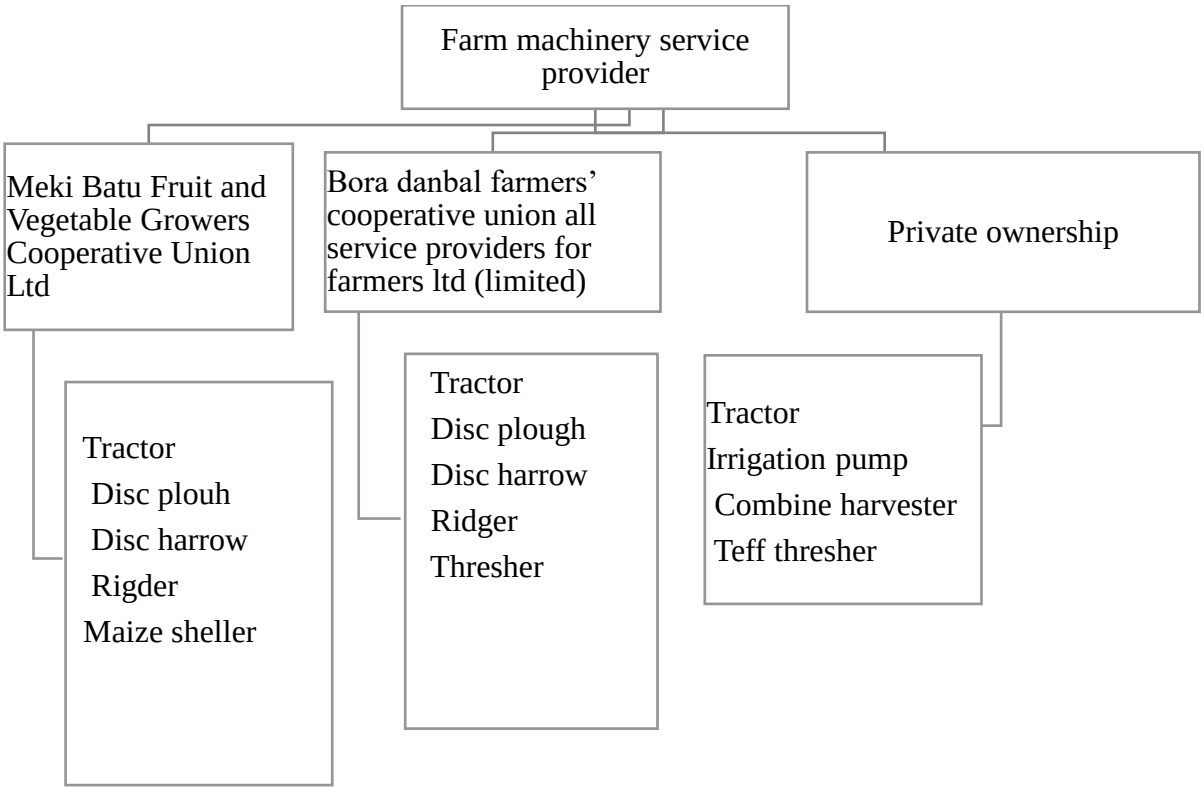


Figure 4.4. Diagram of hiring provider farm machinery and equipment.

Meki Batu farmer cooperative union: This union is called Meki Batu Fruit and Vegetable Growers' Cooperative Union Limited. The following activities are done, like seed, fertilizer, and chemical distribution, through credit and customary hiring of agricultural machinery and equipment for the farmers. Here is the list of agricultural machinery and equipment available for customs hiring in the Meki Batu cooperative union service in Figure 4.5 below. These two engine-operated shellers were out of service due to engine failures; only four of them were on jobs. It happened due to a lack of maintenance.

Bora Denbel farmers' cooperative union: The customary hiring service of farm machinery and equipment is provided in these districts: Dugda, Bora, Adami Tullu, Jido Kombolcha, and Batu Dugda. This union differed from the Meki Union, which mainly focused on wheat cluster production, while the previous union focused on maize, fruit, and vegetables. Two walking tractors and two wheat threshers were not in service, according to union data. The primary cause of the walking tractor was that farmers were not using it carefully because of its low penetration during plows and lack of horsepower. The union expresses dissatisfaction about the walking tractor's malfunction and the agriculture minister's support.

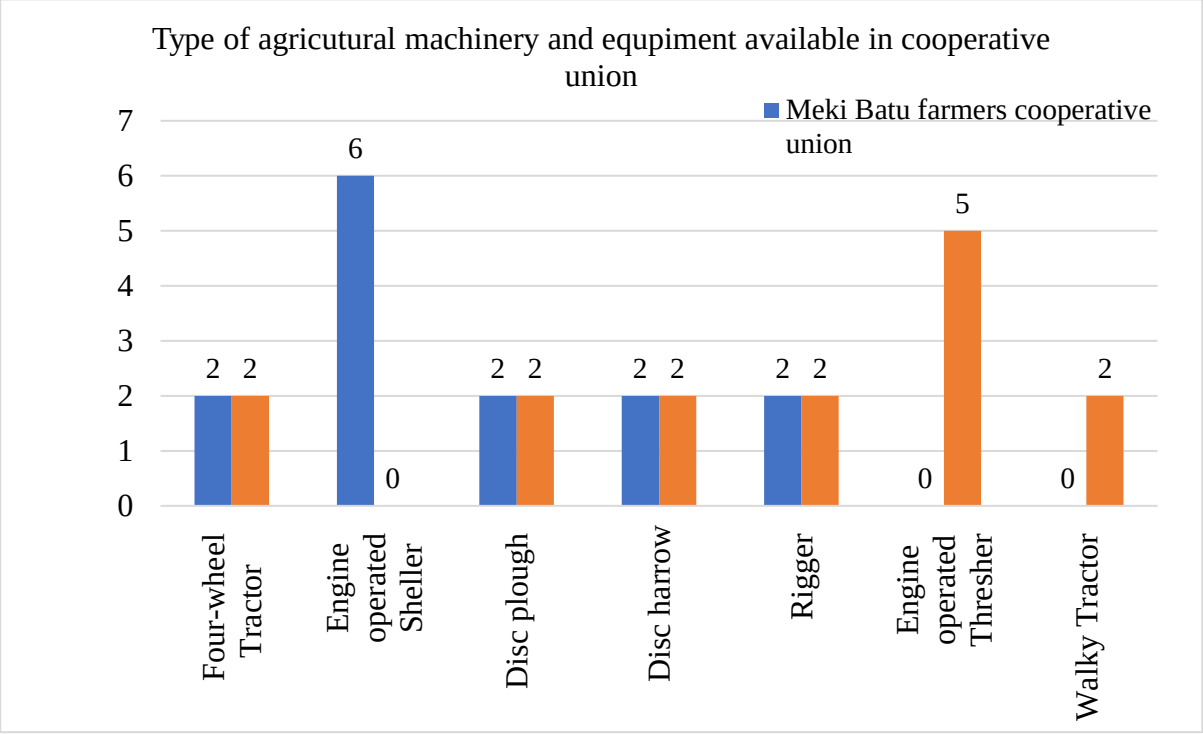


Figure 4.5. Agricultural machinery and equipment found farmers' cooperative union

4.1.7. Availability Agricultural machinery and equipment private ownership

The availability of custom hire businesses has become essential to speeding the mechanization process and generating an additional income among farmers (Paman et al., 2010). According to data from the Dugda district, there are 120 tractors now available, of which 84 are functional. The remaining 36 tractors are non-functional owing to failure and a lack of maintenance and spare parts.

In 2019, 2020, and 2021 one tractor, thirty, and one tractor were purchased with government credit, respectively, and 50 tractors were purchased privately. From this number, 32 were bought with the support of the government and Oromia regional states by facilitating credit. These listed tractors were bought in each Kebeles with the support of credit as follows: in Sera Wakale, there are five tractors: three are 75 horsepower, one is 95 horsepower, and one is 120 horsepower. H/qamale has two tractors with 120hp and 95hp, Meki Batu Union has two tractors with 120hp, X/Chorqe has one 120hp, B/G/Sabole has one 120hp and one 95hp, Walda Qalina has one 120hp, K/ Biliti has one 120hp, T/Dambal has one 95hp, B/ Baalwold has one 95hp and one 75hp, B/Gaale has one 95hp, Q/Adama has one 95hp, W/Horgoco has one 135hp, G/Q/Adi has one is 135hp and one is 120hp, K/Jejeba has one 95hp, and M/Lalu has one 95hp. In general, two tractors with 135 horsepower, nine with 95 horsepower, and six with 75 horsepower were delivered. (Dugda woreda office, 2023).

So, the number of tractors starting from 2019–2021 totals 82; the remaining 38 were bought before 2018 (Dugda woreda office, 2023). From this, the numbers of tractors found in the targeted kebeles are as follows:

Table 4.9: Agricultural machinery and equipment available in the targeted kebeles

Targeted kebeles	Agricultural machinery & Equipment	Hp	Brand	In numbers
Walda Qalina	4WT	120	John Deere, YTO	2
	Walking tractor	0		0
	Maize Sheller	-	-	3
	Irrigation pump	4,6,10 &15	Eigle, Hadrsen,	550

			Kaprari INGCO and Robbin	
Darara	4WT	95	John deere	2
Dalacha	Walking tractor	0	-	0
	Maize Sheller	-	-	1
	Irrigation pump	6,10 &15	Eigle, Hadrsen, Kaprari &INGCO	367
Biliti	4WT	75&95	John deere	2
Balwolde	Walking tractor	0	0	0
	Maize Sheller	-	-	1
	Irrigation pump	6 &10	Kaprari &INGCO	6
Sera wakale	4WT	75,95 &120	John deere	5
		120	Newholand	1
	Walking tractor	0	0	0
	Maize Sheller	-	-	2
	Irrigation pump	6,10,15 &20	Eigle, Hadrsen, Kaprari &INGCO	24
Birbirsa Guda	4WT	120&95	Jonhn deere	2
Sabole	Walking tractor	-	0	0
	Maize sheller	-	-	2

Due to the lack of tractors and other essential agricultural machinery, some farmers reported that their farm activities were frequently laborious. According to the acquired data from woreda sampled kebeles tractors 2, 2, 2, 6, and 2 found in WQ, DD, BB, SW, and BGS, respectively, the number of maize shellers and irrigation pumps in WQ, DD, BB, SW, and BGS is 3, 1, 1,2, and 2, and 550, 367, 6, 24 except for irrigation pump BGS. The number of irrigation pumps found in WQ and DD 917, however, was 200 due to improper usage, lack of maintenance, and spare parts. Out of 14 tractors, two were due to a lack of spare parts, and three were due to a

lack of timely maintenance, so there were only 9 tractors on the job. Hoverer claimed there was a delay in farm operation owing to the non-availability of farm equipment.

The wants brand of private farm machinery ownership of custom hiring service provider tractor with various brands from these farmers: 25.3% John Deer tractor, 3.4% Class tractor, 17.7% Case tractor, 24.4% New Holland tractor, 3.4 (N = 12) YTO tractor, 13.1% others. These data imply that the number of Johns Deere tractor is higher than others, which is why the region gives credit to Kengn Trading Company for price. Currently, however, the preferability of most farmers is low.

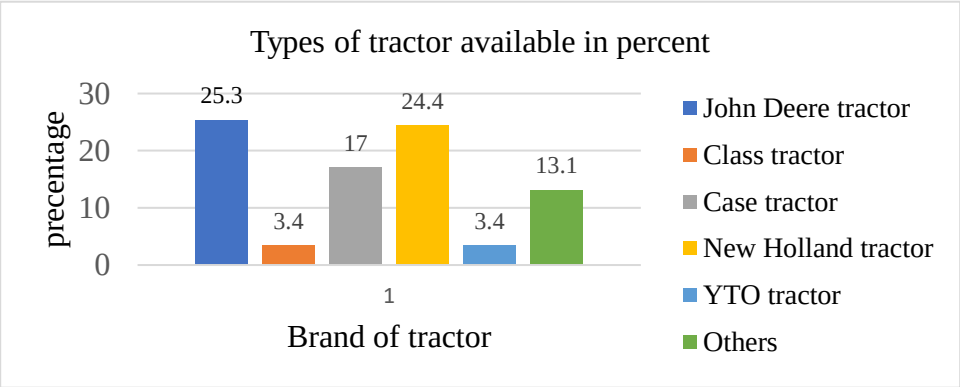


Figure 4.6: Type of tractor brand in the area

4.1.8 Cost of hiring farmer cooperative union agricultural machinery and equipment

The cost of customs hiring services in private ownership and farmers' cooperative unions varies based on distance (in km), crop type, farm size, soil type, availability of roads, and availability of farm machinery. In a cooperative farm union, the cost of farm machinery and equipment varies based on kilometers and hectares, while in Meki Batu Fruit and Vegetable Growers Cooperative Union Ltd.it is simple hectares. Which is shown below in the Table 4.10. As we can see from the table, the cost of a sheller machine is 55 birr per unit, while the cost of plowing, harrowing, and ridging is similar in Dugda, Adami Tullu, Jido Komolacha, and Bora districts but is not cost-effective. For our case in the target district, customs hiring is similar to what it means in BB, DD, WQ, SW, and BGS. This is advantageous for farmers in the distance farmer custom hiring service area. However, the availability is low since the number of tractors found in Meki Batu Union is only two and five engines operated shellers. These tractors work in four districts. Therefore, the cost of custom hiring and timely availability make it difficult.

