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Developing Generic Production - Distribution Business Model of Mechanized Agricultural Technology in West Gojjam.

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**Developing Generic Production - Distribution Business Model of
Mechanized Agricultural Technology in West Gojjam.**

A Thesis submitted to Bahir-Dar University, Bahir-Dar Institute of Technology, Bahir-Dar Ethiopia, Faculty of Mechanical and Industrial Engineering, in partial fulfillment for the award of the Degree of Master of Science in Industrial Engineering (Production Engineering and Management Stream).

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Developing Generic Production - Distribution Business Model of
Mechanized Agricultural Technology in West Gojjam

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DECLARATION

I hereby declare that the thesis presented herewith, entitled, “**Developing Generic Production - Distribution Business Model of Mechanized Agricultural Technology**” comprises my own work, has not been presented for a degree of any other university and all the resource of materials used for this thesis have been dually acknowledged. I understand that non-adherence to the principles of academic honesty and integrity, misrepresentation/fabrication of any idea/data/fact/source will constitute sufficient ground for disciplinary action by the university and can also evoke penal action from the sources which have not been properly cited or acknowledged.

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ABSTRACT

Mechanized technology is used to bring high agricultural productivity in the study areas. And even, it has a greater role in Ethiopian economy and useful for millions of our citizens. The majority of agricultural practices in Ethiopia haven't used mechanized agricultural technology which result in a lack of agricultural output and productivity for our smallholder farmers. Therefore, the problems such as lack of trainings, low purchasing power of the end-users, high price of the technology, inaccessibility of aftersales maintenance services, hire services , credit services, lack of skills for blacksmith/manufacturers/,poor quality of technology, inaccessibility of suppliers, distributors, maintenance work shops and finally, un supporting of infrastructure are the related identified factors that affected the farmers' use of mechanized technology in the study areas. The objective of this study was to investigate socio-economic, technical and distribution factors that affected the farmers' use of mechanized technology and also to develop a generic production-distribution business model of mechanized agricultural technology in West Gojjam, Amhara Regional State. In this thesis, it is used both quantitative and qualitative research methods, moreover, the qualitative data was used to triangulate the structure of the thesis body. The sampling technique, which was used in this thesis, is two-stage sampling technique which include both purposive and systematic sampling methods that can be used to select the representatives from west Gojjam zones and woredas, in Amhara Regional State. The data collection tools used in this thesis were self-administrated questionnaires, focused group discussions,

observation, and semi-structured interview questionnaires so as to address the basic objective of the thesis.

The generic production-distribution business model is a conceptual structure model that solved the problem of how to produce and distribute mechanized agricultural technology for the end users. Finally, unavailability of production and maintenance workshops, shortage of finance, low communication between farmers and DAs', and unavailability of distributors and suppliers were found to be the challenge of the farmers' use of mechanized technology in the study areas.

Keywords: Mechanized Agricultural Technology, Production and Distribution.

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LIST OF ABBREVIATIONS

AAMI:	Adama Agricultural. Machinery Industry.
ACI:	Amhara Credit Institute.
AMFSRC:	Amhara Mechanization and Food Science Research Center
AMIMTDE:	Amhara Metal Industry and Machine Technology Development Enterprise.
AMSE:	Agricultural Mechanization Service Enterprise)
ARAB:	Amhara Regional Agricultural Bureau.
ARARI:	Amhara Region Agricultural Research Institute.
ATA:	Agricultural Transformation Agency.
BBM:	Broad Board Metal.
BDU:	Bair-Dar University.
BoFED:	Bureau of Finance and Economic Development.
BoQ:	Bill of Quantity.
CSA:	Central Statistics Authority.
DA's:	Developmental Agents.
FAO:	Food and Agricultural Organization.
FDRE:	Federal Democracy of the Republic of Ethiopia.
FGD:	Focused Grouped Discussions.

IFPRI:	International Food Policy Research Institute.
JICA:	Japan International Cooperation Agency.
LB:	Load Balance.
MAT:	Mechanized Agricultural Technology.
METC:	Metal Engineering Technology Corporation.
ML:	Machine Load.
MPP:	Manufacturing Process Plan.
MSP:	Master Schedules Plan.
NGO's:	Non-Governmental Organizations.
PDD:	Product Design Document
PPC:	Production Planning and Controlling.
PR:	Purchasing Requisitions.
SPSS:	Statics Package Social Science Software.
SSA:	Sub-Saharan Africa.
TVET:	Technical and Vocational Education Training.
UNDP:	United Nation Development Program.
UNIDO:	United Nation International Development Organization.
WOP:	Work Order Plan

CHAPTER ONE

INTRODUCTION

1.1 Background and Justification

Agricultural mechanization technology can be defined as the application of mechanical technology to facilitate the effectiveness and productivity of human labor (FAO and UNIDO, 2008). This include different agricultural technologies which are engaged from land preparation up to the transportation process. Further defined, agricultural mechanization technology is used to help decrease in human drudgery, accomplish agricultural operation activities on time and finally reduce the number of labors who are involved in agricultural operation activities (FAO, 2005). Mechanized agricultural technology, according to the source of power, can be classified in to hand tools technology, which the source of power is human muscles, animal draughts technology, which the source of power is in animal muscles and mechanical power technology, which the source of power is mechanical power (Sims and Kienzle, 2006). From the definition point of view, mechanized agricultural technology has a great role in agricultural productivity in Ethiopia and useful for millions of our citizen. Due to inaccessibility aftersales maintenance services, hire services, credit services, low purchasing power of the end-users, no trainings are made, and high price of technology, poor quality of the technology reasons, the majority of agricultural practices in West Gojjame are not used mechanized agricultural technology by the end-users effectively as it is expected. And hence, it results in the lack of agricultural output and productivity for our smallholder farmers.

Until now, Ethiopians farmers' used a kind of tool known as 'Maresha', which is still used to cultivate more than 95 percent of the land for annual (Goe, 1987 and Ehret, 1997). Moreover, more than 85 percent of farming communities in Ethiopia have relied on hand tool and draught animal technology in agricultural production (FAO, 2012). And hence 15% of the rest of farming communities have no used even hand tools and animal draught technology. To overwhelm the above-mentioned challenges, modern types of agricultural mechanized technology must be manufactured and distributed for Ethiopian farmers from a local private or governmental manufacturing companies. Therefore, mechanized agricultural technology has made effective output for agricultural development (Muchiri, 1981). In recent years, some progress has been made for introducing and manufacturing different types of mechanized agricultural technology for the end-users by regional mechanization research centers such as BBM, tiredger, beehives, solar systems, animal draught carts, engine motor maize Sheller, rice huller, seed planter, butter churner and weedier (Kelemu, 2015). Therefore, promoting about mechanized agricultural technology should be made and encouraged for the end-users to use it effectively on the study areas. On the other side, many shreds of evidence showed that some agricultural operations such as seedbed preparation, planting, harvesting, threshing and water pumping can be done by using mechanized agricultural technology in some areas. So, it is necessary to replace mechanized agricultural technology with traditional methods to bring high agricultural productivity in the study areas. Therefore, so as to use mechanized agricultural technology effectively and efficiently in the study areas, there should be systems to link agricultural mechanized technology manufacturers, suppliers, and distributors with the end-users.

1.2 Problem Statement

The majority of the end-users have faced number of different problems to use mechanized agricultural technology effectively on agricultural operation activities. The main problems that influenced for success of using mechanization agricultural technology in the study areas includes low purchasing power of the end-users, inaccessibility of after-sales maintenance, hire and credit institute services, unavailability of supporting with infrastructure, unavailability of distributors, suppliers, production and maintenance workshops nearby and gape of technical skills for blacksmith/manufacturers. Beside this, there was a problem concerning about how to manufacture and distribute mechanized agricultural technology for the end-users even as a regional aspect. And finally, the regional agricultural bureau did not give great attention to mechanized agricultural technologies except only for seed and fertilizer technology (Kelemu, 2015). Thus are the problems that have greatly reduced for the advantageous use of mechanization agricultural technology for the end-users in the study areas. As a result, it has been particularly restrictive and limited to farmers from benefitting the most advantages of mechanization agricultural technology in West Gojjam, Amhara Regional State. Therefore, all these were problems that has been faced and affected the farmers' use of mechanized agricultural technology in the study areas.

1.3 Research Questions

The following research questions should answer the general objective of the thesis:

1. What are the socio-economics and technical factors that affected farmers' use of mechanized agricultural technology?
2. What are the distribution factors that affected farmers' use of mechanized agricultural technology?
3. What kind of a generic production-distribution business model of mechanized agricultural technology is developed?

1.4 Objective of the Study

1.4.1 General Objective

The general objective of this study is to investigate socio-economic, technical and distribution factors that affected the farmer's use of mechanized agricultural technology and to develop a generic business model for production and distribution of mechanized agricultural technology in West Gojjam, Amhara Regional State.

1.4.2 Specific Objective

- To identify the most demanded mechanized agricultural technology by the end-users.
- To examine socio-economic and technical factors that affected the farmers' use of mechanized agricultural technology.
- To identify factors that affected the distribution of mechanized agricultural technology for the end-users.
- To develop a generic business model for the production and distribution of mechanized agricultural technology.

1.5 Scope and Limitation of Study

The scope of the study is only focused to develop a generic production-distribution business model of mechanized agricultural technology in West Gojjam, Amhara Regional State. But it is limited to cover the whole Amhara Regional State, due to financial and time constraints. Moreover, it is unique of its type.

1.6 Significance of the Study

The study will help stakeholders and policymakers to use it as a source of data while they are preparing about mechanized agricultural technology programs and packages. So, the policy makers will benefit from the research output since they require some information to formulate policies and strategies about how to produce and distribute mechanized agricultural technology for the end-users. Moreover, this work tries to identify and show a generic production-distribution business model for those who are interested and involved to manufacture and distribute mechanized agricultural technology for the end-users in West Gojjam, Amhara Regional State. And finally, it can be used as a source of data for those who want to conduct further research which is related to this thesis.

1.7 Organization of the Thesis

The rest of this thesis is organized into five chapters. Chapter two presents reviews of related literature about mechanized agricultural technology in Ethiopia, in chapter three presents about the methodology that is used in the study, in chapter four presents about results and discussion of the collected data. And finally, in chapter five presents about conclusion and recommendation of the study.

CHAPTER TWO

REVIEWS OF RELATED LITERATURE

2.1 Background of Agricultural Mechanizations in Ethiopia

Agricultural mechanization technology is not new to Ethiopia since the federal republic of Ethiopia established a mechanized research center which was collaborated with UNDP project in 1984. The aim of this research center was to develop, hand tools technology, animal draught technology and mechanical power technology (Kelemu, 2015). But at a time of 2009, different agricultural mechanized technologies were developed by this research center such as moldboard plow, planter, weedier, harvester, storage structure, donkey cart, potato digger, tie rigger, groundnut sheller, and enset processing device (FAO, 2012). According to MoA discovered that the farm power in Ethiopia is calculated from those who have 13 million oxen (87%) and 12,500 tractors (13%) which is currently available. From this index, it can be concluded that till now, animal draught technology in agricultural operation activity is in practice in our country. Therefore, the most common agricultural mechanized technology utilized in Ethiopian agriculture is still animal-drawn technology for example plows. But power-driven mechanized agricultural technology utilization in Ethiopia is available in some large rural areas where farms are able to produce largely for crop-based agricultural activities. This allows for machinery to be used across smallholder farmers more economically. Because of mechanical power technologies are used effectively, especially in Oromia region, they are benefited by reducing high post-harvesting losses from food crops such as ‘tiff’, sorghum,

wheat, and maize are 12%, 9%, 14.8%, and 10.9% respectively (Ferris and Wheatley, 2001).