Table 4.10: Cost of hiring in Meki Batu Fruit and Vegetable Growers Cooperative Union Ltd

No.	Agricultural machinery and equipment	In hectares and in Kuntal	Cost in ETB
1.	Tractor attached with Disc plough	1 ha	5200
2.	Maize Sheller	1 Kuntal	55
3.	Tractor attached with Disc harrow and rigder	1 ha	4000

Bora Denbel farmers' cooperative union provides custom hiring services for farmers to use in the target area. It gives service through credit to farmers, which provide agricultural input like seeds, fertilizer, chemicals, and hiring services for agricultural machinery and equipment. For the following woredas: Dugda, Bora, Adami Tulum, Jido Kombolcha, and Batu Dugda. This cooperative union specifically provides for ploughing, chemicals, and threshing activities for districts in addition to BB, DD, WQ, SW and BGS. Sera Wakale (SW) and BGS are more expensive than the other three kebeles since the cost of renting tractors from this cooperative union fluctuates according to kilometers, as is shown in the table 4.11 below.

Table 4.11: Bora Denbal farmers' cooperative union all service providers for farmers limited

No.	Agricultural machinery and equipment	Distance far apart from fields	In hectares or in kuntals	Cost in ETB
1.	Tractor attached with Disc plough	10-15 km	1 ha	4800 Birr
		15-25 km	1ha	5000 Birr
		≥ 25 km	1ha	5200 Birr
2.	Teff Thresher	-	1Kuntal	275 Birr
3.	Tractor attached with Disc harrow and rigger	-	1ha	4000 Birr
4.	Planter machine	-	1 ha	3500 Birr

4.1.9. Cost of custom hiring in private ownership

The cost of hiring agricultural machinery and equipment depends on the willingness of private owners; there is no policy that standard guidelines set the owner in different situations. The rate of hiring according to the respondents surveyed for plowing was 5200–5600 with a mean of 5400birr/ha; for harrowing and ridging, 4000–4400 with a mean of 4200 birr/ha, respectively. According to the respondent interview, combine harvester rates with a minimum of 250 and a maximum of 300 birr/Kuntal, a mean of 275 birr/Kuntal, and also for maize shelling and teff threshing, average rates of 55 and 200 birr/Kuntal, respectively.

Table 4.12: Rate of custom hiring farm machinery and equipment in private ownership

	Rate of hiring in private								
	Farming activities with tractor				Combine harvester		Engine maize sheller	Engine teff thresher	Irrigation pump
	Primary ploughing		Harrowing & ridging						
	Birr/Qerx	Birr/ha	Birr/Qerx	Birr/ha	Birr/Kuntal	Birr/ha	Birr/Kuntal	(Birr/Kuntal)	Birr/month
Min	1300	5200	1000	4000	250	4000	55	150	3000
Max	1400	5600	1100	4400	300	4000	70	250	3500
Mean	1350	5400	1050	4200	275	4000	55	200	3250

The cost of hiring depends on the interest in ownership, as indicated by the survey data from the responses of the farmer who targeted Kebeles. The cost in the above table only shows the starting cost increase based on availability. In addition, combine harvester and planter machines were not found in the targeted district; they come from Bale, Asasa, Shashemane, and Adama. This makes it difficult to get machinery, as we need it for planting and harvesting.

As we can see from the graph, the cost of harvesting increased from 80 ETB/Kuntal to 300 ETB/Kuntal from 2018/2019 to 2022/2023, respectively, showing a highly increased cost of harvest in the kebeles. The response from the owners was a cost increase due to distance, working time, operator cost, and fuel.

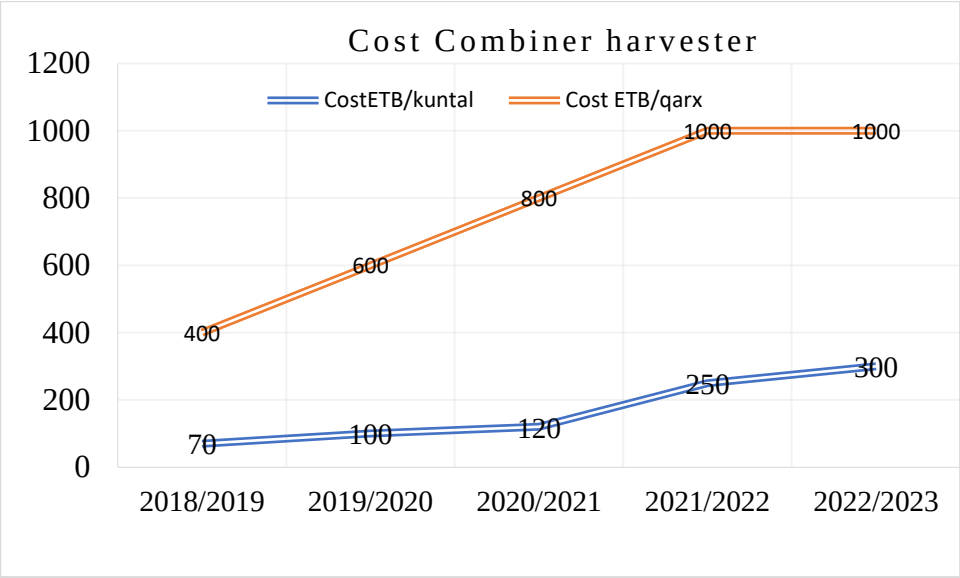


Figure 4.7: Rates of custom hiring service of combine harvester for wheat harvesting

4.2. Comparison of farmer cooperative union and private owner custom hiring service

4.2.1. Comparison on availability of farm machinery and equipment

Meki and Dugda Bora cooperative unions are owned and operated by a group of farmers who join together to enhance their collective bargaining power and share resources. It is typically governed by democratic principles, with each member having an equal say in decision-making. Both the Meki and Dugda Bora cooperative unions had four tractors with their tillage implements (two-disc plough, two-disc harrow and two rigders), maize shellers, and threshers.

This Meki Batu cooperative union was established in 2002 by the government of Sweden with the project support of an Ethiopian self-help NGO. Twelve farmer unions from Dugda, Bora, Adami Tullu, Jido Kombolcha, and Batu Dugda were established at that time. At that time, just three people were present: Wero Shitaye Dejene, Ato Niguse Shume, and Ato Tesgu G/tsedik. In Ethiopian self-help project managed by Dr. Awal, the project was under his direction. The main problem for the establishment was a high loss of fruit and vegetables. Currently, there are 153 farmer's unions, named Meki Batu Fruit and Vegetable Growers' Cooperative Union Ltd., and they consist of 17 board committees that provide different services. These include custom hiring services for agricultural machinery and equipment, delivery services to Ambo University, Arsi University, and Adama Science and Technology University, as well as the delivery of fruit and vegetables from the farmer's union.

Bora Denbel Farmers' Cooperative Union All Service Providers for Farmers Ltd. was founded in 2006 to assist farmers by delivering seeds, fertilizer, crop protection chemicals, and the customary hiring services of agricultural machinery and equipment for plowing, harrowing, and threshing activities, as well as harvesting.

The Meki Batu and Bora Denbel farmer cooperative union may provide various services to its members, such as on-land tillage, chemical and fertilizer/seed distribution, wheat threshing and maize shelling, fruit and vegetable supply services, to address the needs and concerns of its members collectively. An owner custom hiring service provider focuses primarily on offering machinery and equipment for rent. Their responsiveness to individual farmers' needs may vary, and they may not provide additional services beyond equipment rental.
An owner of a custom hiring service provider is a business entity or an individual who owns agricultural machinery and equipment and offers them on a rental basis to farmers for specific operations.

According to the respondent interview, they prefer, in terms of cost, most of the selected farmer cooperative union machinery and equipment, as indicated in the below pie chart (61.93% farmer cooperative and 38.07%) private ownership. The main reason was that the cost of a cooperative was lower than that of a private provider; however, there was a lack of tractor customer service at the peak time of harvest.

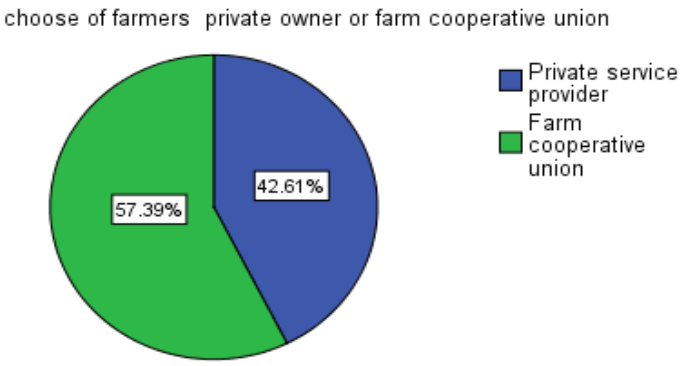


Figure 4.8: preference of cost of custom hiring in private and farmer cooperative union

Training can increase farmers' knowledge. Training can increase farmers' knowledge (Landini et al., 2017). Then, if operators participate in education and training for relevant agricultural machinery maintenance skills to master the maintenance skills, they may have more advantages

in agricultural machinery operation services. According to the interview, respondents said that farm machinery and equipment, such as tractor training support, are accessible in 35% of cases and unavailable in 65% of cases in private, but farmer cooperative unions are available in 44.4% of cases and unavailable in 55.6% of cases. According to this data, farmer cooperative unions had better access to training help than private unions. However, the discussion with respondents revealed that the training was inadequate.

Table 4.13.Training and support of agricultural machinery and equipment in the study area

Agricultural machinery and equipment training and support	Availability	Numbers of respondents (N=32)			
		In private ownership=14		Farm cooperative union, district Saff N=18	
		No of respondents	%	No of respondents	%
Tractor(4WT)	Available	5	35	8	44.4
	Not available	9	65	11	55.6
Maize sheller	Available	4	28.6	6	33.3
	Non available	10	71.4	12	66.7
Teff thresher	Available	2	14.3	4	22.2
	Not available	12	85.7	14	77.8
Irrigation pump	Available	7	50	8	44.4
	Not available	6	42.8	10	55.6

4.1.2. Availability of maintenance and repair service

As indicated by the respondents interviewed from farmer cooperative unions (Bora Denbel and Meki Batu) and private ownership from kebeles (operator and owner) from the sampled respondents of 18 and 14, respectively. According to the respondent, the owner's availability and

non-availability of maintenance and repair services for the disc plough are 28.6% and 71.4%, the mold board plough is 21.4% and 78.6%, the disc harrow is 28.6% and 71.4%, and the rigder is 35.7% and 71.3%, respectively. Whereas for farmer cooperative union service provider disc plough 33.3% and 61.9%, mold board 11.1% and 88.9%, disc harrow 33.3% and 76.7%, and rigder 22.2% and 77.8% availability and non-availability of equipment maintenance and repair, respectively. As shown in table 4.14, when we compared the respondent's interview, disc plowing, disc harrow availability of maintenance and repair in farmer cooperatives was better than private service.

Table 4.14: Availability of maintenance and repair service equipment

Equipment /implement	Availability	Numbers of respondents (N=32)			
		In private ownership, N=14		Farm cooperative union, district staff N=18	
		No of respondents	%	No of respondents	%
Disc plough	Available	4	28.6	6	33.3
	Not available	10	71.4	13	61.9
Moldboard plough	Available	3	21.4	2	11.1
	Not available	14	78.6	16	88.9
Disc harrow	Available	4	28.6	6	33.3
	Not available	11	71.4	12	76.7
Rigder	Available	5	35.7	4	22.2
	Not available	9	64.3	14	77.8

According to the respondents interviewed in the table from the farmer cooperative union (Bora Denbel and Meki Batu), district staff, and private ownership from kebeles (operator and owner) from the sampled respondents 14 and 18, respectively. According to the study conducted, the owner's availability of maintenance and repair services for the tractor (4WT) and the wheat thresher were 0%, respectively, for the irrigation pump, the maize sheller, 7.1%, and 14.3% for the irrigation pump. In contrast, the availability of equipment maintenance and repair for the farmer cooperative union service tractor (4WT), teff thresher, and irrigation pump were 0% and

5.6%, respectively. As shown in Table 4.15, when we related the respondent's interview, the availability of maize shellers and irrigation pumps for maintenance and repair in farmer cooperatives was better than in private service.

Table 4.15. Availability of maintenance and repair service small engine machine

Small engine Machine	Availability	Numbers of respondents (N=32)			
		In private ownership, N=14		Farm cooperative union &district staff, N=18	
		No of respondents	%	No of respondents	%
Tractor (4WT)	Available	0	0	0	0
	Not available	14	100	18	100
Teff, wheat	Available	0	0	0	0
thresher	Not available	14	100	18	100
Maize sheller	Available	1	7.1	2	11.1
	Not available	13	92.9	16	88.9
Irrigation pump	Available	2	14.3	1	5.6
	Not available	12	85.7	17	94.4

4.1.3. Availability spare parts

According to the respondents interviewed in the table from the farmer cooperative union (Bora Denbel and Meki Batu), district staff, and private ownership from kebeles (operator and owner) from the sampled respondents 14 and 18, respectively. According to the respondent, the owner and cooperative union spare parts tractor (4WT), moldboard plough, and ridger were not available in the targeted district area. This cost the owner when they needed replacements due to the downtime of farm machinery.

Table 4.16. Availability agricultural machinery and equipment spare parts

Agricultural machinery and equipment	Availability	Numbers of respondents (N=32)			
		In private ownership, N=14		Farm cooperative union, No=18	
		No of respondents	%	No of respondents	%
Tractor (4WT)	Available	0	0	0	0
	Not available	13	92.9	16	88.9
Disc plough	Available	2	14.3	1	5.6
	Not available	12	75.7	17	94.4
Moldboard plough	Available	0	0	0	0
	Not available	14	100	18	100
Disc harrow	Available	1	7.1	0	0
	Not available	13	92.9	18	100
Rigder	Available	0	0	0	0
	Not available	14	100	18	100

4.3 Factors that affects the availability of agricultural machinery and equipment

4.3.1 Access of fund

To determine the financial resources allocated by the government (development bank), save cooperatives and non-governmental organizations for promoting the availability of agricultural machinery and equipment.

The access to finance for credit from the government and from others, as obtained from the respondent interview, is shown in the below Figure 4.9: bank 28.28%, saving and credit: 34.68%, cooperatives: 34.10%, and others: 6.94%. According to the interview respondents, they select much more from saving and credit cooperatives (Equb and Edir) and informal lenders. That is why the process of getting money is easy, whereas the farmer needs to model farmers. To get the budgetary supplies for subsidies, grants, loans, and other financial support mechanisms, however, to get finance, there is no access in the district, and the criteria for a loan to get money from the development bank for lower farmer challenges.

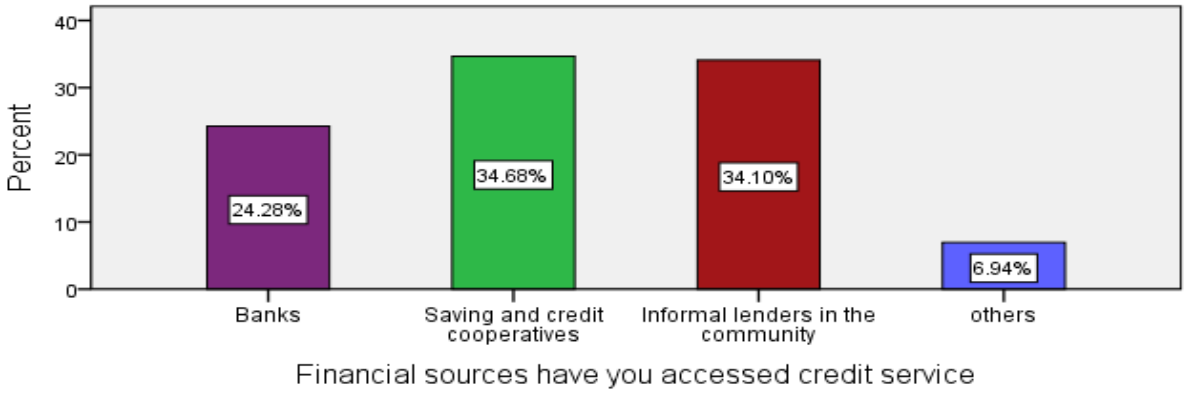


Figure 4.9: Financial access in credit service

4.3.2. Rate agricultural machinery and equipment for operation

According to the interview respondent and Dugda district office data, the rate of farm machinery and equipment operation varies based on the distance and farm size of farm land. For the private customs hiring service, here are the mini, max, and mean as follows for primary plough (5200, 5600, 5400) birr/ha or (1300, 1400, 1350) birr/qerx, respectively. So, if the farm size increases, the rate of hiring decreases; however, the owner of the customs hiring provider was not interested in small, less than half-hectares due to the cost of fuel. For tractor harrowing and ridging, it is also true as a tractor plough; however, its rates are lower here: min, max, and mean (1000, 1100, 1050) birr/qerx or (4000, 4400, 4200) birr/ha, respectively.

The rate of hiring a combine harvester was the same at the place since the farm had a minimum of one hectare (4000 birr/ha). If the farm size was smaller, it varies for min, max, and mean 250, 300, and 275, respectively. The main problems were transportation, fuel and oil costs, and distance. Rate for engines (teff thresher and maize sheller): min, max, and mean birr per Kuntal: 150, 250,200, and 55, 70, and 62.5, respectively. As seen from the data from the respondent interview, the threshing time of teff takes longer than that of maize. Due to this, the rate of threshing is more expensive than that of maize sheller, as well as having lower availability. Finally, for the irrigation pump rate of hiring in average min, max, and mean of 3000, 3500, and 3250 birr/month, respectively, it was cheaper than others. This was due to the easy availability given in the table below. Generally, as observed from being interviewed, the rate was not fixed due to a lack of common measures to regulate and monitor rate owners and farm unions through government agencies.

Table 4.17. Rate of hiring for operation agricultural machinery in private and cooperative

	Rate of hiring in private								
	Farming activities with tractor				Combine harvester		Engine maize sheller	Engine teff thresher	Irrigation pump
	Primary ploughing		Harrowing & ridging						
	Birr/Qerx	Birr/ha	Birr/Qerx	Birr/ha	Birr/kuntal	Birr/ha	Birr/Kuntal	(Birr/Kuntal)	Birr/month
Min	1300	5200	1000	4000	250	4000	55	150	3000
Max	1400	5600	1100	4400	300	4000	70	250	3500
Mean	1350	5400	1050	4200	275	4000	62.5	200	3250
	Rate of hiring in farmer cooperative union								
Mini	1200	4800	1000	4000	-	-	50	-	-
Max	1300	5200	1100	4400	-	-	60	-	-
Mean	1250	5000	1050	4200			55	-	-

4.3.3. Government facilitation of agricultural machinery for credit

It has a significant influence on how readily available agricultural machines and equipment. The availability and cost of machinery can be directly impacted by trade agreements, taxes, limitations on imports, aid, and incentives. The government prepares ways of getting farm machinery like a 4-wheel tractor, a Walking tractor for farmers, a community of model farmers, and a cooperative union. In the targeted area, credit policies related to tractor. One way is by direct purchase, and the other is through credit. 30% of the cost is required from the farmers, while 70% is provided by the government as credit to repay over five years.

The main requirements for farmers and cooperatives to buy tractors are as follows: First, they must bring letters from their kebeles stating what kind of farmer they are; second, they must bring identification cards from their kebeles; third, they must bring marriage certificates; fourth, they must bring rural land ownership certificates (Karta); fifth, they must provide their tin number, his and his wife, as well as receipt of tax payment. social security numbers: sixth, they must provide bank statements showing their 30% deposit, and finally, they must present investment papers from the zone. After the completion of the above-mentioned stages, However, the process of getting farm machinery is very tiresome, as the interviewee respondent spent six

months and more than six months due to bank processes and a lack of proper coordination between the bank and zone as well.

Kegna Agricultural Equipment Manufacturing and General Trading P.L.C. provides support to the Oromia regional states in obtaining the tractor. Farmers were interested in using 4-wheel tractors, a walking tractor, a combine harvester, an engine-powered sheller, an engine-powered thresher, a water pump baler, and equipment like a disc plough, a mold board, a disc harrow, and a rigger during a crucial time, but there wasn't enough agricultural machinery and equipment available for custom hiring. In addition, there are no standard ways to regulate custom hiring services for private ownership that provide service.

4.3.4. Farm machinery utilization

These differences can be caused by the disparity in supplying machines and farmers' social-economic conditions. Farm machines like tractors and combine harvesters for wheat farmers are supplied through two methods. Firstly, farm machines are directly aided by the government, which budgets them every year in its annual budget.

These machines mostly consisted of power tillers, tractors, water pumps, and combine harvesters. The machines are delivered to farmer groups to be managed and used by group members to provide custom hiring services. All group members can use the services to work on their farming operations. Now, the available services are just tillage, irrigating, and threshing operations.

Secondly, farm machines, which are directly purchased by individual farmers from dealers, they are usually farmers who have money to purchase the machines. The machines are used primarily to work their farming operations, and the excess capacity is offered to other farmers for hiring machinery services. Most farmers offered services to make full use of their machines, which is difficult to achieve due to small farm holdings.

4.4. Compare traditional and custom hiring service model

This research used crops (wheat, teff and maize), fertilizer and agricultural machinery (walky tractor, teff thresher, maize sheller, four-wheel tractor and combine harvester) as input, however the farm machinery were used through custom hiring systems. However, in the study area farm house had not interested for walky tractors to hire due lack of knowledge in terms of usage and

shortage. The study used two models:1) traditional farming model which uses oxen and human as a power; This model used traditional farming ways which is fully traditional farming because of the combination of human and oxen used in such a way that human power is used to push plough oxen forward alongside of operation; 2) Mechanization model through custom hiring service (farm machinery) which uses walky tractor ,maize sheller, teff thresher, four wheel tractor and combine harvester as a power source for ploughing and harvesting field operation.

4.4.1. Model 1. Traditional farming operation by oxen and human as power source

A. Wheat production by traditional farming system per hectare Model 1

From the study of traditional farming Model 1 indicates Table 4.18. This model represents the traditional farming by human and animal powers in Dugda district. Depending on the interview, this model would reflect the existing farming practices and the data collected in the five kebeles and Bora Denbel cooperative union. The collected data and farming practices used to estimate man power, oxen power and production cost required per hectare indicated in model 1. Oxen's owner hires on a five-hour-per-day basis to perform primary tillage, secondary tillage, and broadcasting. Pairs of oxen are led by one farmer, and another assists with broadcasting.

Table 4.18 illustrates the number of days needed for every particular farming activity, including primary and secondary plowing, broadcasting, applying herbicide, hand weeding, harvesting, threshing, and transporting by donkey or cart, based on the data results. The number of days needed by oxen and labor is also indicated. 30 days and 10 hours are needed for the following tasks: 5 days for primary plowing, 4 days for secondary plowing, 2 days for seed preparation, 3 days for broadcasting, 4 hours for applying herbicide, 5 days for hand weeding, 5 days for harvesting, 3 days for threshing, and 6 hours for transporting by donkey or cart.

Oxen and human hours required: Table 4.18 results indicate the total number of hours required by oxen and humans for each activity. For instance, 25 hours are needed for primary plowing, 20 hours for secondary plowing, and so on. The total number of hours required for all activities is 225.

Cost for hiring oxen: Table 4.18 represents the cost associated with using draft oxen for each farming activity. The costs are given in Ethiopian birr (ETB). The cost of starting from primary plowing up to transporting the draft oxen is 5750 ETB.

Cost for man: Table 4.18 shows the cost of employing labor for each activity. The cost of starting from primary plowing up to transporting the total cost of labor is 11,050 ETB.

Cost per operation: This column indicates the total cost for both labor and draft oxen for each activity. For example, the cost for primary ploughing is 2000 ETB, and the total operation cost is 16,800 ETB.

Model 1: Input Cost: This section lists the input costs for Model 1, including the cost of wheat seeds (7000 ETB) and fertilizer (9500 ETB). The total input cost is 16,500 ETB. Operational cost shows the total operation cost for Model 1, which is 16,800 ETB, and output income for this model indicates the income generated from wheat production is 78,000 ETB.

Total return: In this case, the total return is 44,700 ETB. Overall, based on the given information, Model 1 table 4.15 shows a total return of 44,700 ETB for wheat production using the traditional farming system for one hectare.