While there was a major aggravating system that push the farmers to use agricultural mechanization by African governments during past decades, but these are largely failed down due to lack of demand and promotion (Pingali et.al., 1987). So, from these points of view, in the study areas, promotion and demand study should be made to utilize agricultural mechanized technology effectively by all farmers. As a result, as a country, even agricultural economic growth and food security will be very high and stabled respectively.

2.2 The currently Issues of Agricultural Mechanization Technology in Ethiopia

The first idea of tractor assembling plant was generated from the former governor called the Derge regime but it was built and finished by the current government at 1992 in Adama town, which its name was AAMI. At 2010, all tractor assembling plant duties and tasks were transferred and managed by METEC which includes all the number of sister companies (kelemu, 2015). The main duties for tractor assembling plant which was built in Adama town is to assemble tractor spare parts which were coming from abroad for different horsepower engine. And finally, it was to manufacture water pumps and tractor spare parts having with different horsepower for agricultural operation activities. All products coming from the tractor assembling plant were distributed for farmer unions, state-owned enterprise and the government for agricultural activities, water irrigation, and construction as well as transportation purpose. And also this tractor assembling plant gave training about how to operate tractor too (MoA, 2014). The council of ministers issued under the regulation of

NO.97/2004 to establish AMSE in 2004 for the purpose of multiplying agricultural mechanization technology services which are focused on:

- ✓ Providing maintenance services on a rental basis for the end users.
- ✓ Sales mechanized agricultural technology with spare parts which are manufactured from local as well as abroad.
- ✓ Providing transportation services for agricultural end products and inputs.
- ✓ Providing promotion about the utilization of modern agricultural mechanized technology for the end-user.
- ✓ Providing rental services for smallholder farmers and finally,
- ✓ Providing training and consultation services for the end-users, particularly in wheat-based Arsi and Bale highlands (FDRE, 2004). ATA has also advocated mechanization for weeding, seeding, and threshing of 'tiff'. The study showed by ATA, farmers were using 'tiff' threshing machines to reduce post-harvest 'tiff' losses by 9-12%, valued at roughly \$87 per farmer (Ferris and Wheatley, 2001). However, the study also cautioned that due to lack of repair service in some localities, some previously purchased 'tiff' threshers were not currently in operation. Moreover, the Ethiopian agriculture machinery imports at 2003-2007 were 5,477 in numbers (FAOSTAT, 2012). From the total machine, seeder 15%, combine harvester 9%, milking machine 3%, manure spreader 6%, baler 2%, plows 21%, and agricultural tractors 44%. Whereas the Ethiopian agriculture machinery imported in value from 2001-2007 was total USD \$ 90 million. From this value, manure distributor 1%, seeder 2%, baler 1%, plows 2%, combine harvester 19% and agricultural tractors 75%. But, farming communities in Ethiopia have still relied on human and draught animal technology in agricultural production activities (FAO,

2005). Many Ethiopian farmers still used a traditional “Maresha” plow for preparing and weeding land due to this reason some argue that the use of mechanized agricultural technology by the end-user still now is not sufficient.

A number of studies suggested that it is improved, but still, it is non-mechanized, and livestock implements might improve labor productivity among Ethiopian farmers (Alem, 2018). These implements included livestock powered ridge tiers, inter-row weeders, improved plows, and winged plows. Finally, AMFSRC included both food and mechanization science in together for long period of time since it is difficult to manage the two big streams together, as result, it needs to transfer human resource workers staff and food science branch for ARARI as well as mechanization science with the technical and administration workers staff are transferred into the new established manufacturing company called AMIMTDE. It is a governmental enterprise which is focused on designing and manufacturing of mechanized agricultural technology and others metallic technology products. Mechanized agricultural technology is manufactured in this company according to the demand of the RAB and other respective customers but AMIMTDE is now at investment phase which was started in 2015.

2.3 Strategy for Agricultural Mechanization Technology

Strategic is the main plane that needs to be revised to see the detail problems that affects the farmer’s use of MAT in the new existing circumstance. To analyze the existing technical factors that affect the farmers’ use of MAT, the following main agents should be included:

- Local manufacturers.

- Local assemblers.
- Importers and finally
- End users.

The above-mentioned agents will show the problem statement for formulating of the best strategic plan about mechanized agricultural technology usage for the end-users. Factors that affected the farmers' use of mechanized agricultural technology needs to differentiate and take the analysis on the problem in the case of policy issues. And finally, the type of constraints will be distinguished. So as to cancel out the problem happened in the study areas, there should be working on together with officials from the Ministry of Agriculture, other cooperatives and related Ministries. As a result, discussion with them will be solved about the implication of political measures on farmers' use of agricultural mechanization technology and agricultural production too. These general activities consist of policy adjustments to amend mistakes which is happened in farm mechanization usage. All interested and involved members and stakeholders should be included in the use of mechanized agricultural technology too.

Thus are:

- ❖ End users
- ❖ Retailers and Wholesalers
- ❖ Manufacturers
- ❖ Sprayers and
- ❖ Government

So, if the problem of strategy is solved, as a result, the farmers can use MAT effectively and efficiently on their farmland and then, the economic development as a country can be brought. Moreover, the retailers should have access to supply MAT from wholesalers and small manufacturer (village shop or artesian). And large –

scale manufacturer should have regular access to supply MAT on time for wholesalers and the wholesalers should supply MAT for retailers. As a result, the end-user will be satisfied and the majority of the farmers will be the user of MAT on their land.

Therefore, if one of the above-included members are not working together with each other, finally the whole members will be adversely affected. That means the end-user will never be satisfied. But most of the time, the above member of collaborators will be totally collapsed, especially in developing countries. Therefore, the main objective of mechanized agricultural technology strategic plan is to ensure and fix the above mentioned agents of relations or linkage not to be isolated forever. The role of government is to define a suitable policy environment as well as provide supporting activities in order to create these linking conditions be stabled (FAO, 2000). The current Ethiopian government has got better attention and emphasis on the agricultural sectors. Due to the overall economic development depending on the performance of these agricultural sectors, the government should put a clear agricultural development strategy which is focused on enhancing technology generation and used by smallholder farmers to close the productivity gap in major crops (Clarke, 2000). However, in the study areas that have been observed and indicated that agricultural mechanization was not given equal attention as like as improved seed and fertilizer technology. So, in the country, there was no clear agricultural mechanization technology strategy until the recent draft developed by ATA and MoA because of the above members are not working together. Which it leads the majority of our farmers are not benefited from the MAT. Because they still used primitive technology called 'Maresha'. Mechanization strategic plan is a comprehensive document that can put different agricultural mechanization technology options for different farm sizes. Therefore, the strategic plan for

mechanized agricultural technology should be formulated and included from designing machinery, productions of machineries, importing machineries/spare parts, assembling, distribution, after-sale maintenance and hiring services up to the farmers to use MAT effectively by the end-users.

2.4 Mechanized Agriculture Technology Importation and Distribution Trends from other Countries

There are different methods for which mechanized agricultural technology is imported and distributed according to fig-1 shown below. Some of these ways are more successful and sustainable than others. The following options are in practice:

- ❖ Specialist private importers of agricultural machinery

Thus are kind of importer companies that have a license to sell and import especially limited types of brand. All this kind of companies obtained their license from farm machinery manufacturer. Therefore, not only such kind of companies is established and located in the capital city, but also their branches are located near to major city and town so as to facilitate and get their markets easily. Moreover, they have also traditionally licensed from the major western agricultural machinery manufacturer. In SSA market, sales of major items of equipment such as tractors and combiners remain almost very low due to this reason, the licensed companies want to change their aim to supply other brands and types of equipment rather than agricultural types of machinery from manufacturers. The countries like Asia and Latin America want to involve such kinds of marketing activities.

- ❖ Occasional private Importers

They are kind of general traders that can import batch types of machinery including farm machinery but they don't have any experience and knowledge about farm

machinery. Moreover, such kind of importer companies are not forced to supply any spare parts and services for the end-user when they sold their equipment's. And also such kind of companies bring a batch type of machinery from different manufacturers.

Unfortunately, when the farmers are purchasing farm machinery from this kind of companies, really that they will face a problem about its functionalities of the technology and spare parts as well as difficult to get different services from such kind of companies. Because there is no obligation to obtain spare parts and different services from such companies.

❖ State Institutions

It is a governmental company that can import a batch of farm type of machinery. But as like as private imports, the farm type of machineries are not distributed to local distributors as a result, spare parts and different services are not obtained easily. But the price of this farm machinery is very cheap enough that can purchase any farmers from them easily. Whereas it is very difficult to get spare parts and other services for farmers and finally, the operating time for farm type of machineries become too short and it tends to expense more money to repair it which is more than the farmers purchased as new farm type of machineries. Most of the African countries enable to establish a tractor assembly plant with a misguided concept by thinking to promote farm type of machinery for their farmers or to supply the farm machineries by low cost.

❖ Donations of Agricultural Machinery

Different countries are very interested to donate farm type of machineries for those countries that they want to get from them and also all type of machineries are manufactured from them too. So, such type of machineries are donated more in

numbers in African countries. Most of the time, the donated farm type of machineries aren't compatible with those machines which are obtained from the existing markets. Due to unavailability of spare parts and other services such as maintenance and hire service, the donated farm type of machineries become "Orphan" which means that the farm machines are once breaking down, it can't be repaired easily. This kind of situations is happening in many developing countries.