Table 4.18. Wheat production by traditional farming system for one ha. model 1

Wheat production	Farming				Seeding	Cultivation		Harvesting			
Factors	Primary plough			Secondary plough	Broadcasting	applying herbicide	Hand weeding	Harvesting	Threshing	Transporting (donkey)	Total
	1st	2nd	3rd	seedbed preparation							
No of days required by oxen and man	5	4	3	2	3	4hr	5	5	3	6 hrs	30day &10hrs
Oxen and man hour required	25	20	15	12	15	4	49	49	20	16	225hrs
Cost for draft oxen	1250	1000	750	500	750	-	-	-	-	1500	5750
Cost for man	750	600	450	300	450	2500	-	3000	2250	750	11,050

Cost per operation	2000	1600	1200	800	1200	2500	-	3000	2250	2250	16,800
		Model 1 -input cost			Operation cost			Output income cost		Total return	
Wheat seed, 7000		Fertilizer 9500		Total input A=16,500	Y=16,800			Z= 78,000		Z-(X+Y)) =44,700	

200kgx(3500ETB/100) =7000ETB X+Y=16,500ETB Z= 2600kg/ha x(3000ETB/100)

Note: average wheat production per hectares in the study area in traditional way of farming 26kg/ha (Dugda woreda office,2023)

B. Teff production by traditional farming system per hectare in Model 1

From the study of traditional farming model 1 indicates Table 4.19. This model represents the traditional farming by human and animal powers in Dugda district. Depending on the interview, this model would reflect the existing farming practices and the data collected in the five kebeles. The collected data and farming practices used to estimate man power, oxen power and production cost required per hectare indicated in model 1. Oxen's owner hires him on a five-hour-per-day basis to perform primary tillage, secondary tillage, and broadcasting. Two oxen are led by one farmer to labor, and another assists with broadcasting.

Table 4.19 illustrates the number of days needed for every particular farming activity, including primary and secondary plowing, broadcasting, applying herbicide, hand weeding, harvesting, threshing, and transporting by donkey or cart, based on the data results. The number of days needed by oxen and labor is also indicated. 26 days and 8 hours are needed for the following tasks: 4 days for primary plowing in first round, 3 days for secondary plowing, 3 days for seed preparation, 2days for broadcasting, 4 hours for applying chemical, 4days for hand weeding, 6 days for harvesting, 4 days for threshing, and 4hours for transporting by donkey or cart.

Oxen and human hours required: Table 4.19 results indicate the total number of hours required by oxen and humans for each activity. For instance, 20 hours are needed for primary plowing, 15 hours for secondary plowing, and so on. The total number of hours required for all activities is 161.

Cost for hiring oxen: Table 4.19 represents the cost associated with using draft oxen for each farming activity. The costs are given in Ethiopian birr (ETB). The cost of starting from primary plowing up to transporting the draft oxen is 3750 ETB.

Cost for man: Table 4.19 shows the cost of employing labor for each activity. The cost of starting from primary plowing up to transporting the total cost of labor is 11,000 ETB.

Cost per operation labor and oxen: Table 4.19, column indicates the total cost for both labor and draft oxen for each activity. For example, the cost for primary ploughing is 1600 ETB, and the total operation cost is 14,750 ETB.

Model 1 - Input cost: This section lists the input costs for Model 1, including the cost of teff seeds (9500 ETB) and fertilizer (18,300 ETB). The total input cost is 28,500 ETB. Operational cost of the result shows the total operation cost for Model 1, which is 14,750 ETB and Output income result indicates the income generated from teff production in Model 1, which is 81,900 ETB. The total return result calculated the total return by subtracting the total input cost and operation cost from the output income. In this case, the total return is 38,650 ETB.

Overall, based on the given information, Model 1 shows a total return of 38,650ETB for teff production using the traditional farming system for one hectare.

Table 4.19. For teff production by using traditional farming system per ha. model 1

Wheat production	Farming			Seeding	Cultivation	Harvesting				
Factors	Primary plough		Secondary plough	broadcasting	Applying chemical	Hand weeding	Harvesting	Threshing	Transporting Donkey or gari	Total
	1st	2nd	seedbed preparation							
No of days required by oxen and man	4	3	3	2	4hr	4	6	4	4hr	26&8hr

Oxen and lobar hr required	20	15	15	10	4	30	32	24	15	161
Cost for draft oxen	1000	750	750	750	-	-	-	-	500	3750
Cost for man	600	450	450	300	2500	1500	3500	1200	500	11,000
Cost per operation	1600	1200	1200	1050	2500	1500	3500	1200	1000	14,750
		Model 1 -input		Operation cost			Output income cost		Total return	
cost										
teff seed		Fertilizer	Total input	Y=14,750ETB			Z= 81,900 ETB		Z-(X+Y) =38,650	
9500		19,000	X= 28,500							

100kgx(9500ETB/100), X=200kg*(9500ETB/100) Z= 900kg/ha x(9100ETB/100)

Note: Average teff production per hectares in the study area in traditional way of farming 9kg/ha (Dugda woreda office,2023). For this research, in models 1 and 2, x stands for total input cost stands for operation cost, and z stands for output income cost.

C. Maize production by traditional farming system for one ha. Model 1

From the study of traditional farming Model 1 indicates Table 4.20. This model represents the traditional farming by human and animal powers in Dugda district. Depending on the interview, this model would reflect the existing farming practices and the data collected in the five kebeles. The collected data and farming practices used to estimate man power, oxen power and production cost required per hectare indicated in model 1. Oxen's owner hires him on a five-hour-per-day basis to perform primary tillage, secondary tillage, and broadcasting. Two oxen are led by one farmer to labor, and another assists with broadcasting.

Table 4.20 illustrates the number of days needed for every particular farming activity, including primary and secondary plowing, broadcasting, digging and hand weeding, harvesting, threshing, and transporting by donkey or cart, based on the data results. The number of days needed by oxen and labor is also indicated. 36 days are needed for the following tasks: 4 days for primary plowing in first round, 4 days for secondary plowing, 3 days for seed preparation, 3 days for planting, 4 days for digging and hand weeding, 4 days for harvesting, 3 days for threshing, and 2 days for transporting by donkey or cart.

Oxen and human hours required: Table 4.20 results indicate the total number of hours required by oxen and humans for each activity. For instance, 20 hours are needed for primary plowing, 20 hours for secondary plowing, and so on. The total number of hours required for all activities is 177.

Cost for hiring oxen: Table 4.20 represents the cost associated with using draft oxen for each farming activity. The costs are given in Ethiopian birr (ETB). The cost of starting from primary plowing up to transporting the draft oxen is 6150 ETB.

Cost for man: Table 4.20 shows the cost of employing labor for each activity. The cost of starting from primary plowing up to transporting the total cost of labor is 7900 ETB.

Cost per operation labor and oxen: This column shows the total cost for both labor and draft oxen for each activity. The costs are given in ETB. For example, the cost for primary ploughing is 1600 ETB, and the total operation cost is 14,050 ETB.

Cost per operation labor and oxen: This column indicates the total cost for both labor and draft oxen for each activity. The costs are given in ETB. For example, the cost for primary ploughing is 1600 ETB, and the total operation cost is 14,050 ETB.

Model 1 - Input cost: This section lists the input costs for Model 1, including the cost of maize seeds (2500 ETB) and fertilizer (19,000 ETB). The total input cost is 21,500 ETB.

Model 1: Input Cost: This table 4.20 lists the input costs for Model 1, including the cost of wheat seeds (2500 ETB) and fertilizer (19,000 ETB). The total input and operational cost are 21,500 ETB and 14050 respectively for Model 1, and output income for this model indicates the income generated from maize production is 87,400 ETB.

Total return in table 4.20 results is 35,550 ETB. Overall, based on the given information, Model 1 table 4.20 shows a total return of 35,550 ETB for maize production using the traditional farming system for one hectare.

Table 4.20. For maize production by using traditional farming system per ha. model 1

Wheat production	Farming				Seeding	Cultivation	Harvesting			
Factors	Primary plough			Secondary plough	Planting	Hand weeding &digging	Harvesting Threshing		Transporting (donkey/Gari)	Total
	1st	2nd	3rd	seedbed preparation						
No of days required by oxen and man	4	4	3	3	3	4	4	3	2	36
Oxen and man hour required	20	20	15	15	15	24	28	18	16	177
Cost for draft oxen	1000	1000	750	750	750	-	-	-	1900	6150
Cost for man	600	600	450	450	450	2400	600	1800	550	7900
Cost per operation	1600	1600	1200	1200	1200	2400	600	1800	2450	14,050

	Model 1 -input cost		Operation cost	Output income cost	Total return
Maize seed 2500	Fertilizer 19,000	Total input 21,500	Y=14,050	Z= 87,400	Z-(X+Y) = 35,550

100kg*2500ETB/100 =2500ETB 19,000ETB X= 21,500ETB 3800kg/ha*2300/100 = Z= 87,400 ETB

Note: average teff production per hectares in the study area in traditional way of farming produced 38 kg/ha (Dugda woreda office,2023)

4.4.2. Custom hiring service operation by farm machinery per ha. Model 2

A. Wheat production by CHS of farm machinery per ha. Model 2

Model 2 shows Table 4.21 based on the study area of mechanized hiring services in wheat production. This model represents the mechanized farming by custom hiring system of farm machinery powers (teff thresher, maize sheller, four-wheel tractor, and combine harvester) in Dugda district. Tractor of 75,95 and 120 in horse power and combine harvester 120 horse power respectively 0.5-1 ha/h in average field capacity were most commonly used in the study Dugda district. Depending on the interview, this model would reflect the existing farming practices and the data collected in the five kebeles and cooperative union. The collected data and farming practices used to estimate tractor power, cost of hiring respectively and wheat production cost required per hectare indicated in model 2. Tractor hires in primary tillage time taken and price of hiring service 2:30 -3:00 hours and 5400ETB/ha to perform farm activities respectively. In this study, according to the data respondents, it takes 2:30 hours for secondary tillage, 2:30 hours for seedbed preparation, 2 hours for seed drilling, 30–40 minutes for harvesting by combine harvester, and 30 minutes for transporting and storage by tractor, respectively. In general, it takes 12 hours to accomplish these tasks.

Service charge for machine operator and assistant as labor cost 600ETB for primary tillage,500ETB harrowing, 500 seed bed preparation, harvesting and transportation of wheat crops operations respectively. Hiring costs of combine harvester was 50ETB per 100 kg while truck cost of loading and transporting respectively.

The amount of grain produced of wheat per hectare was 3500 kg on average. In terms of machine and man-hours, Table 4.21 indicates the costs and work hours required by Model 2 to farm one hectare based on the aforementioned methods.

The input costs for wheat production using Model 2 of CHS farm machinery include the cost of wheat seed, which is 8,000 ETB, and the cost of fertilizer, which is 9,500 ETB. The total input cost amounts to 17,500 ETB.

The operation costs include various activities such as ploughing, seed drilling, applying chemicals, and transporting and storage, resulting in a total operation cost of 24,900 ETB.

The output income cost is stated as 105,000 ETB, which represents the income generated from the wheat production.

The total return yield is calculated as 62,600 ETB, which is the difference between the output income cost and the total input and operation costs.

Based on these figures, it appears that the wheat production using Model 2 of CHS farm machinery for one hectare has yielded a positive return of 62,600 ETB. This indicates that the wheat production has been profitable, considering the income generated from the output and the costs incurred for inputs and operations. However, please note that the interpretation is based solely on the given information. Other factors such as market prices, quality of the yield, and additional overhead costs are not considered. Therefore, a comprehensive analysis of the profitability would require more detailed information and a broader assessment.

Table 4.21. For wheat production by using CHS of farm machinery per ha. model 2

Wheat production	Farming			Seeding	Cultivation	Harvesting		
Factors	Primary plough	Secondary plough		Seed drilling	Applying chemical	Harvesting and threshing By combine harvester	Transporting and storage	Total
	1st	Harrowing	seedbed preparation					
No of days required by 4W tractor	2.30-3hrs	2:30hrs	2:30hr	2hr	1hr	30-40min	0.5hr	12hrs
Power hrs. required	3hrs	2.5hr	2.5hr	2hr	1hr	0.5-0.6hrs	0.5hr	12hrs
No of man required	1	1	1	2	1	1	3	10
Cost of 4W tractor	5400	4200	4200	3000	-	4000	1750	22,550
Cost for man and broker	600	500	500	-	-	-	750	2350

Cost per operation	6000	4700	4700	3000	-	4000	2500	24,900

	Model 2 -input cost		Operation cost	Output income cost	Total return yield
Wheat seed	Fertilizer	Total input	B=24,900	Output income cost	Total return yield
8,000ETB	9500ETB	17,500		Z= 105,000	(X+Y) =62,600

200kgx4000ETB/100, 9500ETB X= 17,500ETB 3500kg/hax3000/100

Note: Average wheat production per hectares in the study area by CHS of farm machinery of harvested 35 kg/ha (Dugda woreda office,2023).

B. Teff production by CHS of farm machinery per one ha. model 2

Model 2 shows Table 4.22 based on the study area of mechanized hiring services in teff production. This model represents the mechanized farming by custom hiring system of farm machinery powers (teff thresher, four-wheel tractor, and combine harvester) in Dugda district. Tractor of 75,95 and 120 in horse power 0.5-1 ha/h in average field capacity were most commonly used in the study Dugda district. Depending on the interview, this model would reflect the existing farming practices and the data collected in the five kebeles. The collected data and farming practices used to estimate tractor power, cost of hiring respectively and teff production cost required per hectare indicated in model 2.

Tractor hires in primary tillage, harrowing time taken and price of hiring service 2:30 -3:00 ,2:30 hours and 5400ETB/ha and 4200 ETB/ha to perform farm activities respectively. In this study, according to the data respondents, it takes, 2 hours for broadcasting, 3:30 hours for harvesting by teff thresher, and 30 minutes for transporting and storage by tractor, respectively. In general, it takes 12 hours to accomplish these tasks.

The input costs for Teff production using Table 4.20, Model 2 of hiring service farm machinery include the cost of Teff seed, which is 9,500 ETB, and the cost of fertilizer, which is 19,000 ETB. The total input cost amounts to 28,500 ETB.

The operation costs include various activities such as ploughing, seed drilling, applying chemicals, and transporting, resulting in a total operation cost of 22,200 ETB.

The output income cost is stated as 136,500 ETB, which represents the income generated from the Teff production. The total return yield is calculated as 85,800 ETB, which is the difference between the output income cost and the total input and operation costs.

Based on these figures, it appears that the Teff production using Model 2 of CHS farm machinery for one hectare has yielded a positive return of 85,800 ETB. This indicates that the Teff production has been profitable, considering the income generated from the output and the costs incurred for inputs and operations. However, please note that the interpretation is based solely on the given information. Other factors such as market prices, quality of the yield, and additional overhead costs are not considered. Therefore, a comprehensive analysis of the profitability would require more detailed information and a broader assessment.

Table 4.22. For Teff production by using CHS of farm machinery per ha. model 2

Teff production	Farming			Seeding	Cultivation	Harvesting and post harvesting			
Factors	Primary plough 1st	Secondary plough Harrowing	seedbed preparation	Broad casting	Applying chemical	Harvesting (by manual)	threshing By teff thresher	Transporting	Total
No of days required by 4W tractor	2.30-3hrs	2:30hrs	2:30hr	2hr	1hr	4 days	3:30hr	0.5hr	less than 1day
Power hrs. required	3hrs	2.5hr	2.5hr	2hr	1hr	-	3:30 hrs.	0.5hr	15hrs
No of man required	1	1	1	2	2	8	2	3	12
Cost of 4W tractor	5400	4200	4200	-	-	-	3000ETB/ha	1000	17,800
Cost for man	600	500	500	-	-	1600	450	750	4,400
Cost per operation	6000	4700	4700	-	-	1600	3450	1750	22,200

	Model 1 -input cost		Operation cost	Output income cost	Total return
teff seed 9,500ETB	Fertilizer 1900ETB	Total input X=28,500ETB	Y=22,200ETB	Z= 136,500 ETB	Z-(X+Y) =85,800ETB

100kgx9500ETB/100, 1900ETB X= 28,500ETB 1500kg/ha*9100/100 =Z

Note: Average teff production per hectares in the study area by CHS of farm machinery of farming produced 15 kg/ha (Dugda woreda office,2023)

C. Maize production by using CHS of farm machinery for one ha. model 2

Model 2 shows Table 4.23 based on the study area of mechanized hiring services in maize production. This model represents the mechanized farming by custom hiring system of farm machinery powers (teff thresher and four-wheel tractor) except harvesting operation in Dugda district. Tractor of 75,95 and 120 in horse power 0.5-1 ha/h in average field capacity were most commonly used in the study Dugda district. Depending on the interview, this model would reflect the existing farming practices and the data collected in the five kebeles and Batu cooperative union. The collected data and farming practices used to estimate tractor power, cost of hiring respectively and maize input, operational, output income and return cost required per hectare indicated in model 2.

Tractor hires in primary tillage, harrowing time taken and price of hiring service 2:30 -3:00 ,2:30 hours and 5400ETB/ha and 4200 ETB/ha since number of labour required to operate tractors and perform farm activities only one for each respectively. In this study, according to the data respondents, it takes, 2 hours for planting labor required two to operate and to assist, 10hrs hours for harvesting done manually required 2 labor and costs 200ETB for each, while maize can be done by thresher takes 4hrs to accomplish one hectare harvested maize, and half an hour for transporting and storage by tractor, respectively. In general, it takes less than aday except for harvesting accomplish these tasks.

According to model 2, table 4.23, primary plowing, secondary plowing, and planting operations require 2.5–3,2 and 2.5 hours, respectively, and the price of hiring operations is 5400, 4200, and 3000 ETB performed by a 4W tractor to accomplish one hectare, respectively. However,

harvesting was done manually; it took 2 days with a labor cost of 200 ETB for each labor, and the harvested maize was threshed with a hired thresher; its price per kuntal was 62.5 ETB for one hectare (45 kuntal/ha). The average production in the area costs 2812.5 ETB/ha, and with a service charge of 450 ETB. Transporting requires 0.5 hours and involves the labor of two individuals to load on a tractor with an average of 1000 ETB, depending on the distance of the storage from fields.

Cost for labor operator charge in farm operation for primary tillage, harrowing and planting were 600,500 and 500ETB as mentioned in table 4.20 respectively.
Model 1 - Input Cost: This row represents the input costs for maize production, including the cost of maize seed (2,500 ETB) and fertilizer (19,000 ETB). The total input cost is 21,500 ETB. Operation Cost: This row represents the total cost for all the operations involved in maize production. The total operation cost is calculated as 23,412.5 ETB.

Output Income Cost: The output income is not explicitly provided in the given information. However, it can be inferred to be 136,500 ETB, based on the equation represented the output income.

Total Return: The total return is calculated by subtracting the sum of the input cost and operation cost from the output income. Therefore, the total return is 58,587.5 ETB.

The input costs for maize production using Table 4.23, Model 2 of hiring service farm machinery include the cost of maize seed, which is 2500 ETB, and the cost of fertilizer, which is 19,000 ETB. The total input cost amounts to 21,500 ETB.

The operation costs include various activities such as ploughing, seed drilling, cultivating, and transporting, resulting in a total operation cost of 28,412.5 ETB.

The output income cost is stated as 103,500 ETB, which represents the income generated from the maize production. The total return yield is calculated as 58,187 ETB, which is the difference between the output income cost and the total input and operation costs.

Based on these figures, it appears that the maize production using Model 2 of hiring service of farm machinery for one hectare has yielded a positive return of 58,187 ETB. This indicates that the maize production has been profitable, considering the income generated from the output and the costs incurred for inputs and operations. However, please note that the interpretation is based

solely on the given respondent results. Other factors such as market prices, quality of the yield, and additional overhead costs are not considered. Therefore, a comprehensive analysis of the profitability would require more detailed information and a broader assessment.

Table 4.23 Maize production by using CHS of farm machinery per ha. model 2

Maize production	Farming			Seeding	Cultivation	Harvesting and post harvesting			
Factors	Primary plough 1st	Secondary plough Harrowing	Seedbed and ridging preparation	Planting	Cultivating	Harvesting (manual)	threshing By Maize sheller	Transporting	Total
No of days required by 4W tractor	2.30-3hrs	2:30hrs	2:30hr	2hr	2hrs	2days	3hr	0.5hr	less than 1day since 2day manually
Power hrs. required	3hrs	2.5hr	2.5hr	2hr	2hrs	10hrs	3.5 hrs.	0.5hr	12.5hrs
No of man required	1	1	1	2	2	2	2	4	12
Cost of 4W tractor	5400	4200	4200	3000	-	-	2812.5 ETB/ha	1000	20,612.5
Cost for man	600	500	500	-	400	450		750	3200
Cost per operation	6000	4700	4700	3000	400	650		1750	23,812.5
		Model 1 -input cost		Operation cost		Output income cost		Total return	
Maize seed 2500ETB		Fertilizer 19000	Total input 21,500	Y=23,812.5		C= 103,500		Z-(X+Y) =58,187.5	

100kgx2500ETB/100 ,19000ETB, X= 21,500ETB 4500kg/hax2300/100=Z

Note: average maize production per hectares in the study area by CHS of farm machinery of farming produced 45 kg/ha (Dugda woreda office,2023)

Generally, based on the respondent results analyzed in models 1 and 2, the traditional method requires more labor for wheat, teff, and maize than mechanized (model 2). So, farm operation in custom hiring farming was better than traditional based on model 2 in comparison to model 1 with respect to total return production. Therefore, model 2 was more recommended for farmer households than model 1, based on the above results from Tables 4.18-4.23.

CHAPTER FIVE
CONCULUSION AND RECOMMANDATION

5.1. Conclusion

The study assesses agricultural machinery and equipment custom hiring services in Dugda district, focusing on five kebeles and two cooperative union.The majority of respondents in district surveys come from an agricultural background, with male farmers being more likely to participate. The target region grew wheat, teff, maize, fruit, and vegetables, with wheat and maize being the most frequent crops.

The study involved 363 farmers from five kebeles in Dugda district. The study indicates that tractor and combine harvesting are more widely accepted in as compare to maize sheller and teff thresher. Other tractor hiring services, such as planting and spraying, are not available in the woreda. The majority of respondents had no formal education or primary school, indicating that the customs hiring service for machinery farmer households was challenged in understanding the written contract agreement. This could result in a positive effect on custom hiring of agricultural machinery and equipment.

The survey found that land ownership is critical for rural communities, with the majority holding between 0.5 and 1.5 hectares. According to the research, the dispersed farmlands made be spoke hiring problematic. Cluster farming is utilized for maize and wheat, although more practice is required in Sera wakale and Biliti balwolde, but not as a whole. The majority of land is covered with sandy loam and clay loam soils, which are ideal for crop cultivation.

The study area had many tractor, however operational failure and lack of maintenance.Farmers confront difficult farm responsibilities owing to a lack of necessary agricultural machinery. 25.3% of targeted Kebeles farmers own private farm machinery, with John Deere benefiting the most from the Kebeles farm machinery importer. However, just 200 irrigation pumps were found in WQ and DD out of 917 owing to inefficient usage, lack of maintenance, and non-functional replacement parts.

Cooperative unions in Meki Batu and Bora Denbel provide farm preparation, chemical, and threshing services. Private ownership rates are higher, but 61.93% prefer cooperative unions. Challenges include tractor availability, insufficient tractor training, low maintenance and repair services, and the unavailability of spare parts. The traditional method for wheat, teff, and maize

requires more labor than mechanized methods. Custom hiring farming yields better total return production, making it more recommended for farmer households. Development banks aim to improve machinery availability, but accessing funds and meeting loan criteria remain challenges.

4.4.Recommendation

The following recommendations are made in considering the study's conclusions and limitation described above:

- Farm roads and off-road areas must be accessible in order to hire services.
- Increase the way of farmer household to get farm machinery on the behave of district agricultural office
- Motivate the household farmer to use of cluster farm to engage in much more; to reduce fragment of farm
- Increase the number of farmer cooperative unions with respect to agricultural machinery and equipment service.
- Providing clear information, the purpose and their production on annual when the use agricultural machinery and equipment to the users over a period of time
- Increase the way of farmer household to get farm machinery on the behave of district agricultural office

The following recommendations are suggested for future work:

- Further study should be done on the lease of the tractor with respect to years of recovered income as well as the interest rate.
- Further study should be done on small machinery specially on walky tractor maize sheller and Teff thresher on their efficiency in the targeted areas.
- Further soil types and effect on farm machinery in details needed

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Appendix 1; English version Questioner for users

Request's short self-introduction and purpose of doing this research. The purpose of this questionnaire is to collect data for my master's thesis. The study is essential for the assessment of agricultural machinery and equipment custom hiring service in Oromia region a case of Dugda district, east Shoa zone, particularly for agricultural machinery and equipment services. Honest responses to each of the survey questions are highly useful. You may choose more than one answer. Responses will be treated confidentially only for this academic purpose.

I extremely appreciate your readiness to participate in this investigation.

Objectifies

- To assess the current status of agricultural machinery and equipment custom hiring service
- To conduct a comparative analysis of the custom-hiring services of farmer cooperatives union and private
- To determine the factors that affects the availability of agricultural machinery and equipment under government policy.