❖ Direct Importation

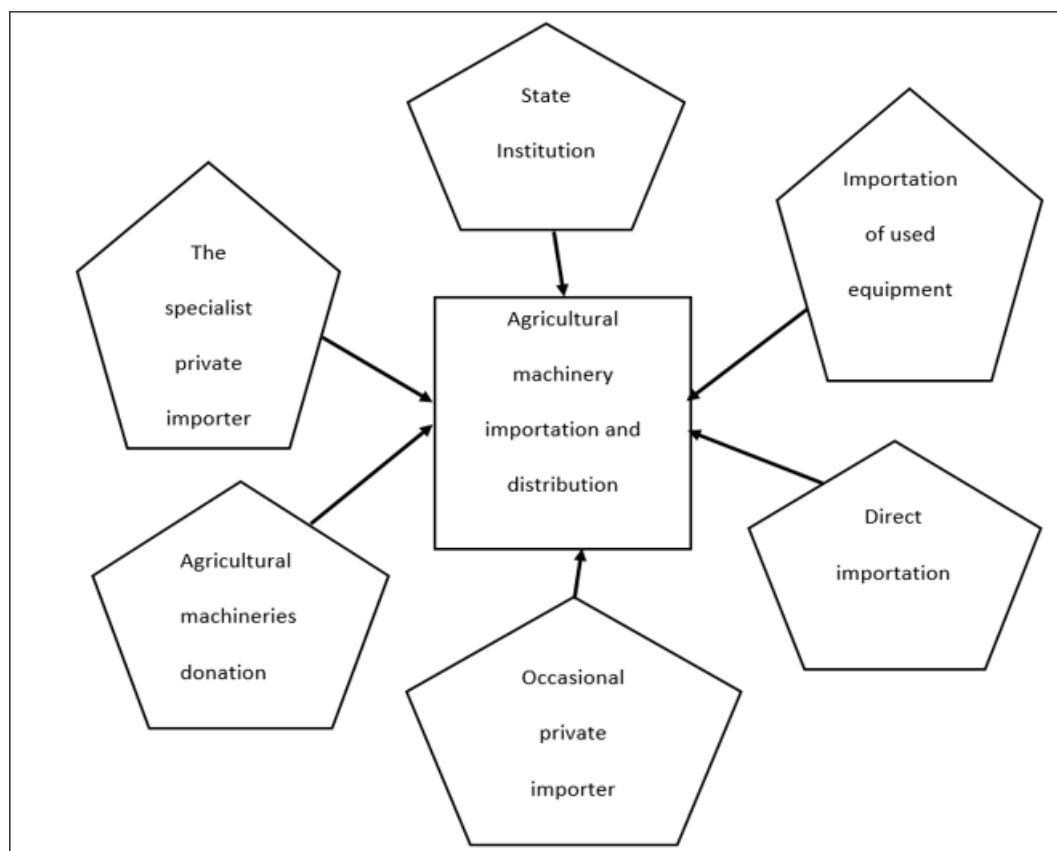
It is used for only large - scale farmers' union and Agro-industrial companies. If the companies or unions are very interested to get farm type of machineries at low cost, they can purchase what they want to import directly from abroad, according to their choices. As a result, they can get full of resources about spare parts and different maintenance service activity which is very important for their farm type of machineries. And also they can stock more resource type of machineries to work with it for a long period of time. Therefore, direct importation is a great solution to use farm type of machineries for a long period of time without getting any failures happened on it.

❖ Importation of Used Equipment

When the farm type of machineries are expensive, the farmers can't afford to purchase a new type of machinery. But in practice, used equipment is not beneficial for farmers due to the importer don't always provide additional services such as repairs and provision of spare parts. Moreover, such systems need the availability of highly skilled manpower with low cost paid unless or otherwise, the failures for farm types of machinery will happen during operation time (FAO, 2013d).

Figure 1 Summary of Agricultural Machinery Importation and Distribution Trends

From Others Countries. Source: FAO2013d



2.5 Supply Chain of Mechanized Agricultural Technology

Problems are happened that need to be distinguished during the supply chain of MAT. If there will be a great problem existing during supply chain activities, then the problem may be for governmental policy during supply chain systems. After identifying and recognizing the effect of the governmental policy, there should be a

form which is very important and helpful for strategy formulation purpose to eliminate the problem happened on the side of government. Subsidies effect for both direct and indirect for government and private sector's activity need great attention and intervention to cancel out the problem which is happened during their relations.

Moreover, government activities such as education, extension, training, credit, research, and development, as well as any external intervention should be known to identify the problem happened in this areas. Therefore, it is important that the existing supply chain system problem should be clearly identified and analyzed by collecting data about the manufacturer, importer, and artisanal, national, regional, and local distribution. After analyzed the collected data from the above agents, it will lead to understand the constraints faced by different companies, individuals and organization which are engaged in the supply chain of MAT. The government should support the supply chain of the MAT by creating an enabling environment for private sectors to continue and satisfy the demand of farmers about the MAT (Clarke, 2000). This implies that farmers who are willing and able to use any MAT more efficiently may obtain their own demand from the private supply chain, a potentially important consideration for government distribution programs to take into account (Takeshima et.al., 2014). Moreover, supply chains providing support to owners of MAT with spare parts, advice, after-sales maintenance and hiring services, but most of the time, thus services are often weak by considering that it may not easily reach very remote rural areas.

2.6 Production of Mechanized Agricultural Technology

There are different countries including Ethiopia that can manufacture farm hand tools and appropriate farm implements which are used from pre harvesting up to post-

harvesting agricultural activities. The manufacturing types that are used in different countries are different, but Ethiopia is used the simplest method to produce and maintain the farmhand tools mostly by smith black operators. And it is available everywhere and equipped with a simple and easy type of tools.

Whereas other developed countries used especial purpose of manufacturing facilities to produce and maintain the farm types of machinery easily. But the industries, which are engaged to manufacture farm types of machinery, aren't always sustainable. Since there is a lack of suppliers of proper raw material, the demand is dynamically changed, the quality of the issue of the product is low and finally ordering of over mass production are always faced especially for private industry sectors. Now a day, there are different manufacturers are available, thus are:

❖ State-owned and operated companies:

Which is established by the government for such purpose.

❖ Private industry enterprises:

Which are established as an enterprise by a private group.

❖ Informal smith black:

Which is established by any individual person everywhere, which is equipped with simple tools (Sims, Hilmi, and Kienzle, 2016).

But private industry enterprises have become an important element of manufacturing mechanization agricultural technology that can work effectively even in different countries region (Shetto, 2005). They can largely fabricate implement and post-harvest equipment which includes maize hulling and milling, shelling, rice threshing, coffee pulping, cassava grating, chipping and oil expelling machines based on prototypes but the design should be obtained from local universities or research institutes. Other types of tractor-drawn implement and threshing machines

are commonly manufactured in a number of African countries including Ethiopia (Tokida, 2011). But in the Amhara regional state, mechanization agricultural research centers and informal and formal artisan levels are available.

In many case where mechanization agricultural technology has made a positive contribution to agricultural development in agricultural sectors and it has been by chance but not by design (Muchiri, 1981). In others country point of views, the development of agricultural mechanization and the farm machinery manufacturing industry in China has made significant contributions to the transformation of the country's traditional farming in modern agriculture (Stavis, 1978). From this point of view, if we have number of significant private manufacturing workshops and quality design of mechanized agricultural technology, it can be satisfied the demand of the farmers throughout our country.

2.7 Availability of Maintenance and Repair Services

The general concept about maintenance and repair of the hand tool of mechanized agricultural technology is not a problem. Because it is made at a local level by small and medium workshops as well as in the informal sector is known as a blacksmith. However, such micro-enterprises are confronted with the same problems that other private sectors have to face. The problem being happened is the access to get training and updates on new knowledge which is required to improve their service for maintenance and repair activities. Repair and maintenance are also provided by part retailers that are often small-scale businessmen that can be important source of business income to them (Takeshima et.al, 2014). In terms of spare part, the manufacturing process has been improved in some countries by keeping standardization for different tools of mechanized agricultural technology. However, many problem for any mechanical power-driven mechanized technology

are still remaining. This is due to poor maintenance activity and a critical lack of spare part. This situation leads to be becoming a great failure to use the full capacity of the equipment for a long time.

For years ago, great attention was given to the public sector that needs to develop agricultural mechanization maintenance and repair for agricultural equipment and farm types of machinery (Sims, Hilmi, and Kienzle, 2016). This includes farm system maintenance and administration, including proper selection, application and maintenance/repair of equipment (Mijinyawa and Kisaiku, 2006). Moreover, aid agencies such as JICA and tractor manufacturing companies have focused on training programs for tractor owners, operators, and mechanics that will be important for improving operating efficiency for the end-users (JICA, 2014). In general, the maintenance and repair services were not successful as intended because of most ideas concerning about maintenance and repair services have failed down. So, maintenance and repair of farm types of machinery are now still under discussions.

2.8 Availability of Hire Services

There are different countries that have used the concept of hire services about farm type of machinery for their farmers to make and get high agricultural productivities in their countries. But so as to do a better hire service about farm types of machinery for their farmers , different problems are faced to proceed it easily such as lack of finances, how to maximize profit, lack of market access, lack of demand and lack of how to run as an enterprise are the problem about hire a services (Hilmi, 2013). For example: In Nigeria (IFRI, 2015b), different market and social limitation hinder the effective use of hire services. But there are different operation activities that can be

covered through hire service such as threshing, transporting, shelling, animal draught and etc.

So as to sustain and use mechanized agricultural technology effectively on the study areas, there should be a hiring service in the market that includes medium and large scale tractor owning farmers to provide hire service for small scale farmers (IFPRI, 2015d). This idea was very important to cover the cost of the tractors by giving hire service for those farmers that can't afford to buy such tractors. But such idea is still not stable for the following reasons such as break down the machines, unavailability of subsidies by the government to keep the hire service running, the farmers can't afford hire charges, long-distance for traveling of hire types of machinery and etc... During the 1960s several countries established a public sector that run hire service of farm types of machinery. These experience showed that public sector tractor hire services are generally not sustainable if they are not working together with the government and the private sector as partnerships (Sims, Hilmi, and Kienzle, 2016). In Ethiopia as like as Uganda mechanization policy, the private sector has mainly been involved in the provision of hire services on some study areas example, in bure zuria woreda used a private tractor hiring services. Mostly tractor owners have spare capacity and hire out their machines to generate income and to assist in covering costs. And hence, small and medium-scale farmers have limited access and/or capability to purchase new machinery and are heavily dependent on hire service from the large scale estate farms (MAAIF, 2005). But to solve the above problem of hire services, FAO has conducted on hire service training on agricultural products to meet the demand satisfies besides the technical skill training for conservation agricultural equipment in East Africa.

2.9 Manufacturers, Importers, and Distributors of Mechanized Technology

The farmers should be satisfied by providing farm types of machinery with their demand at sustainable price. But special attention should be given for importers, manufacturers, and distributors that how that they can get a benefit from the government. Such commercial units should require a stable and competitive environment to develop their business constantly. Therefore, the following enabling environmental condition should be created by the government such as:

- ✓ Stable market to sell their products.
- ✓ Access to get foreign exchanges.
- ✓ Fair competitive markets and
- ✓ Access to get credit to make their business easily.

Not only this but also the manufacturers require and get an accessibility

- ✓ To get a stable supply of raw materials at stable price.
- ✓ To get market information.
- ✓ To get and supported by research and development activities and finally,
- ✓ To get some times a production engineer to get a consultation.

Moreover, the government, especially for farm types of machinery and tool, should make free from any tax as well as the importers should be allowed to get free access to the market. If all the above environmental conditions are full filed, then the farmers can get and satisfy the demand of farm types of machinery everywhere. Finally, it creates a domestic manufacturing industry that can be focused and aggravated to manufacture mechanized agricultural technology with quality,

functional and the end products will be provided by the manufacturing industries with competitive and fair price at the market (Sims, Hilmi, and Kienzle, 2016).

2.10 Agricultural Mechanization Technology Practices in Amhara Region

In Amhara region, like other Ethiopian regions, the first agricultural research center was established with the name of Bahir-Dar rural technology promotion center in 1985. The aim of this center is to manufacture a prototype, promote and multiply the effective mechanized agricultural technology for farmers. And this center started to add additional ideas of research and development centers to make it an effective center about the mechanized agricultural technology in 1996 (Kelemu, 2015). Moreover, this center again needs to establish and include the field of food science. And finally, it was named as Bahir-Dar mechanization and food science research center at 2007/8. According to observation in the study areas that were still faced problem by the farmers were: lack of mechanized technology which is used for pre harvesting operation activities, post-harvesting operation activities, fetching water from the cliff for cultivation purpose and sowing operation activities. Since the majority of the end-users are still used in primitive farming practices. So, to eliminate the above problems by using mechanized agricultural technology, the research center tried its best by designing and manufacturing different types of mechanized agricultural technology in the workshop and finally, the prototypes as well as the imported types of mechanized agricultural technology, were distributed to different Amhara regional state including in the study areas. Purposefully, bahir-dar research center conducted a field assessment study by its experts to collect data whether the distributed mechanized agricultural technology in different areas are working or not. And hence, this field assessment study was conducted in 2014 and the data obtained from this study result will be discussed to some extent to show what it seems like

about mechanized agricultural technology practice in Amara regional state, in the following ways:

1. Seed cleaner: Which clean seed 1-20 quintals per hour in which the seed property depends on the variety and impurity.

Total 43 numbers of seed cleaner were distributed throughout Amhara regional zones and woredas. But many numbers of seed cleaner were coming from abroad. As a result, the field assessment study revealed out that there weren't any machinery that can be functional in the distributed area due to improper operation and poor handling system.

2. Thresher: it is a farm machine which is used for separating wheat, peas, soybeans, small grain and seed crops from their chaff and straw. The distributed threshers machinery were 7 in type and 43 in numbers of thresher machinery were distributed on different Amhara regional zones and woredas. According to the team reported that all thus types of machinery thresh 66,360 to 114,240 quintal per year when all the distributed types of machinery were functional. But all these types of machinery were not functional because according to the team report said that there were poor handling system that were observed in the distribution area.

3. Maize Sheller: it is a motor -held device or a piece of machinery to shell corn kernels off the cob for feeding to livestock or for other uses. The distributed maize Shellers machinery were 7 in numbers. Half numbers of machinery were made by the research center and the rest of the others were coming from abroad. The field assessment study committee revealed out that no maize Sheller's were working on the distributed area because of poor handling management systems.

According to the view of the team said that if all distributed maize Shellers type of machinery were working on the distributed area about 80,220 to 163,380 quintal per year can be shelled.

4. Rice huller: A rice huller or rice husker is an agricultural machine used to automate the process of removing the chaff (the outer husks) of grains of rice. It is very important in Fogera woreda. There were three type of rice hullers machinery were distributed specifically on this woreda.

The field assessment study committee revealed out that none of the types of machinery were working in the distributed area because of inappropriate operation and handling systems that were observed in the areas. Others mechanized technologies, which were designed and manufactured on the research center were distributed for the end-users such as BBM, Tie rigger, Butter churner, Manual baler, Animal driven cart, Man-driven 'tiff' and fertilizer sowing machine, 'Moffer' attached wheat seed, fertilizer sowing machines, 'Degussa' flail machine and Beehives. All the above-mentioned types of mechanized technologies were the property for Amhara agricultural research center. Even though the research center was playing a vital role to promote mechanized agricultural technology in Amara region, still most of farmers are using a primitive traditional system in the study areas. The prototype of mechanized agricultural technologies that were designing, manufacturing and distributing for different Amara regions, because of different reasons, don't bring any change in the life of farmers as well as agricultural productivities including in the study areas. During my observation on the study areas, there were large numbers of BBM, two-wheel tractors, maize Sheller and rope pumps that were not working properly due to the following reasons:

1. There is no maintenance service when the failure is happened to the machines.
2. Lack of awareness and knowledge about how to operate and handle the machines.
3. Lack of maintenance and operation manual for farm types of machinery which is written in the Amharic language.
4. There is no responsible person who manages and handles the machines easily.

All these were overall practices of the end users about the use of mechanized agricultural technology in different districts and woredas in Amara Regional State. Therefore, this thesis will address mechanized agricultural technology for the end users through a generic production-distribution business model.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Description of the Study Areas

3.1.1 Locations

Amhara National Regional State covers a total area of 152.6 thousand km² (BoFED, 2008). The total population's number of this region is estimated to be 17.21 million of which 15 and 2.21 million people live in rural and urban areas respectively (FDREPCC, 2008). The regional state is currently structured under 10 administrative zones, 138 woredas, and 22 town administrations. The study was conducted in West Gojjam zuriea woreda at which the agricultural offices are located near to bure, danegla, and bahir-dar zuriea woreda town. Bure, danegela and bahir-dar zuriea woreda town are far distant from Addis Ababa by 414 Km, 485.2 km and 556.6 km respectively. And also all the above-mentioned zuriea woredas towns include 45 rural kebeles. But from 45 rural kebele, the research was conducted only for 7 kebele which are far distance from zuriea woreda towns by minimum and maximum of 5 and 9km which needs to travel by car and foot to reach on the study areas.

3.3.2 Population Distributions

Based on agricultural extension agents data reported that those who are living in bahir-dar zuriea woreda kebele has a total number of 35,860, from the total number,

20,500 are men and 15,360 are women. Whereas bure zuriea woreda kebel has a total number of populations are 24,450 from the total number, 18,400 are men and 6,004 are women.

And finally, danegla zuriea woreda kebel has a total number of populations are 19,556 of whom 14,350 are men and 5,216 are women. The total number of the three selected zuriea woreda kebel populations are 79,866.

3.2 Research Design

This study used quantitative research which was more supported by qualitative research design. The quantitative approaches were applied to analyze data obtained through the survey method which was conducted with sample households in order to identify socio-demographic, socio-economics, technical and distribution characteristics in the study areas. Moreover qualitative data was used to triangulate the research data analysis.

3.3 Sampling Techniques

The two-stage sampling methods, which are purposive and systematic sampling methods, were used to select the representatives. The first step is: West Gojjam Zone was selected by a systematic sampling methods. And then from West Gojjame Zone, three districts are selected by purposefully based on its representative zones in Amhara regional state for which they are considered to be the user of agricultural mechanized technology which includes burea zuriea woreda that has three kebel, dangela zuriea woreda, which includes two kebel and bahir-dar zuriea woreda, which includes again two kebeles. Therefore, there are seven total number of kebeles were selected so as to conduct the research thoroughly, thus are: zalema, wadera, denbun from burea zuriea woreda, dageshita and abedere from danegela

zuriea woreda and finally, robit-bata and gonebat from bahir-dar zuriea woreda. All seven kebel were selected based on the accessibility of using different agricultural mechanization technology in the study areas.

The second step is: from zuriea woreda towns such as agricultural officers, producers and extension development agents were selected as key informants. The total number of the key informants were 30 in number and also from the farmers (in the area of the selected kebeles), 100 of respondents were selected. Finally, a total of 130 valid respondents were selected for this research study purpose.

3.4 Sampling and Sample Size Determination

The number of populations to be selected from the target population constitute a sample size or participant of the research. The researcher intentionally selects the participants that he thinks that can produce information on the topic under research (Leedy&Ormrod, 2010). Moreover, the researcher selects information-rich case for the research in-depth without the need to generalize it to all the other similar cases. So from these points of view, the researcher selected different kebeles purposefully which were based on household heads that contribute to mechanized technology implements. Therefore, the total household heads for each selected sample kebeles were: zalema 1060, wadera 1100, denebun 960, abadere 850, dageshita 1065, robot-bata 1250, and gone-bat 855, the total number of households from the seven kebeles was 7140. So, the sample size of the respondents was determined by using a simplified formula (Tailor, 1993) in the following ways:

$$n = \frac{N}{1+N(e^2)}, \text{ Where } n = \text{the number of sample size}$$

N = the total number of the population

e = Precision level,

Assume that the precision level was taken as 10% and the total number of the households from the three selected zuriea woreda kebels was 7140.

So, the sample size can be calculated in the following formula as follows:

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

$$n = \frac{7140}{1+7140(0.1)^2}$$

$$n = 98+2 = \underline{\underline{100}}$$

From the total number of the households, 98 respondents were selected by using the above formula. In addition to this, 2 respondents were added to compensate for the dropout rate of the sample respondents. The number of household heads from each kebele was determined by a systematic sampling method. Which is considering and including that the farmers, who were using mechanized agricultural technology in the study areas, were firstly selected. The number of household heads from each selected kebeles in the above data were based on the information of DA's data. From the table -1 given below, the sampling size calculation was clearly obtained and stated in detail for each kebele. The number of household heads from each kebele was determined the sample size as follows: from zalema 16, wadera 15, denebun 13, dageshita 12, abadere 15, robot-bata 17 and gone-bat 12 and finally, the total number of the sample size of household heads were 100. This sample size respondents were directly conducted for this research purpose.

Table 1 Sample Size Determination for all Kebeles

No	Name of Kebeles	Numbers of Household	Sample Size
1.	Zalema	1060	16
2.	Wadera	1100	15
3.	Denbun	960	13
4.	Dageshita	850	12
5.	Abader	1065	15
6.	Robet Bata	1250	17
7.	Gonebat	855	12
	Total	7140	100

3.5 Data Tool, Source and Approaches

The data collection instruments were structural and semi-structural questionnaires, focused group discussions, observation, and interviews. Thus were prepared so as to address the basic objective of this research questions. The source of data is primary and secondary data. Primary data was collected from the targeted population of zuriea worda agricultural officers, rural agricultural development extension agents, private producers and farmers themselves but this primary data was qualitative or quantitative form. Secondary data was collected from bahir-dar mechanization and food science research center and ARIRA documents and reports, international and national best mechanized agricultural technology trends, zuriea worda agricultural offices and DAs report, newspaper of the regional agricultural bureau and online searches. And

also different questionnaires were given to the respective respondents by giving adequate orientation about the purpose and how to fill it. And finally, all the questionnaires were changed into Amharic language to make easily understand by the respective respondents in the study areas.

3.6 Data Collection Procedures

While conducting the research, the following steps were followed to solve the research questions.