Investigation Region: Oromia Regional State:

East Shao Zone: Dugda District: _____ Kebele: _____

Name of respondent: _____ Code: _____Date: _____

I. Basic information farmers, please put your tike mark for questionnaire given below

1. Age of the farmers _____years.
   1. 12-18
   2. 18-40
   3. 40-65
   4. Above 65
2. Sex of the farmers 1. Male 2. Female
3. Marital status of family head:
   1. Married
   2. Unmarried
   3. Widowed
   4. Divorced
4. Educational status of farmers
   1. Illiterates
   2. Read and write
   3. Primary School
   4. High school and preparatory
   5. TVET College
   6. University

II. Resource profile of the respondent please put your tike (√) mark for the questionnaire

1. Do you have your land?
   1. Yes 2. No
2. What is the size of your land in _____ hectares
   1.0.5-1ha 2.1-1.5 ha 3 .1.5-3ha 4.3-5. ha 5. greater than 5 hectares
3. How many plots of land do you own? _____
   - ❖ If more than one scattered land, the size of each plot _____
   - ❖ On which plots did you hire a tractor or combine harvesting services?
     1. On all 2. Partly
4. If your answer to the above question is 'partly', what was the main reason for not hiring agricultural machinery (like tractor or combine harvester) and equipment?
   1. Land size too small
   2. Topography sloppy
   3. Located far road
   4. Due to road problems
   5. If other reason, specify
5. Do you hear about cluster farming? 1. yes 2. No
   - ❖ If your answer is yes what is the purpose of cluster farm?
     1. Easy for tractor plowing

2. Easy for harrowing by using a tractor
3. Easy for seeding using seed drilling machine
4. Easy for chemical spraying using boom sprayer
5. Easy for harvesting by using a combine harvester
6. Specify if others

6. Do engage in a cluster farming union? 1. Yes 2. No
   - ❖ If your answer is yes what are the advantages from the past ways?
     1. Increase production
     2. Comfort to apply tractor and combiner harvester
     3. Reduce cost of production
     4. Easy for seeding using farm machinery
     5. Easy of for chemical application and cultivation
     6. Specify if others
7. Did you hire out/share-cropping land during 2021-2022/23?
   1. Yes 2. No
8. What is the reason to hire out your land?
   1. Shortage of seeds
   2. Lack of tractor
   3. Shortage of labor
   4. If specify others
9. What type of power do you use for plowing land?
   1. Human power (e.g., manual digging)
   2. Animal power (e.g., Oxen)
   3. Mechanical power (e.g., Walky tractor or Two wheel /Four-wheel drive tractor)
   4. Specify if others
10. From question 9 if you use a tractor do you select the model of tractor before hiring from a custom hiring provider? 1. Yes 2. No
    - ❖ If your answer is yes what is the reason?
      1. Reliability
      2. Availability
      3. Quality of plowing (effectiveness)
      4. Capacity to plow high land covered with a limited time
      5. Specify if others

11. Which type of tractor is highly available in your area?
    1. John Deere tractor
    2. Class tractor
    3. Case tractor
    4. Holland tractor
    5. Specify if others are available

12. Do use a farm tractor for land preparation? 1. Yes 2. No

- ❖ If your answer is yes, when do you use it?
    1. For virgin land plowing (primary tillage)
    2. For harrowing (secondary tillage)
- ❖ If your answer is no, what is your main reason?
    1. Due to scattered land
    2. Due high cost of production
    3. Due to shortage of availability on time
    4. Due to lack of information
    5. Due to topography (e.g., slope land)
    6. Specify if others

13. Ho may time do you use a tractor for harrowing?
    1. One times
    2. Two Times
    3. Three times
    4. Specify if more

14. What types of crops and soil on what size of land have you grown in the production year 2021-2022/23?

15. For which purpose you have been producing crops?
    1. Selected seed enterprise supply
    2. Industrial raw material supply
    3. Local market Own consumption
    4. Other specify

16. Amount of grain produced and consumed in the 2022/2023 production season?

Type of land	Soil type	Produced (Kg)	Consumed (Kg)
Own land			
Hired land			

18. Do you have a family labor shortage? 1. Yes 2. No

- ❖ If yes, for what specific activities you have encountered labor shortage?

1. Land preparation period
2. Cultivation period
3. Weeding
4. Harvesting period
5. Threshing
6. Other specify

19. If yes, how do you overcome the problem during the peak labor requirement period?
    1. Hiring labor
    2. Labor exchange or Debo
    3. Hiring out farmland
    4. Family labor
    5. Other specify

20. Custom hiring of agricultural machinery and equipment for crop production? Use tike for the given below in the box

Activities	Tractor used		Seeding machine/sowing machine			Sprayer machine	Harvesting machinery and simple machine				
	Walky tractor (2W)	Tractor (4W)	Broad caster	Seed drill machine	Row Planter machine	Boom sprayer	Combine harvester	Baler	Pump	Thresher	Sheller
1st plowing											
2nd plowing											
3 rd. plowing											
Sowing											
Application of pesticides											
Weeding											
Harvesting											
Transporting											

22. What are tractors highly used in the area?
    1. Two-wheel tractor / power tiller
    2. Four-wheel tractor
    3. Specify if others

23. Which tractor is the farmer's top choice when hiring it specifically for a certain area's purpose?
    1. New Holland Tractor
    2. Class Tractor
    3. Case tractor
    4. John deer tractor
    5. Landin tractor
    6. YTO tractor
    7. Specify if others

24. What are the primary criteria of the local selection tractor?
    1. Availability
    2. Simplify to use
    3. Lower cost
    4. Lack of information

25. If hiring a tractor how much is the cost? [tractor cost per day or hectare]
    1. Land preparation
    2. Weeding
    3. Harrowing
    4. Rigger
    5. Specify if others

26. Does any of your young have the interest to continue farming as a successor to you?
    1. Yes
    2. Not at all
    3. May-be if using mechanization
    4. Uncertain

27. Do you have a financial problem with your agricultural activity? 1. Yes 2. No
    - ❖ If yes, do you have access to credit from financial institutions? 1. yes 2. No
    - If yes, from which financial sources have you accessed credit in the past?
        1. Banks
        2. Saving and credit cooperatives
        3. Informal lenders in the community
        4. Others

❖ If yes, can you use the credit to hire agricultural machinery and equipment services?
    4. Yes 2. No

28. Do you get the credit? 1. Yes 2. No
    - ❖ If yes, for what development activities have you received credit?

1. To purchase farm inputs (fertilizers, seeds, tractor, combine harvester and water pump, Thresher and sheller)
2. To rear livestock
3. To hire agricultural machinery and equipment
4. Specify if others

❖ If not, what are the main reasons?

1. Due to high-interest rates
2. Shortage of down payment
3. Lack of law and regulation for a loan in financial institutions
4. Inaccessibility to formal credit
5. Other specify

29. The main source of household income and livelihood basis is?

1.Agriculture
2. Trading
3. construction
4. others

30. Do you know about Agricultural machinery hiring services? 1. Yes 2. No

❖ If yes, - please explain which services are common in your area.

1. Tractor plowing
2. Tractor harrowing
3. Tractor sowing
4. Tractor boom spraying
5. Combine harvesting
6. Tractor with trailer transportation

31. From where do you get agricultural machinery and equipment hiring services?

1. Farmers co-operatives/unions
2. Government agency
3. Private service providers
4. Other specify

32. Have you used agricultural tractors and combine harvester services in the last two years?

1. Yes 2. No

❖ If yes, which of the services you hired in the 2021-2022/23 cropping season? Q32

Farm operation	Area (ha)	Rate (cost /ha)	(cost/kg)
Tractor plowing			
Tractor harrowing			
Tractor row planting			
Water pumping			
Boom spraying with a tractor			
Threshing with Engine operated			
Combine harvesting			

33. What was your main reason for hiring agricultural machinery and equipment (tractor, combine harvester, baler, water pump, thresher, sheller) services?
    1. Lack of oxen
    2. Lack of labor
    3. Quality of work and better Yield
    4. Shortage of time
    5. Agricultural machinery and equipment do faster operations
    6. Less costly
    7. Other specify
34. What is your opinion on the yield when comparing tractor-prepared fields with that of oxen?
    1. Very good
    2. Good
    3. Fair
    4. Bad
35. Manual harvesting more wastage than combine harvesting
    1. Yes
    2. No
    3. Uncertain
    4. If others specify
36. If you hired only for specific operations (e.g., plowing), what is your main reason for not hiring other operations (e.g., harrowing, sowing, and spraying) farm tractors?
    1. Due to the cost of machinery too high for other operations (sowing and spraying)
    2. Not available in my area
    3. I don't have cash
    4. I don't trust the machine
    5. Due to lack of operator

6. other specify

36. Will you be interested in hiring more agricultural machinery services, such as row planting, irrigation, and spraying, if they become available more?

1. Yes 2. No

37. How much do you trust your neighbors about sharing ideas on agricultural machinery and equipment technologies?

1. Very highly
2. High
3. Uncertain
4. Less
5. Least

38. Who made you convinced to decide to hire agricultural machinery and equipment service for the first time?

1. Neighbors
2. Extension workers
3. Brokers
4. Others specify

39. What is your opinion on the cost of hiring a tractor for different operations?

- Plowing: 1. Very expensive 2. Expensive 3. Moderate 4. Cheap
- Harrowing:1. Very expensive 2. Expensive 3. Moderate 4. Cheap
- Planting: 1. Very expensive 2. Expensive 3. Moderate 4. Cheap
- Spraying: 1. Very expensive 2. Expensive 3. Moderate 4. Cheap
- Transporting: 1. Very expensive 2. Expensive 3. Moderate 4. Cheap

40. What is your opinion on the cost of hiring harvesting machinery for different operations?

- The engine-operated thresher: 1. Very expensive 2. Expensive 3. Moderate 4. Cheap
- Combine harvester: 1. Very expensive 2. Expensive 3. Moderate 4. Cheap
- Baler: 1. Very expensive 2. Expensive 3. Moderate 4. Cheap

41. What is your opinion on the cost of hiring engine operated water pump?

1. Very expensive 2. Expensive 3. Moderate 4. Cheap

III. Put a mark in the for supply and Time factors given below

1. Is there any custom hiring service provider in your area? 1. Yes 2. No
   - If your answer is yes put in a number. _____.
   - If your answer is no, where do you get agricultural machinery custom hiring service

1. From private custom hiring provider away for the distinct
2. From government agencies from Shashemane and Adama (Ethio Engineering)
3. On the behave of the farm cooperative union from Shashemane
4. From Meki Batu fruit and vegetable grower cooperative union of farmers limited plc
5. From bora Denbel cooperative union of farmers limited plc
6. Specify if others

2. Which is low-cost private owner or farm cooperative union for hiring service?
   1. Private service provider 2. Farm cooperative union
3. Are there many tractors and combine harvesters in your area to hire, if you want to get the service?
   1. Very few (almost zero) 3. Many
   2. few

❖ Are they available whenever you need them? 1.Yes 2. No

4. How far is your farm from the main road in km? _____
5. The main problem for obtaining tractor and combine harvester hiring service is_____.
   1. Supply problem 4. Lack of information
   2. Price problem 5. Absence of timely supply
   3. Access and transport problems 6. Specify if others
6. The main problem for obtaining planter and booms sprayer hiring service is_____.
   1. Lack of information 4. Access and transport problems
   2. Supply problem
   3. Price problem 5. Absence of timely supply
   6. Specify if others
7. Are there agricultural machinery and equipment broker service in your locality?
   1. Yes 2. No
8. Did you hire agricultural machinery and equipment services through the arrangement of brokers? 1. Yes 2. No
9. How do you see the role of brokers in the agricultural machinery and equipment hiring business?

1. Not important
2. Make the entire job easier
3. Make the service cost
4. Specify if others

10. Did you hire an agricultural machinery and equipment service in the suffering of unexpected weather changes? 1. Yes 2. No

11. If yes which service, did you hire?

1. Plowing
2. harrowing
3. Sowing/planting
4. Spraying
5. Harvesting
6. Transporting
7. Other specify

IV. Description of factors relating to farmers' subjective assessment on the level of the importance of a series of decision variables

1. By putting a √ mark, please rate the level of importance of the following factors for your hiring decision

No	Item	Level of importance				
		Not important at all	Not important	Neutral	Somewhat Important	Very important
1	Quality of agricultural machinery and equipment Work					
2	Availability of repair and maintenance					
3	Weather factors-uncertainty					
3	Role of brokers					
4	Hiring fee					
5	Timely availability of service					

	Providers					
6	Concepts about cluster farming					
	Suggestion neighbors' on Agricultural machinery and equipment services					
7	Labor cost					
8	Farm income					
9	Opinion about sowing and spraying machine					

V. Questionnaires for targeted districts agricultural office and farmer cooperative union

1. Does your district provide any opportunities for the operator of different farm machinery and equipment?
2. Which tractor brands are most common in your district?
3. Which crops are cultivated most commonly in your district?
4. How did you see the attitude of farmers toward farmer cooperative union?
5. How do you see status of farm machinery and equipment custom hiring service in your farmer cooperative union?
6. How do you see status of agricultural machinery and equipment custom hiring service in your district?
7. Is their available tractor maintenance and repair in the Meki Batu and Bora Denbel cooperative union?
8. What about the availability of agricultural machinery and equipment spare parts in district area?
9. How do you attract farmers to use farm machinery from Meki Batu and Bora Denbel cooperative union?
10. How many tractors are there in your district?
11. How do you see interests of farmers to hire tractor from cooperative union?

12. When compared to the traditional agricultural system, how productive are farmers using custom-hire farm machinery and equipment?
13. Do you believe that farm machinery is directly impacted by the type of soil in your district?

Appendix 2: Afan Oromo version Questioner for users

Of beeksisuu gabaabaa fi kaayyoo qorannoo kana raawwachuu ni gaafata. Kaayyoon gaaffilee kanaa daataa barruu qorannoo mastersii walitti qabuudha. Qorannoon kun barbaachisaa dha. assessment of agricultural machinery and equipment custom hiring service in Oromia region a case of Dugda district, east Shoa zone**,** particularly to farm machinery and equipment services. Tokkoon tokkoon gaaffilee qorannoo kanaaf deebii amanamaa kennuun faayidaa guddaa qaba. Deebii tokkoo ol filachuu dandeessa. Deebiin kennamu kaayyoo barnootaa kanaaf qofa iccitiidhaan kan ilaalamu ta'a.