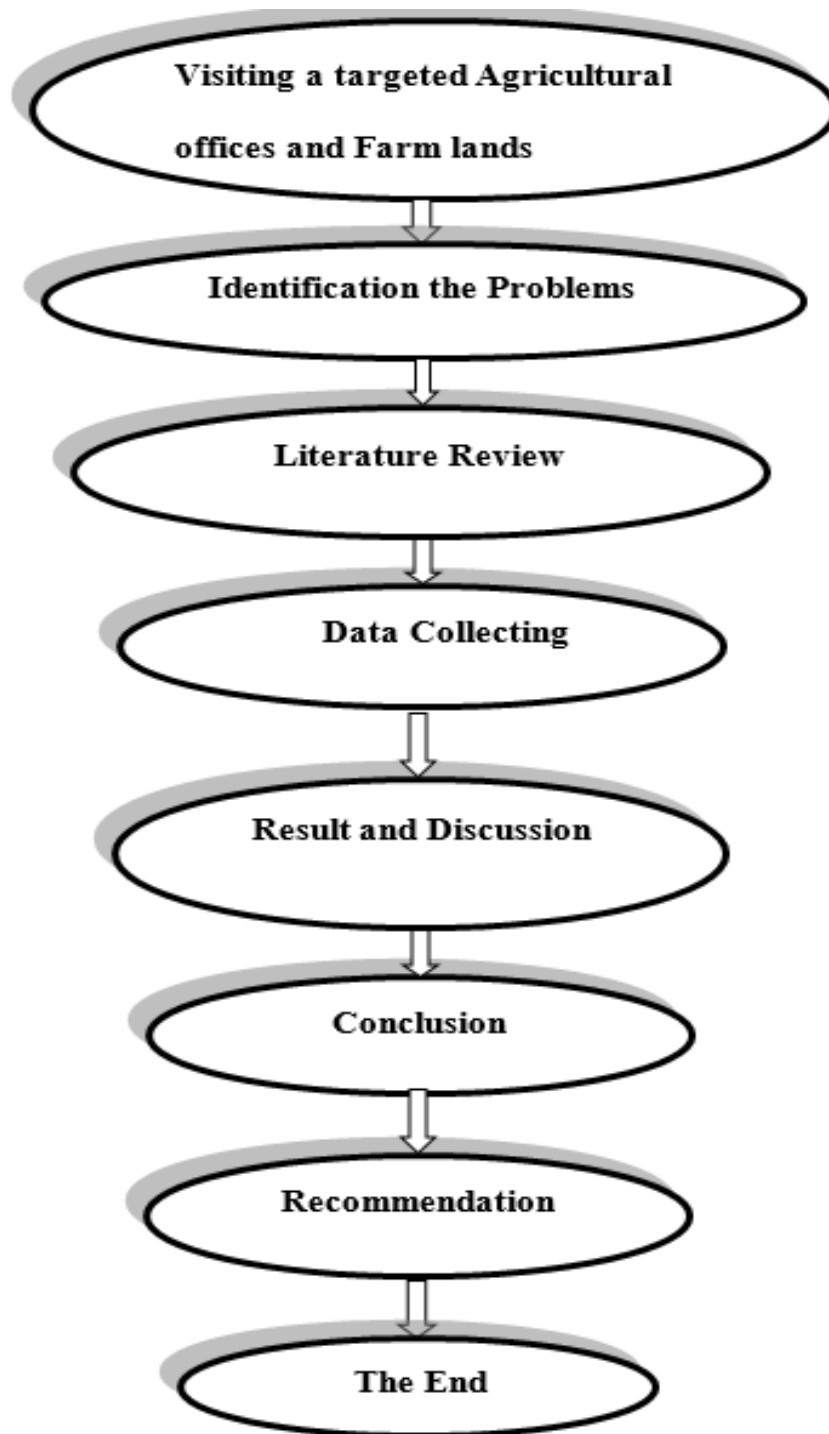


Figure 2 Research Flow Chart Methodology

3.7 Reliability and Validity of Data

Cronbach alpha is one of the effective tool which is used to test the internal consistency of data. It describes the extent to which all the items in a test measure the same concept or construct and hence it is connected the interrelatedness of the items within the test. It should be determined before a test can be employed for research to ensure validity. It is the most commonly used for multiple liquid questions in survey or questionnaires that form a scale that needs to determine the scale is reliable or not. It is a measure of internal consistency that shows how closely related a set of items are as a group and it is considered to be measurable of scale reliability. It can be expressed in numbers between 0 and 1. According to the above points of view, in this paper, the Cronbach alpha value is 0.701 which is acceptable since alpha of 0.7 is usually required to be deemed and reliable (Werhahn & Brettel, 2012). And also, this generic production-distribution business model is a conceptual structural model type. But, the correlation tools showed that all the dependent and independent variables are positively correlated to each other. As a result, some positive variables are included on this model as shown in table11. Moreover, the correlation tool showed that the relation between the variables are more significantly correlated at different P-values. So, it can be said that the data is internally validated to solve the problem faced in the study areas. Finally, during observation, in bahir-dar town, there is a local governmental manufacturing company or an enterprise (AMIMTDE), which its production line system is looks like similar with this developed generic production-distribution business model, which indicated that the generic business model is externally validated.

3.8 Variables of the Study

3.8.1 Dependent Variables

It is a type of variable which is depends on the other factors. Mechanized agricultural technology helps the farmers to increase their agricultural productivities on the study areas. Therefore, Farmers' use of mechanized agricultural technology is the dependent variable.

3.8.2 Independent Variables

It is variable that stands on alone and that can't change with other adding factors. In this study, there are many variables that considered as independent variables. Thus variables are: Scio-demographic variables (such as , sex, educational background and farm experience), Scio- economic variables (such as family size, farm land size and access of services), technical variables (such as quality , ergonomics, pretest, training and promotion) and distribution variables (such as demand, proxy distance, infrastructure and price).

3.9 Data Processing and Analysis Methods

The researcher used quantitative data which was supported with qualitative data for this research purpose. So that the collected data were analyzed in different ways. And hence this data needs to analyze based on the objective of this thesis. The raw data, which was obtained through different questionnaires, was checked, arranged and organized in different forms according to its characteristics. The questionnaires were coded and analyzed by using SPSS. Therefore, two type of analysis tool were used to address the basic objective of the thesis. Thus analysis tools were descriptive statistics and correlation.

Moreover, frequency, percentage, mean, average mean and standard deviations were presented to show the level of agreement of the respondents. The answer of the respondents for different variable question was measured on Five-Point Likert Scale which is referred to 1= strongly disagree (SD), 2= disagree (D), 3= undecided (U), 4= agree (A) and 5= strongly agree (SA). Moreover, to make the interpretation to be clear and easily understood, the following formula is used as reference to get the mean value which means that $(N (SA)*5) + N (A)*4 + N (U)*3 + N (D)*2 + N (SD)*1 / n$ (Kothari, 1978). Where N= the number of actual frequency and n= the numbers of sample size.

If the items of the mean value are between the range of 4.5-5, then it can be considered as strongly agree, and the same is true for next range of 3.5-4.49 are taken as agree, 2.5-3.49 are taken as undecided, 1.5-2.49 are taken as disagree and finally 1-1.49 are taken as strongly disagree. Moreover, the researcher used qualitative data to triangulate the structure of this research study effectively.

3.10 Conceptual Framework of the Study

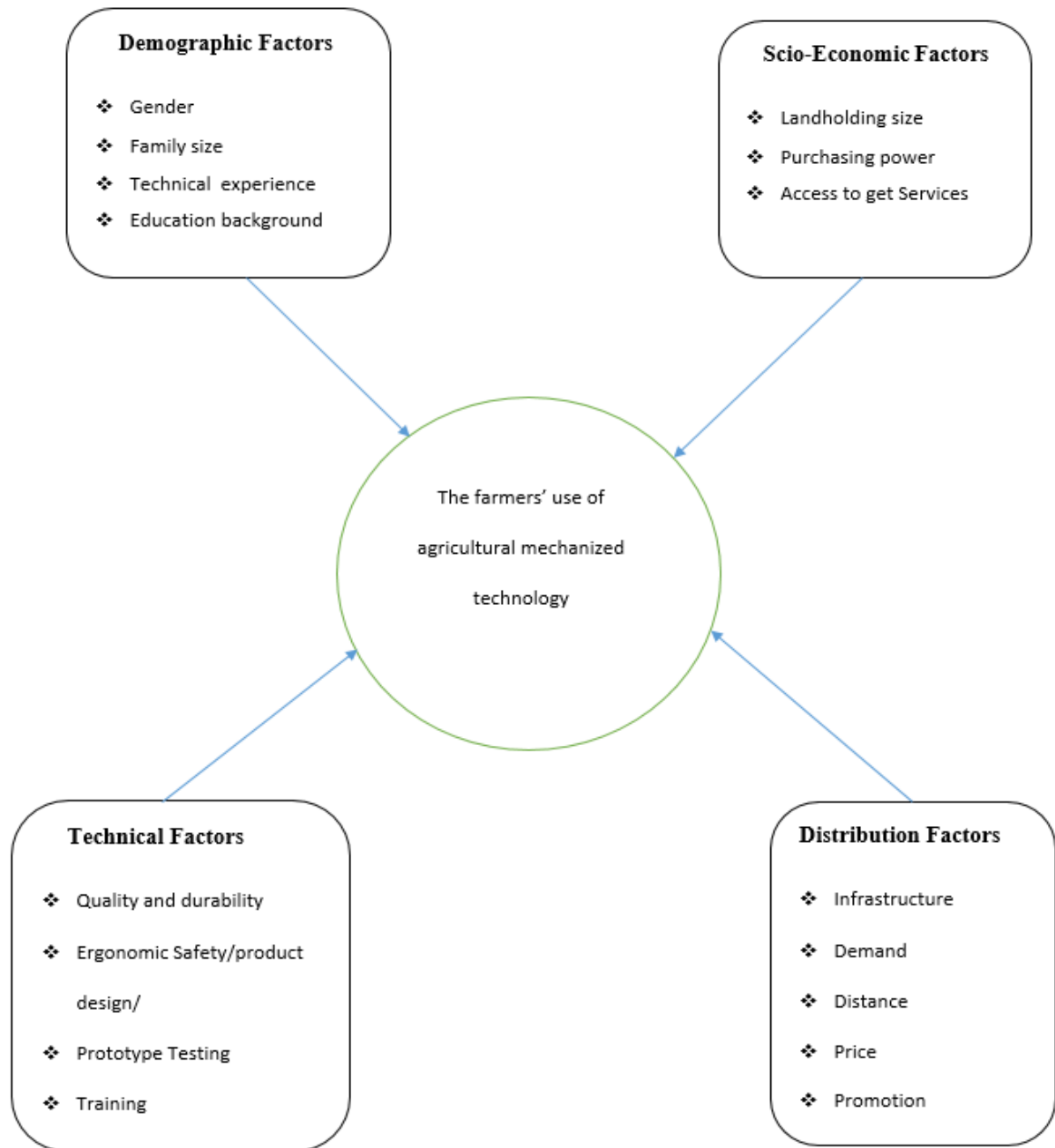


Figure 3 Conceptual Framework of Factors that Affects Farmer's Use of Mechanized Agricultural Technology, in West Gojjam Zone

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio-Demographic Characteristics of Farmers, Producers and Facilitators

In this part of the chapter, sampled farmers, private producers, and facilitators of socio-demographic characteristics such as gender, education background, family size, a technical work experience, land size, and others will be discussed in detail.

4.1.1 Socio-Demographic Characteristics of Farmers

Descriptive statistic tool was run and obtained the following percentage and frequency of the demographic characteristics of the farmers. And it is presented in detail information on table-2 below. Moreover, socio-demographic variables such as gender, education background, family size, and technical work experience are believed to influence the farmers' use of mechanized agricultural technology in the study areas.

Table 2 Demographic Characteristics for Farmers

Description	Numbers of sampled (N= 100) Frequency=F	Percent
Gender 		
Male farmer	67	67%
Female farmer	33	33%
Total	100	100%
Education Background		
Not literacy	85	85%
Literacy	15	15%
Total	100	100%
Family Size		
Below 4	62	62%
[5- 8]	25	25%
Greater than 8	13	13%
Total	100	100%
Technology work experience in years		
For one year	12	12 %
For two years	26	26%
For three years	50	50%
For greater than three years	12	12%
Total	100	100%
Farm land Size in Hectare		
Below 0.5	34	34%
(0.5-1]	38	38%
Greater than 1	17	17%
Rental	11	11%
Total	100	100%

4.1.2 Demographic Characteristics for Facilitators

The survey result indicated that 70 % (14) and 30 % (6) of the respondents were male and female respectively. The number of the respondents' work experience that have below 5 years, [6-10] years, [11-15] years, [16-20] years and greater than 20 years were 4, 1, 8, 2, and 5 in number respectively. And the respondents were graduated with a diploma and certificate as well as degree and above were 45% (9) and 55 % (11) respectively, the detailed information is shown in Table3.