Qorannoo kana irratti hirmaachuuf qophii ta'uu keessan baay'een dinqisiifadha.

Kaayyoo addaa qaba

- Tajaajila kireeffama maashinarii fi meeshaalee qonnaa haala yeroo madaaluu
- Tajaajila kireeffamu aadaa waldaalee hojii gamtaa qonnaan bultootaa yuuniyeenii fi dhuunfaa irratti xiinxala wal bira qabamee ilaalamu gaggeessuu
- Imaammata mootummaa jalatti argama maashinoota fi meeshaalee qonnaa irratti dhiibbaa geessisan murteessuu.

Naannoo Qorannoo: Mootummaa Naannoo Oromiyaa,Zoonii Shao Bahaa: Aanaa Dugdaa:

Kebele: _____

Maqaa deebii kenne:_____ Code:_____Guyya_____

I. Odeeffannoo bu'uuraa Qonnaan bultoonni Gaaffii armaan gaditti kennameef mallattoo tike (√) keessan kaa'aa

1. Umurii qonnaan bultootaa _____waggaa
    1. 12-18
    2. 18-40
    3. 40-65
    4. 65 caalaa
2. Saala qonnaan bultootaa
    1. Dhiira
    2. Dhalaa
3. Haala gaa'ela mataa maatii:
    1. Kan fuudhe / Heerumee
    2. Kan hin heerumne
    3. Haadha manaa abbaan manaa irraa du'e
    4. Hiikte/hikee
4. Haala barnootaa qonnaan bultootaa
    1. Dubbisuu fi barreessuu hin dandeenye
    2. Dubbisi fi barreessi danda'an
    3. Mana Barumsaa Sadarkaa tokkoffaa
    4. Mana barumsaa sadarkaa lammaffaa fi qophii
    5. Kolleejjii TVET
    6. Yuunivarsitii

II. Qabeenya piroofaayilii deebii kennan mallattoo tike (√) keessan kaa'aa

6. Lafa mataa keetii qabdaa? 1. Eeyyee 2. Lakki
7. Lafti hektaara meeqa qaba?
    1. Tokko gadi
    2. 1-2 hektaara
    3. 2-3 hektaara
    4. 3-4 hektaara
    5. Hektaara 4 caalaa
    6. kan biroo ibsu
8. Lafa meeqa qabda ? _____ .

Lafti faffaca'e tokkoo ol yoo ta'e, guddinni lafa tokkoon tokkoon isaa_____hectaran.

Lafa kamirratti tiraaktara ykn kombayinara kiresefata fayadametaan?

1. Hundaa irratti 2. Gartokkoon

9. Gaaffii armaan olii kanaaf deebiin keessan 'gartokkoon' yoo ta'e, sababni guddaan kireesu dhabuu keessaniif maal ture?

1. Bal'inni lafaa garmalee xiqqaadha
2. Teessuma lafaa /sloppy
3. Fagootti kan argamu
4. Rakkoo daandii irraa kan ka'e
5. Sababa biraa, yoo jirate ibsi

10. Waa'ee qonna kilaastaraan ni dhageessa?

1. Eeyyee 2. Lakki

Deebiin kee eeyyee yoo ta'e fayidan qonna kilaastaraa maali?

1. Tiraaktaraan qotuun salpisuuf
2. Maashinii sanyii qotuu fayyadamuun facaasuuf salphaadha
3. Boom spray fayyadamuun keemikaalaa biifamuuf salphaadha
4. Harvester combiner fayyadamuun sassaabuuf salphaadha
5. Yoo kanneen biroo jirate ibsi

11. Yuuniyeenii qonna kilaastara irratti bobba'eete jiraa?

1. Eeyyee 2. Lakkii

Yoo eeyyee jettee deebisteef faayidaan isa irraa argatu maali ?

1. Omisha dabaluu
2. Mijataa tiraaktaraa fi kombaayinara harvester fayyadamuf
3. Omisha baasii hir'isuu
4. Maashinoota qonnaa fayyadamuun fi facaasuuf salphaadha
5. keemikaalaa fayyadama Salphaa dha
6. Yoo kanneen biroo jirate ibsi

12. Bara 2021-2022/23 keessa lafa kireeffattee/qoodattee? 1. Eeyyee 2. Lakki

13. Sababni lafa kee kireeffatu maali?

1. Hanqina sanyii
2. Hanqina tiraaktaraa
3. Hanqina humna namaa
4. Kanneen biroo yoo jirate (ibsi)

14. Bara midhaanii 2021-2022/23tti lafa dabalataa qacartanii?

1. Eeyyee 2. Lakki

❖ Yoo eeyyee ta'e bal'inni lafa qacarame hektaara_____ dha.

15. Lafa qotuuf humna gosa akkamii fayyadamtu?

1. Humna namaa (fkn, harkaan qotuu)
2. Humna bineensotaa (fkn, Qotiyo) .

3. Humna mashinarii (fkn, Tiraaktara Walky / Tiraaktara miila lamaa ykn Tiraketera /Four-wheel drive)
4. Yoo kanneen biroo yoo jirate ibsi

16. Gaaffii 4 irraa yoo tiraaktara fayyadamtan dhiyeessaa qacarrii Amayaa irraa qacaruun dura moodeela tiraaktaraa ni filattu? 1. Eeyyee 2. Lakki

❖ Yoo eeyyee jettee deebisteef sababni maali?

1. Amanamummaa
2. Argamuu isaa
3. Qulqullina qonnaa (bu'a qabeessummaa)
4. Dandeettii uwwisa lafaa ol'aanaa yeroo murtaa'een qotuu
5. Yoo kanneen biro jirate ibsi

17. Gosa tiraaktaraa naannoo sanatti baay'inaan argamu isa kami?

1. Tiraaktara John Deere
2. Tiraaktara Claasii
3. Tiraaktara keesii
4. Tiraaktara Hoolaandii
5. Kanneen biroo yoo jiraatan ibsi

18. Qophii lafaaf tiraaktara qonnaa ni fayyadamtuu? 1. Eeyyee 0. Lakki

❖ Yoo deebiin eeyyee jette yoom fayyadamta?

1. Lafa durbaa qotuu (primary tillage)
2. qonna sadarkaa lammaffaa

❖ Deebiin kee Lakki yoo ta'e maaliif sababa siif kaa'a?

1. Lafa faffaca'e
2. Baasii oomishaa olaanaa
3. Hanqina yeroon argamuu
4. Hanqina odeeffannoo
5. Teessuma lafaa (fkn, lafa qaxxaamuraa) .
6. Yoo kanneen biroo jirate ibsi

19. Yeroo meeqaf qonna tiraaktara fayyadamuudha qotaa ?

1. Yeroo tokko
2. Yeroo Lama
3. Yeroo sadii
4. Yoo baay'ee ta'e ifteessi

20. Bara oomishaa 2021-2022/23tti lafa bal'ina meeqa irratti midhaan gosa fi biyee akkamii guddiste?

21. Qotiyo kee qabdaa? 1. Eeyyee 2. Lakki

- ❖ Yoo eeyyee ta’e, Baay’ina Qotiyo qonnaa ati qabdu _____ .
- ❖ Lakki yoo ta’e lafa kee qopheessuuf filannoowwan akkamii fayyadamta?
    1. Tiraaktara fayyadamuun
    2. Namoota biroo irraa liqeessuu
    3. Kaan biro yoo jirate ibsi

22. Hanqina humna namaa maatii qabduu? 1. Eeyyee 2. Lakki

- ❖ Yoo eeyyee ta’e, hojiiwwan addaa hanqinni humna namaa si mudate maali?
    1. Yeroo qophii lafaa
    2. Yeroo qonnaa
    3. Aramaa
    4. Yeroo sassaabbii
    5. Midhaan dha'uu
    6. Kaannen biroo ibsi

23. Yoo eeyyee ta’e, yeroo humna namaa baay’ee barbaachisutti rakkoo jiru akkamitti mo’atta?
    1. Hojjetaa qacaruun
    2. Jijjiirraa hojjettootaa
    3. Lafa qonnaa qacaruun
    4. Hojii maati
    5. kanneen biroo ibsi

24. Maashinoota qonnaa fi meeshaalee oomisha midhaaniif oolu akkaataa aadaatiin qacaruu? Kan armaan gadii saanduqa keessatti kennameef tike fayyadamaa

Gochaalee	Gosa tiraketra		Gosa machinina faccasuu			Machina chemical bifuu	Maashinoota sassaabuu fi maashinii salphaa				
	Tiraaktara walky (2W)	Tiractera (4W)	Broadcasterii	Maashinii Biqiltuu Tarree	precision Maashinii Biqiltuu	Maashinii chemical bifuu/boom sprayer	Kombinara	Belarii	Pumpi	Thresherii	Shellerii
1ffaa qotuu											
2 ffaa qotuu											
3ffaa qotuu											
Facaasuu											
Bishan obasu											
Qoricha Fayyadamu											
Sassabu											
Geejjibaa											

25. Hojii qonnaa keessaniif rakkoo maallaqaa qabduu? 1 Eeyyee 0. Lakki

❖ Eeyyee yoo ta'e dhaabbilee faayinaansii irraa liqii argachuuf carraa ni dandeessaa?

1. Eeyyee 0. Lakki

- Yoo eeyyee ta'e, yeroo darbe maddoota faayinaansii kamirraa liqii argatte?
  1. Baankota
  2. Waldaa hojii gamtaa qusannaa fi liqii
  3. Liqeessitoota al-seerummaa hawaasa keessatti
  4. Kaannen biro isi yoo jirate

❖ Yoo eeyyee ta'e, liqii kennameef fayyadamuun tajaajila maashinarii fi meeshaalee qonnaa qacaruuf ni dandeessaa?

1. Eeyyee 0. Lakki

26. Liqii argatte beketu ? 1. Eeyyee 0. Lakki

❖ Eeyyee yoo ta'e hojiiwwan misoomaa kamiif galata argatte?

1. Bita (xaa'oo, sanyii, tiraaktaraa, kombaayinii harvester fi bishaan paampii, Thresher fi sheller) bitachuuf.
2. Beeylada guddisuuf

❖ Lakki yoo ta'e sababni guddaan maali ?

1. Sababa dhala guddaa irraa kan ka'e
2. Hanqina kaffaltii duraa
3. Mirga qabiyyee lafaa wabiif ta'u dhabuu
4. Dhaabbilee faayinaansii keessatti liqiidhaaf seeraa fi dambii dhabuu
5. Hubannoo dhabuu
6. Dhaabbilee liqii idilee bira gahuu dhabuu
7. Kanneen biroo ibsi

27. . Maddi galii maatii fi bu'uura jireenyaa inni guddaan?

28. Waa'ee tajaajila qacarrii maashinoota Qonnaa ni beektu? 1. Eeyyee 0. Lakki

❖ Yoo eeyyee ta'e, - maaloo tajaajilli kamtu naannoo keessanitti akka barame ibsaa.

1. Tiraaktaraan qotuu
2. Tiraaktaraa harrowing
3. Facaasaa tiraaktaraa
4. Chemical tiraaktaraa biifamuu

5. Kombayinaran Sassaabbii
6. Tiraaktaraa geejjibaa konkolaachisaa qabu
7. Yoo Kanneen biroo ta'e, ifteessi

❖ .Tajaajila kiresuu maashinoota qonnaa fi meeshaalee qonnaa eessaa argattu?

1. Waldaa Hojii Gamtaa/waldaa Qonnaan Bultootaa
2. Tajaajila dhuunfaa kennan
3. Ejensii mootummaa
4. Yoo Kanneen biroo jirate ibsi

30. Waggoota lamaan darban keessatti tiraaktara qonnaa fi/ykn kombiyinara fayyadamteettaa?

1. Eeyyee 0. Lakki

31. Tajaajila maashinoota fi meeshaalee qonnaa (tiraaktaraa, kombaayinii harvester, baler, water pump, thresher, sheller) kireefaman sababni guddaan keessan maali ture?

1. Hanqina Qotiyoo
2. Hanqina humna namaa
3. Qulqullina hojii-fi oomisha fooyya'aa
4. Maashinarii fi meeshaaleen qonnaa saffisaan hojjetu
5. Baasii xiqqaa
6. Hanqina yeroo kannen biro yoo jirate ibsi

❖ Eeyyee yoo ta'e, tajaajila yeroo midhaan 2021-2022/23 qacartan keessaa isa kami?