Table 3 Demographic Characteristics for Facilitators

Description	Numbers of sampled (N= 20)	Percent
Gender		
Male	14	70%
Female	6	30%
Total	20	100%
Education Background		
Diploma and Certificate	9	45%
Degree and Above	11	55%
Total	20	100%
Work Experience		
Below 5	4	20%
[6-10]	1	5%
[11-15]	8	40%
[16-20]	2	10%
Greater than 20	5	25%
Total	20	100%

4.1.3 Demographic Characteristics of Producers

The survey result indicated that 100 % (10) of the respondents were male. The number of the respondents' work experience that have below 5 years, [6-10] years, [11-15] years, [16-20] years and greater than 20 years were 2, 2, 3, and 3 in number respectively. And the respondents were graduated with diploma and certificate as well as degree and above were 80% (8) and 20 % (2) respectively, the detailed information is shown on table 4.

Table 4 Demographic Characteristics for Producers

Description	Number of Sampled	Percent
Gender		
Male	10	100
Female	0	0
Total	10	100
Education Background		
Diplomma and certificate	2	20
Degree and above	8	80
Total	10	100
Work Experience		
Below Five Years	2	20
[6-10] Years	2	20
[11-15] Years	3	30
[16-20] Years	3	30
Greater than 20 Years	0	0
Total	10	100

4.2 Analysis of Survey Data for Farmers, Producers, and Facilitators

Data were gathered about the implements of mechanized agricultural technology in the study areas from farmers, facilitators and private producers. And hence detail explanations about the data result will be discussed in the following ways:

4.2.1 Descriptive Statistics for Farmer's use of MAT

The respondents assessed their needs for owning mechanized agricultural technology through their capability of purchasing. The results revealed that 79 % of the respondents believed that they don't have purchasing power. And also, they were interested in the credit-based provision of the intermediate mechanized agricultural technology. Whereas 21% of the respondents believed that they have purchasing power. But, they were not interested in credit-based provisions. Because they believed that they have a great capability of purchasing power to purchase mechanized agricultural technology on a cash basis. Besides this, the respondents were assessed about their readiness to get additional mechanized technology in the study areas. The data output analysis revealed out that 74% of the respondents believed that they are ready to need additional mechanized agricultural technology. Whereas, 26% of the respondents believed that they were not interested to need additional mechanized agricultural technology in the study areas. Finally, need assessment was conducted to know in which mechanized technology that they need for their purpose from harvesting up to post-harvesting agricultural operation activities. To see specifically, the majority of respondents from burea and part of dangela zuriea woreda were interested in small tractors and engine maize Sheller. Whereas the other respondents, who are living in bair- dar zuriea woreda, were interested in the motor water pump and rope pump.

Some member of the respondents also wanted to use an animal-drawn cart, seed planter, solar system, modern beehives, combine harvesters and weedier. Therefore, a systematic approach has to be followed by extension service providers to give modify based extension services and to identify techniques for specific areas. Generally, the need assessment study indicated that 36%, 31%, 15%, 12% and 6% of the respondents were interested to have engine drive maize Sheller's, motor water pump, rope pump, seed planter and tractors respectively.

A. Demographic Differences in Farmers 'Use of Mechanized Agricultural Technology

It is believed that there are different types of socio-demographic factors that affected the farmers' use of mechanized technology in the study areas. Therefore, some of the following lists of questionnaire were prepared for the targeted population to know whether socio-demographic factors are affected by the farmers' use of mechanized technology on the study areas or not. So, descriptive statistic tools were run to analyze the data of the questionnaires. Besides this, the result of the output will be discussed in detail in the following ways:

Table 5 Survey Questionnaires for Socio-Demographic Factors

Survey Questionnaires	Rating Scale				
	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1. Technical work experience difference affected the farmers use of MAT on the area.	47	10	23	10	10
2. Family size difference affected the farmers 'use of MAT on the area.	9	21	20	33	17
3. Gender difference affects the farmers 'use of MAT on the area.	10	43	40	3	4
4. Education background affected the farmers' use of MAT on the area.	43	12	25	15	10

The respondents were asked the question whether the technical work experience difference affected the farmers' use of MAT in the study areas or not and the respondents replied: 47% strongly agree, 10% agree, 23% undecided, 10% disagree and 10% strongly disagree. And the analysis output indicated that the mean value is 3.74 and the standard deviation value is 0.870. From this data analysis, the respondents agreed with the question that they were asked. Which implies that when the technical work experience year is increased, they also increase the experience for how to use MAT effectively and efficiently in study areas and they become to be productive enough than those who have less technical work experiences. Therefore, more than half of the respondents believed that the technical work experience is one of the factors that affected the farmers' use of MAT in the study areas.

The respondents were asked the question whether the family size difference is affected the farmers' use of MAT in the study areas or not and the respondents replied: 9% strongly agree, 21% Agree, 20% undecided, 33% disagree and 17% strongly disagree. The data analysis output indicated that the mean value is 2.75 and the standard deviation value is 1.232. From this data analysis, the respondents were undecided with the question that they were asked. But such kind of question was asked during the interview and they replied that those who have more numbers of a family were not interested to use MAT since they believed that they can accomplish different agricultural operation activities by their own within a short period of time rather by using MAT. And hence from the data analysis point of view, the respondents did not decide whether the family size difference is one of the factors that affected the farmers' use of MAT on the study areas or not.

The respondents were asked the question whether the gender difference is a factor that affected farmers' use of MAT in the study areas or not and they replied: 10% strongly agree, 43% agree, 40% undecided, 3% disagree and 4% strongly disagree. The mean value is 3.52 and the standard deviation value is 1.190. From this data analysis output, the respondents were agreed with the idea of gender difference that affected the farmers' use of MAT in the study areas. Moreover, they believed that male farmers are more active than female farmers when they operate mechanized technology in the study areas and male farmers are very active enough to understand the operation of mechanized technology easily than the female farmers. Therefore, it needs treatment to cancel out such ideas that they have in the study areas since to encourage the female farmers to use MAT as like as male farmers. And finally, more than half of the respondents believed that gender difference is one of the factors that affected the farmers' use of MAT in the study areas.

The respondents were also asked the question whether the educational background difference is affected the farmers' use of MAT in the study areas or not and they replied: 43% strongly agree, 12% agree, 25% undecided, 15% disagree and 10% strongly disagree. The mean is 3.78 and the standard deviation is 1.185. From the data analysis, the respondents were agreed with the idea of the question that they were asked. That means, they believed that the more they become educated, the more they easily understand how to operate and maintain mechanized agricultural technology in the study areas. So, more than half of the respondents believed that education background is one of the factors that affected the farmers' use of MAT in the study areas. From the general data analysis output indicated that there are different factors that affected farmers' use of mechanized agricultural technology in the study areas such as technical work experience, educational background, and gender difference.

B. Socio-Economic Differences in Farmers' Use of Mechanized Technology

It is believed that there are different types of socio-economic factors that affected the farmers' use of mechanized technology in the study areas. Therefore, some of the following list of questionnaires were prepared for the targeted population to know whether socio-economic factors are affected by the farmers' use of mechanized technology on the study areas or not. So, descriptive statistics tools were run to analyze the data of the questionnaires. And finally, the result of the output will be discussed in details in the following ways:

Table 6 Survey Questionnaires for Socio-Economics Factors

Survey Questionnaires	Rating Scale				
	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1. Landholding size difference affected farmers' use of MAT on the area.	6	9	16	50	19
2. End-users have a purchasing power to purchase MAT on the area.	10	20	10	20	40
3. There is availability of aftersales maintenance services on the area.	-	7	10	47	36
4. There is access of hire services on the area.	-	5	10	48	37
5. There is access of credit institute on the area.	3	7	10	52	29

The respondents were asked whether the landholding size difference is affected the use of MAT on the study areas or not and then they replied: 6% strongly agree, 9% agree, 16% undecided, 50% disagree and 19% strongly disagree. From the data analysis output indicated that the mean value is 2.33 and the standard deviation value is 1.074. From this data analysis point of view, the respondents were disagreed with the idea of the question that they were asked. Because the farmers were believed that whether they have large or small landholding, it doesn't affect to use MAT in the study areas. During field observation, the farmers did use effective and appropriate types of mechanized technology on their small size landholding which make them be productive in the study areas. Therefore, whether the farmers have large or small land or not, it didn't affect to use appropriate mechanized technology in the study areas. Generally, more than half of the respondents were believed that landholding size is not the factors that affected the use of appropriate MAT in the study areas.

The respondents were asked the question whether there is a capability of purchasing power to purchase MAT in the study areas or not and they replied: 10% strongly agree, 20% agree, 10% undecided, 20% disagree and 40% strongly disagree. The mean value is 2.4 and the standard deviation value is 1.147. The data output analysis result indicated that the respondents were disagreed with the idea of the question that they were asked. During FGD and observation, most of the framers have no purchasing power to purchase MAT in the study areas. But if there is an opportunity to have good credit institute as well as farmers association credit union, through this system, they believed that they can purchase what they need to have. But there are few farmers that have a purchasing power to have MAT and need to use effectively as they wish. Therefore, the data output analysis indicated that more than half of the respondents believed that purchasing power is one of the factors that affected the farmers' use of MAT in the study areas.

The respondents were asked a question whether there is the availability of after-sales maintenance service in the areas or not and they replied: 0% strongly agree, 7% agree, 10% undecided, 47% disagree and 36 % strongly disagree. The data output analysis indicated that the mean value is 1.88 and the standard deviation value is 0.856. Which is implied that the respondents were disagreed with the idea of the question that they were asked. During observation, different MAT was distributed by agricultural officers and NGO's for farmers. But the distributed mechanized technology machinery was not properly working due to unavailability of getting after-sales maintenance services in the study areas. The observed problems which were happened on the machinery were: poor tightening nuts, bolts, rubber caps, chains and welding methods which is resulted due to improper handling system during operation activities.

Therefore, the data output analysis indicated that above half of the respondents were believed that after-sales maintenance service is one of the factor that affected the farmers' use of mechanized agricultural technology in the study areas.

The respondents were asked a question whether there is availability of hire services in the study areas or not and they replied: 0% strongly agree, 5% agree, 10% undecided, 48% disagree and 37% strongly disagree. The data output analysis result indicated that the mean value is 1.83 and the standard deviation value is 0.805. So, the respondents were disagreed with the idea of the availability of hire services in the study areas. During FGD with key informants, they said that there is no association group that can give hire services with a minimum cost in the study areas. But there is only a hire service of the tractor that was given by some farmers with a maximum cost. Therefore, more than half of the respondents were believed that hire service is one of the factors that affected the farmers' use of MAT in the study areas.

The respondents were asked a question about whether there is availability of credit institutes that support and encourage the end-users in the study areas or not. They replied: 3% strongly agree, 7% agree, 10% undecided, 52% disagree and 29 % strongly disagree. The analysis data revealed out that the mean value is 2.06 and the standard deviations value is 1.139. Therefore, the respondents were disagreed with the idea of the question that they were asked. During FGD with key informants, they said that there was Amara credit institute and Farmer association union on the study areas. But ACI sets its criteria which is very difficult to lend money for poor farmers especially those who can't fulfill criteria as a result they can't get money from it. Even if there is the probability that they can lend money from it, the ACI lend money for an individual farmer not more than 3000 Birr per year with an interest rate of 12.55.