Gosa hojii	Bal'ina lafaa (ha).	Sadarkaa (baasii /ha), (baasii /kg)
Tiraaktaraan qotuu		
Tiraaktaraan buleesuu		
Tiraaktaraan Facasuu		
paampii Bishaan Fayyadamu		
Tiraaktaraan chemical bifuu		

Thresher kan Engine operated jedhamu fayyadamuun		
Kombinari dha midhan sassabu		

32. Dirree tiraaktaraan qophaa'ee fi kan qotiyoon yeroo wal bira qabdan oomisha irratti yaadni keessan maali?
    1. Baay'ee gaarii
    2. Gaarii
    3. Walqixxee
    4. Badaa
33. Isa kamtu sasabu harkaan sassaabuu ykn kombiyinarii irraa caalu?
    1. Eeyyee
    2. Lakki
    3. Mirkanaa'aa miti
    4. Yoo kan biroo ibsu
34. Yoo hojii addaa qofaaf (fkn, qotuu) qacarte, tajaajila makaanaayizeeshinii tiraaktaraa keessatti hojiiwwan biroo (fkn, harrowing, facaasuu fi biifamuu) qacaruuf sababni kee inni guddaan maali?
    1. Baasii maashinarii facaasuu fi biifamuu) olka'aa ta'uu isaatiin.
    2. Naannoo kootti hin argamu
    3. Maallaqa dhabu
    4. Maashinicha hin amanuma dhabu
    5. Sababa hanqina opereteraa irraa kan ka'e
    6. kanneen biroo yoo jirate ibsu
35. Tajaajilli maashinarii qonnaa dabalataa kan akka tajaajila tarree dhaabuu, jallisii fi biifamuu yoo argame tajaajilicha qacaruuf fedhii ni qabaattaa?
    1. Eeyyee
    0. Lakki
36. Teeknooloojii maashinoota qonnaa fi meeshaalee qonnaa irratti yaada waliif qooduun walqabatee ollaa keessan hangam ni amanattu?
    1. Baayyee ol'aanaa
    2. Ol aanaa
    3. Mirkanaa'aa miti
    4. Gad bu'aa
    5. Hunda caalaa xiqqaa
37. Yeroo jalqabaaf tajaajila maashinarii fi meeshaalee qonnaa qacaruuf akka murteessitan eenyutu si amansiise?
    1. Ollaa
    2. Daldaltoota
    3. Hojjettoota ekisteenshinii
    4. Kaan immoo ibsu
38. Baasii tiraaktara hojii adda addaatiif kireeffachuuf bahu irratti yaadni keessan maali?

- ❖ Qotuu: Baay'ee qaalii 1. Baay'ee Qaalii 2. Qaalii 3. Giddugaleessa 4 rakasa
- ❖ Harrowing: 1. Baay'ee Qaalii 2. Qaalii 3. Giddugaleessa 4 rakasa
- ❖ Sowing /Dhaabbii: 1. Baay'ee Qaalii 2. Qaalii 3. Giddugaleessa 4 rakasa
- ❖ Biifamuu: 1. Baay'ee Qaalii 2. Qaalii 3. Giddugaleessa 4 rakasa

39. Baasii maashinii sassaabbii hojii adda addaatiif kireeffachuuf bahu irratti yaadni keessan maali?
    - ❖ Engine operated Thresher1. Baay'ee Qaalii 2. Qaalii 3. Giddugaleessa 4 rakasa
    - ❖ Combine harvester: 1. Baay'ee Qaalii 2. Qaalii 3. Giddugaleessa 4 rakasa
    - ❖ Baasii paampii bishaanii motoradhaan hojjetu qacaruuf bahu irratti yaadni keessan maali?

      1. Baay'ee Qaalii 2. Qaalii 3. Giddugaleessa 4 rakasa

III. Qabxiilee dhiyeessii fi Yeroo armaan gaditti kennamaniif mallattoo √ saanduqa keessa kaa'i

1. Naannoo keessanitti tajaajila qacarrii machinarii kan kennu jiraa?

   1. Eeyyee 0. Lakki

   - ❖ Deebiin kee eeyyee yoo ta'e lakkoofsa kaa'i. _____.
   - ❖ Deebiin keessan lakki yoo ta'e tajaajila qacarrii aadaa maashinoota qonnaa eessaa argattu
     1. Dhiyeessaa qacarrii aadaa dhuunfaa irraa fagaatee kan adda ta'eef
     2. Ejensii mootummaa irraa shesmanee fi Adama irraa
     3. waldaa hojii gamtaa qonnaa shashmane irraa
     4. Yoo kanneen biroo jirate ibsi
2. Tajaajila qacaruuf abbaa qabeenyaa dhuunfaa ykn waldaa hojii gamtaa waldaa Qonnaa gatii xiqqaa qabu isa kami?
   1. Dhaabbata tajaajila dhuunfaa
   2. waldaa hojii gamtaa qonnaa
   3. Lachuu ni qixa dha
3. Tajaajila argachuu yoo barbaaddan, tiraaktarootaa fi kombinara midhaan sassaabu naannoo keessanitti kireseesan baay'ee jiruu?
   1. Baayyee muraasa .
   2. Muraasa
   3. Hedduu

   - ❖ Yeroo barbaadde hundatti ni argamuu? 1. Eeyyee 0. Lakkii
4. Qonni keessan daandii guddaa irraa kiloometira hangam fagaata? _____ .

5. Tajaajila kireesu tiraaktaraa fi kombaayinii harvester argachuuf rakkoon guddaan_____ dha.
    1. Rakkoo dhiyeessii
    2. Rakkoo gatii
    3. Rakkoo qaqqabummaa fi geejjibaa
    4. Hanqina odeeffannoo
    5. Dhiyeessiin yeroon kennamu dhabuu
    6. Kan biraa yoo jirate ibsi
6. Tajaajila qacarrii kadhannaa machinaa facasaa fi chemical bifuu argachuuf rakkoon guddaan_____ dha.
    1. Hanqinaa
    2. Rakkoo baasuui
    3. Rakkoo qaqqabummaa figeejjibaa
    4. Dhiyeessiin yeroon kennamu dhabuu
    5. Kan biraa ifteessi Rakkoo gatii
7. Naannoo keessanitti daldaltoonni tajaajila daldaltoota maashinoota qonnaa fi meeshaalee qonnaa jiruu?
    1. Eeyyee 0. Lakki
8. Tajaajila maashinarii fi meeshaalee qonnaa qophii daldaltootaatiin kireesan ?
    1. Eeyyee 0. Lakki
9. Daldala kireesa maashinoota qonnaa fi meeshaalee qonnaa keessatti gahee daldaltoonni qaban akkamitti ilaaltu?
    1. Barbaachisaa miti
    2. Hojii guutuu salphisi
    3. Tajaajilli gatii guddaa akka baasu taasisaa
    4. Kaannen biro yoo jirate ibsi
10. Jijjiirama qilleensaa hin eegamneen rakkachaa tajaajila maashinarii fi meeshaalee qonnaa kireesan?
    1. Eeyyee 0. Lakki

❖ Yoo eeyyee ta’e tajaajila kam, kireesan?

1. Qotuu
2. Lafa bulesuu
3. Facaasuu/dhaabbachu
4. Biifamuu
5. Sassaabuu
6. Geejjibaa
7. Kaan biro ibsi

11. Yoo tiraaktara kireefetan baasii meeqa kefelten? [baasii tiraaktaraa guyyaa ykn heektaara].
    1. Qophii lafaa _____
    2. Aramaa qulqullesu ___
    3. Sassaabuu_____
    4. Kan biroo ibsi_____
12. Ijoolleen keessan keessaa nama isin bakka bu'ee qonna itti fufuuf fedhii qabaa?
    1. Eeyyee
    2. Gonkumaa miti
    3. Yoo makaanaayizeeshinii fayyadame ta'uu danda'a
    4. Mirkanaa'aa miti

IV. Ibsa dhimmoota madaallii mataa qonnaan bultootaa wajjin walqabatan sadarkaa barbaachisummaa jijjiiramoota murtii walduraa duubaan

Mallattoo √ kaa'uudhaan murtoo qacarrii keessaniif sadarkaa barbaachisummaa wantoota armaan gadii madaalaa

Lakk.	**Wantoota**	**Sadarkaa barbaachisummaa isaa**				
		Barbaachisaa miti tasumaa	Barbaachisaa miti	Qaama bilisaa	Gariin maal barbaachisaa	Baay'ee barbaachisaa
1	Qulqullina maashinoota qonnaa Hojii					
2	Suphaa fi suphaa jiraachuu					
3	Qabxiilee haala qilleensaa-mirkanaa'uu dhabuu					

3	Gahee daldaltootaa					
4	Kaffaltii kiresan					
5	Tajaajilli yeroon argachuu dhiyeessitoota					
6	Yaadota waa'ee qonna kilaastara					
	Yaada ollaa' fi hubannoo irratti tajaajila technoloojii machinonota qonna saffisaan hojjechuu					
7	Baasii humna namaa					
8	Galii qonnaa					
9	Yaada waa'ee maashinii facaasaa fi biifamuu					

V. Gaaffilee waajjira qonnaa aanaa fi waldaa hojii gamtaa qonnaan bultootaa xiyyeeffannoo argataniif

1. Aanaan keessan operetera maashinarii fi meeshaalee qonnaa adda addaatiif carraa ni kennaa?
2. Aanaa keessan keessatti modella tiraaktaraa kam fa'aa?
3. Aanaa keessan keessatti midhaan kamtu baay'inaan misoomu?

4. Ilaalcha qonnaan bultoonni waldaalee hojii gamtaa qonnaan bultootaaf qaban akkamitti ilaaltan?
5. Haala tajaajila qacarrii aadaa maashinoota qonnaa fi meeshaalee qonnaa waldaa hojii gamtaa qonnaan bultootaa keessan keessatti akkamitti ilaaltu?
6. Haala tajaajila qacarrii aadaa maashinarii fi meeshaalee qonnaa aanaa keessan keessatti akkamitti ilaaltu?
7. Suphaa tiraaktaraa isaan jiran gamtaa waldaa hojii gamtaa Meekii Baatuu fi Boora Deenbel keessa jiraa?
8. Maashinarii fi meeshaalee qonnaa qaama dabalataa (spare parts) aanan achitti argamuun?
9. Qonnaan bultoonni gamtaa waldaa hojii gamtaa Meekii Baatuu fi Boora Deenbel irraa maashinoota qonnaa akka fayyadaman akkamitti hawwattu?
10. Aanaa keessanitti tiraaktarri meeqatu jira?
11. Fedhii qonnaan bulaa waldaa hojii gamtaa irraa tiraaktara qacaruuf qaban akkamiin ilaaltu?
12. Sirna qonnaa aadaa wajjin wal bira qabamee yoo ilaalamu qonnaan bultoonni maashinoota fi meeshaalee qonnaa akkaataa barbaadamuun kireeffaman fayyadamuun hangam oomishtummaa qabu?
13. Maashinoonni qonnaa gosa biyyee aanaa keessaniitiin kallattiin dhiibbaa akka qaban ni amantaa?

Appendix 3: Sampled targeted kebeles economic levels

No	Names of kebeles	Model farmer			Middle farmer			Poor farmer			Total
		M	F	T	M	F	T	M	F	T	
1	Walda Qalina	252	21	273	499	110	609	84	14	98	980
2	Derara Dalacha	268	16	284	474	128	602	82	16	98	984
3	Sera Wakale	176	14	190	204	16	220	104	58	162	572
4	Biliti Balwolda	129	9	138	199	16	215	33	32	65	418
5	Birbirsa Guda sabole	200	20	220	507	95	602	79	13	92	914

Appendix 4: Sampled targeted kebeles crops grown in the production

Crosstab							
Sampled Kebeles		types of crops grown in the production					Total
		Wheat	Teff	Maize	papaya	Vegetable	
Biliti Balewolde	Count	12	4	17	2	4	39
	%	30.8%	10.3 %	43.6%	5.1%	10.3%	100.0%
Darara Dalacha	Count	36	19	27	2	8	92
	%	39.1%	20.7 %	29.3%	2.2%	8.7%	100.0%
Sera Wakale	Count	18	11	18	0	7	54
	%	33.3%	20.4 %	33.3%	0.0%	13.0%	100.0%
Walda Qalina	Count	23	16	42	7	4	92
	%	25.0%	17.4 %	45.7%	7.6%	4.3%	100.0%
Birbirsa Guda Sabole	Count	24	15	30	0	3	86
	%	27.9%	17.4 %	34.9%	0 %	3.5 %	100.0%
Total	Count	115	66	135	11	26	363
	%	31.1%	17.9 %	36.9%	6.9%	7.2%	100.0%

Appendix 5: photo taken form targeted area during data collection

Figures 1; Appendix I John Deere tractor attached With disc plough in cooperative union

Figure 2 ;Appendix II New holland Tractor ploughing Darara Dalacha

Figure 3; Appendix III John Deere disc harrow Meki Batu cooperative union

Figure 4: Appendix IV New holland combine harvester

Figure 5; Appendix V Walky tractor and sheller Bora Denbel cooperative union

Figure 6; Appendix VI Focus group discussion directly with in staff