From this point of view, key informants believed that this much amount of money is not enough to get MAT on the market. Because of the above reasons, the ACI is not supporting the farmers to use MAT effectively in the study areas. But the study showed that 70 percent of the agricultural machinery sales could be possible by the availability of the credit institute. Therefore, the output data analysis indicated that more than half of the respondents believed that the unavailability of credit institute is one of the factors that affected the farmers' use of MAT in the study areas. From the general data output analysis indicated that there were different factors that affected the farmers 'use of MAT in the study areas such as low purchasing power of the farmers, unavailability of after-sales maintenance services, hire services, and credit institute.

C. The Technical Difference in Farmers 'Use of Mechanized Agricultural Technology

It is believed that there are different type of technical factors that affected the farmers' use of mechanized technology in the study areas. Therefore, some of the following list of questionnaires were prepared for the targeted population to know whether the technical factors are affected by the farmers' use of mechanized technology on the study areas or not. So, descriptive statistics tools were run to analyze the data of the questionnaires. And finally, the result of the output will be discussed in details in the following ways:

Table 7 Survey Questionnaires for Technical Factors

Survey Questionnaires	Rating Scale				
	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1. The distributed MAT on the study area is comfortable and handled easily during operation.	6	5	5	50	34
2. The distributed MAT is quality and durable during operation.	5	15	10	43	27
3. Prototype testing is made always to check its mechanisms on the study area.	10	5	6	52	27
4. There is availability of production and maintenance workshop on the area.	5	10	3	63	19
5. There is availability of MAT with its type and quantity on the area.	5	3	6	64	22
6. There is availability of training about MAT on the area.	1	5	6	49	39

The respondents were asked the question whether the distributed mechanized technologies are comfortable and easily handled during operation activities or not and then they replied: 6% strongly agree, 5% agree, 5% undecided, 50% disagree and 34% strongly disagree. The analysis revealed out that the mean value is 1.99 and the standard deviation value is 1.067. This indicated that the respondents were disagreed with the idea of the distributed mechanized technologies were comfortable and easily handled during operational activities. During an observation, there were different type of distributed mechanized technologies that were not comfortable and easily handled by the end-users. Due to the ergonomics aspect problem which was faced during the design stage. However, zonal agricultural offices forced the end user to use it but they didn't accept and use mechanized technologies properly on their working site. The studies proved that ergonomics attempt to harmonize the work and working environment in order to raise productivity, work efficiency and promote well-being through optimizing the effort of the worker (Jafry and O'Neill, 2000).

From these points of view, above half of the respondents believed that ergonomics is one of the factors that affected the farmers' use of MAT in the study areas.

The respondents were asked the question whether the distributed mechanized technologies have quality and durable for operation activities on the study areas or not and they replied: 5% strongly agree, 15% agree, 10% undecided, 43% disagree and 27% strongly disagree. Finally, the result showed that the mean value is 2.28 and the standard deviation value is 1.023. The respondents were disagreed with the idea of the question that they were asked. During FGD with key informants said: when the end-users use distributed mechanized technologies on operation activities, the distributed mechanized technologies became fail down without deserving the expected working life. Therefore, they said that most of the time during operation, the quality of mechanized technology is the problem that the farmers always faced. Finally, more than half of the respondents were believed that quality and durability is one of the factors that affected the use of MAT in the study areas.

The respondents were asked questions about whether prototype field testing is made on their working site or not and they replied: 10% strongly agree, 5% agree, 6% undecided, 52% disagree and 27% strongly disagree. The analysis result indicated that the value of the mean and standard deviation is 2.19 and 1.217 respectively. From this point of view, the respondents were disagreed with the idea of prototype field testing is made on their working site. During FGD with key informants: they said that especially Amara agricultural research center was coming to test whether their prototype testing mechanism is effective or not on the field. But most of the time, their prototype testing is failed down during operation activity. And hence they forced to leave it as it is.

In general, the key informants believed that prototype testing was not made continuously in the study areas.

If the prototype testing is perfect, they reported to the Amara regional agricultural bureau to get an order to manufacture the prototype as mass production for the end-users. As a result, the regional agricultural bureau and offices distributed the most successful types of a prototype for on a cash or a credit bias for farmers. Therefore, key informants believed that before mechanized technology is manufactured as mass production, prototype test on the field should be continuously made. Finally from data analysis showed that more than half of the respondents were believed that prototype testing is one of the factors that affected the use of MAT in the study areas.

The respondents asked the questions whether there is the availability of production and maintenance workshop that help the farmers to repair or manufacture mechanize technology as they wish in the study areas or not and they replied: 5% strongly agree, 10% agree, 3% undecided, 63% disagree and 19% strongly disagree. The mean and the standard values are 2.19 and 1.132 respectively. From this analysis, the respondents were disagreed with the idea of the availability of production and maintenance workshop even near to their areas. During FGD with key informants said: when the end-users were working with mechanized technology unfortunately it is failed down due to different problems, as result, the farmers wanted to repair it as it is before or wanted to get it as new from production and maintenance workshop. But they don't get any production and maintenance workshop nearby, therefore, they forced to throw it and hopeless about the use of mechanized technology in the study areas. Not only had this problem happened, if they get a chance to be maintained it by artesian, they also can't maintain it exactly as the farmers want to be due to lack of skill and training. So, more than half of the respondents were believed that

unavailability of production and maintenance workshop is one of the factors that affected farmers' use of MAT on the study areas.

The respondents were asked the question whether there is availability of mechanized technology with its types and quantities on the study areas or not and then they replied: 5% strongly agree, 3% agree, 6% undecided, 64% disagree and 22% strongly disagree. The mean and the standard values are 2.05 and 1.123. From the analysis output indicated that the respondents were disagreed with the idea about the question that they were asked. During FGD with key informants said: when the farmers need to have mechanized technology with its type and quantity on the market, they can't get it easily as they wish to have. So, key informants believed that there is no suppliers, wholesalers, and retailers that can easily distribute and supply mechanized technology for the end-users which is according to their demand. Therefore, they conclude and believed that the Government should give great attention to this area to make the farmers be effective for their agricultural productivity. And hence more than half of the respondents believed that production with its types and quantity unavailability is one of the factors that affected farmers' use of MAT in the study areas.

The respondents were asked the questions whether there is training which is given about mechanized technology on the study areas or not and they replied: 1% strongly agree, 5% agree, 6% undecided, 49% disagree and 39% strongly disagree. From data analysis output resulted that the mean value is 1.80 and the standard deviation is 1.147. Which implies that the respondents disagree with the idea of training is given about mechanized technology in the study area. This shows that most of the time no training was given for farmers even by DAs and other bodies. During FGD with key informants said: occasionally, training was given for small numbers of farmers about

how to operate and maintain mechanized technology but not a continuous training was given for farmers as like as how to sow seed and fertilizer on their lands.

Structural questionnaires were dispatched for DA's whether they were trained or not, but the result showed that most of them are not taking training about mechanized technology, as a result, they were not supporting the end-users to use mechanized technology in the study areas. Therefore, above half of the respondents believed that training is one of the factors that affected the farmers' use of mechanized technology effectively in the study areas. Since aid agencies such as JICA and tractor manufacturing companies have emphasized on training programs for tractor owners, operators, and mechanics, which will be important for improving operating efficiency (JICA, 2014). From the general data analysis output showed that there are factors that affected the farmers' use of MAT in the study area such as ergonomics aspects, quality, training, prototype testing, production and maintenance workshops.

D. The Distribution Differences in Farmers' Use of Mechanized Agricultural Technology

It is believed that there are different types of distribution factors that affected the farmers' use of mechanized technology in the study area. Therefore, some of the following lists of questionnaires were prepared for the targeted population to know whether distribution factors are affected by the farmers' use of mechanized technology in the study areas or not. So, descriptive statistics tools were run to analyze the data of the questionnaires. And finally, the result of the output will be discussed in details in the following ways:

Table 8 Survey Questionnaires for Distribution Factors

Survey questionnaires	Rating Scale				
	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1. MAT is distributed and used according to farmers' demand.	3	5	10	40	42
2. The price of MAT is expensive.	17	48	16	15	4
3. Villages distance is far away from working site.	11	48	16	21	4
4. There is availability of infrastructure on the area.	2	3	35	40	20
5. There is available of suppliers and distributors of MAT and its spare parts.	7	6	16	44	27
6. There is a promotion about MAT and its spare parts on the areas.	10	10	5	55	20
7. There is communication between farmers and DA's about the use of MAT on the areas.	5	9	8	48	30

The respondents were asked questions whether the distribution of mechanized technology is made according to farmers' demand on the study areas or not and they replied: 3% strongly agree, 5% agree, 10% undecided, 40% disagree and 42% strongly disagree. From the data output analysis indicated that the mean and standard values are 1.87 and 1.150 respectively. From the output, the analysis indicated that the respondents disagree with the idea in which mechanized technology was distributed according to the demand of the farmers in the study area. During FGD, the points that were raised about the distribution of mechanized technology according to the demand of the farmers, they said that different types and quantities of mechanized technology were distributed by the Government for the end-users such as BBM, Tie-ridger, Bee-hives, Treadle-pump, Apridive-pump, Two-wheel walk tractors, and others.

But there were different large numbers of mechanized technology that was not functional in the study area such as BBM, tiredgers and two-wheel walk tractors due to lack of ergonomics, which weren't comfortable to operate and handle it easily, and also mechanized technology, which was distributed for end-users on study area, was not match with land nature since they didn't study about the demand of end-users and the land nature too. From this points of view, key informants conclude that the Government used the distribution systems as political issues rather no intention to make the farmers benefit from mechanized technology because of this the key informants said most of the farmers were not interested to use it for their agricultural activities. During the observation, mechanized technology, which was manufactured and distributed, but not used by farmers, were stored in mechanization agricultural research center and other zonal agricultural offices with its types and quantities. Therefore, more than half of the respondents believed that demand is one of the factors that affected farmers' use of MAT in the study areas.

The respondents were asked the question whether the price of mechanized technology is expensive in the study area or not and they replied: 17% strongly agree, 48% agree, 16% undecided, 15% disagree and 4% strongly disagree. From this, the data, the mean and standard values are 3.59 and 1.094 respectively. From the data output analysis revealed out that the respondents strongly agreed with the idea about the question that they were asked. During FGD, the key informants said that the price of mechanized technology is expensive and hence poor farmers can't afford to purchase it. So, they said that there should be competitive wholesalers and retailers who supply mechanized technology with a minimum price. Moreover, the manufacturing company should manufacture mechanized technology at a minimum cost.

Therefore, the key informants believed that to make all farmers use MAT effectively and efficiently, the Government should subsidize and support those farmers who can't afford to purchase it in the study area. Finally, more than half of the respondents believed that price is one of the factors that affected the farmers' use of MAT in the study areas.

The respondents were asked the question whether a proxy distance from the working site up to their village is far distance or not and they replied: 11% strongly agree, 48% agree, 16% undecided, 21% disagree and finally, 4% strongly disagree. From this data, the mean and standard values are 3.61 and 1.065 respectively. The data output analysis indicated that the respondents agree with the idea that they were asked. During the interview, the respondents said that more than half of the farmers' residual area is far from their working site which is even difficult to take and address mechanized technology from their village. From these points of view, above half of the respondents believed that proxy distance is one of the factors that affected farmers' use of MAT in the study areas.

The respondents were asked whether there is the availability of infrastructure, which is suitable to distribute and address mechanized technology, on their working site or residual kebele in the study area or not and they replied: 2% strongly agree, 3% agree, 35% undecided, 40% disagree and 20 % strongly disagree. The mean and standard values were 2.27 and 1.186 respectively. The analysis revealed out that the respondents disagree with the idea of the availability of infrastructure in the study area. During FGD with key informants said: the distance covered from residual kebele up to their working site isn't infrastructure with a normal road which is very difficult for them to transport mechanized technology up to their working site.

And they believed that there should be infrastructure which makes the end-users transport mechanized technology up to their working site unless they said that it is difficult to do so. Moreover, during observation, departing from woreda town up to farmers' residual kebele, there was infrastructure with a normal road that can give any transportation system up to their kebele. But more than half of the respondents believed that infrastructure is one of the factors that affected farmers' use of mechanized technology in the study area.

The respondents were asked whether there is the availability of distributors and suppliers of mechanized technology and its spare parts for the end-users on the study area or not and they replied: 7% strongly agree, 6% agree, 16% undecided, 44% disagree and 27% strongly disagreed. From the data output analysis indicated that the mean and standard values were 2.22 and 1.124 respectively and from this data analysis indicated that the respondents disagree with the idea of the question that they were asked. During FGD with key informants said: there is no any distributors and suppliers that can distribute and supply mechanized technology and its spare parts for the end-users except Regional Agricultural Bureau, Bair Dar University and NGO's that can sometimes distribute and introduce only mechanized technology for the end-users on the study area such as BBM, beehives, solar system, rope pump, motor-driven water pump, seed planters, motor-driven maize Sheller's, pulley mechanism, animal-driven carts , walkway tractors and etc...But when the end-users need to change spare parts for their mechanized technology, they can't get it easily even from the market. So, the key informants said that the farmers forced to throw it and put as it is on their working site. Not only this but also, in Regional Agricultural Research Centers expertise said that because of unavailability of the desired engine in the market, different maize Sheller machines, which were manufactured in the center, were not distributed for the end-users.

Moreover, there are different types of mechanized technology that were not distributed for the end user due to unavailability of different engine motors suppliers. In general, the key informants during FGD said that the Government should encourage the suppliers and distributors those that can supply and distribute mechanized technology and its spare parts for the end-users on the study areas. Therefore, more than half of the respondents believed that the unavailability of distributors and suppliers are the factors that affected the farmers' use of MAT in the study area.

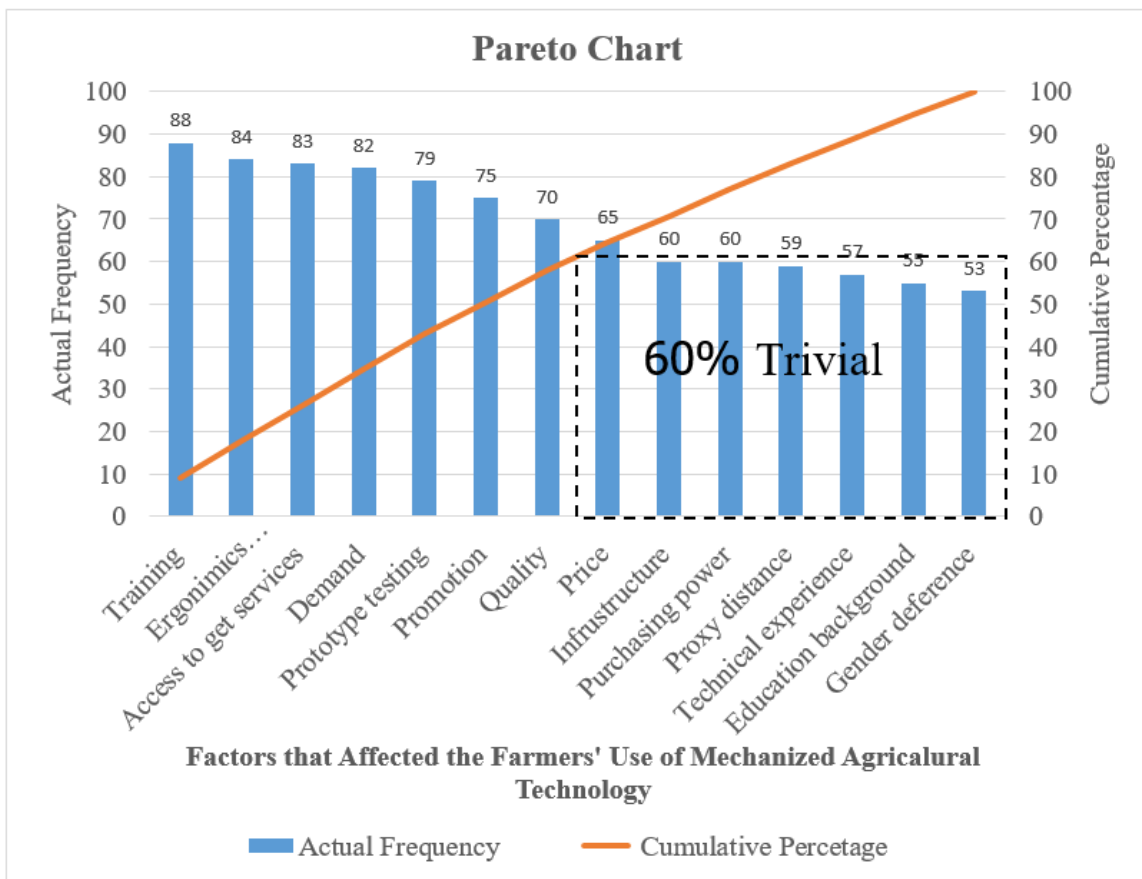
The respondents were asked the question whether promotion about mechanized technology is made in the study area or not and they replied: 10%strongly agree, 10% agree, 5% undecided, 55% disagree and 20% strongly disagree. The output result showed that the mean and the standard values are 2.35 and 1.201 respectively. From this result points of view, the respondents disagree with the idea about the promotion of mechanized technology is made in the study area. During FGD with key informants said that especially Regional Agricultural Research Center came to the selected farmers' area of land and they tested their developed prototype, at this stage, the farmers, those who are a chance to see it, will get as a source of information and promotion about mechanized technology on the area. Moreover, Bair Dar University tried its best to make promotion about mechanized technology for the farmers in the study area too. But there may be any numbers of farmers who may not get full of promotion about mechanized technology which is made by different sectors since they can't cover all the study area as they expected to address it. So, more than half of the respondents believed that promotion is one of the factors that affected the farmers' use of MAT in the study areas.

The respondents were asked the question whether there is great communication between farmers and DA's about the effective use of MAT in the study areas or not and they replied: 5% strongly agree, 9% agree, 8% undecided, 48% disagree and 30% strongly disagree. The data analysis output indicated that the mean value is 2.07 and the standard deviation value is 1.139. From this data analysis, the respondents disagree with the idea that they were asked. During field observation, DA's were communicated with farmers to support ideas about how to use and prepare seed and fertilizer in their land. To know whether the farmers were supported by DA's about how to use and operate mechanized technology or not, structured questionnaires were prepared and dispatched for all DA's in the study area. From this questionnaire, the result indicated that almost all their field study weren't related to the field of technical aspect rather they are graduated in animal science and plant science which showed that the farmers were not supported well to use mechanized technology effectively in the study area. Therefore, the Government should give great attention to it by reorganizing the human resource structure in the case of agricultural bureau and offices. Finally, the respondents were believed that communication between DA's and farmers is one of the factors that affected the farmers' use of MAT in the study areas. The general concept about the data analysis output indicated that there are different factors that affected the farmers' use of MAT in the study areas such as farmers' demand, infrastructure, distributors and suppliers, promotion, communication between farmers and DAs and the price of mechanized agricultural technology.

4.3 Factors that Affected the Farmers' use of Mechanized Agricultural Technology

In general, in the study areas, there were different factors that affected farmers' use of mechanized agricultural technology. To show clearly about the cause of the problems that were happened in the study area, it is better to use Pareto analysis which stated that 20% of invested input is often times responsible for 80% of the result obtained. But to minimize about the cause of the problems and to give great attention, this paper tries to use 40% of few vital and 60% of trivial many according to the principle of Pareto data analysis which is a scientific tool in the following ways:

Figure 4 Factors of Causes and Problems for the Study Variables



Therefore, the cause of the problems that affected farmers' use of mechanized agricultural technology in the study area are identified and examined as shown in the Pareto analysis diagram in the following:

1. Training: it is the cause of the problems which its actual frequency is 88.

Which implies that no training about how to operate and maintain was given for the end-users or other grouped members in the study areas. Therefore, training is one of the factors that should be given great attention to increasing farmers' use of mechanized agricultural technology in the study area.

2. Ergonomics aspect/ product design/: it is the cause of the problems which its actual frequency is 84. This indicated that distributed mechanized technologies were not comfortable to handle and difficult to work with it in the study areas. Therefore, before mechanized technology is distributed for the end-users, the ergonomics consideration of mechanized technology should be given great attention to the design stage.

3. Access to get services: it is the cause of the problems which its actual frequency is 83. This result showed that most of the respondents were complaining that they didn't get any services in the study areas such as aftersales maintenance services, hire services, and credit services. Therefore, it should be given great attention to incorporate such services so as to increase the farmers' use of mechanized technology in the study areas.

4. Demand: it is the cause of the problems which its actual frequency is 82. This indicated that most of the respondents were complaining about the distributed mechanized technology because it is distributed without the demand of the end-users. So, demand study should be given great attention before distributing mechanized agricultural technology for the end-users in the study areas.

5. Prototype testing: almost, it is not tested continuously in the study area, therefore, the production center should focus to manufacture and test a prototype on the farmers' working site to check whether its mechanism is perfect or not.

So as to increase the farmers' interest to use mechanized agricultural technology in the study area, it needs to give great attention to promote prototype testing on the working site.

6. Promotion: it wasn't made a promotion in the study areas whether there are appropriate and different alternative mechanized agricultural technology with spare parts are available on the market or not. Therefore, it needs to give great attention to promotion to increase the demand for farmers' use of mechanized technology in the study areas.

7. Quality: it is the cause of the problems which its actual frequency is 70. This result showed that most of the respondents were complaining about the quality and durability of the distributed mechanized technology. Because they believed that it failed down frequently during operation activities in the study areas. Therefore, the quality and durability of mechanized technology during the design stage and manufacturing process should be given high attention by the quality assurance in the local manufacturing companies.

In general, the cause of the problems that affected the farmers' use of mechanized technology are identified in the following way:

- From technical factors, training, ergonomics aspect, quality, and prototype testing
- From socio-economic factors, access to get service such as aftersales maintenance services, hire services and credit services and finally

- From distribution factors, demand study and promotion were identified by 40/60 % of Pareto analysis method that needs to give great attention by any stakeholder, government and NGO's in the study areas.

4.4 The Challenges of Farmers' Use of Mechanized Agricultural Technology

There were different problems and challenges that were raised by key informants during FGD to use the mechanized agricultural technology effectively in the study areas.

These were:

1. There weren't accessibility of Production and Maintenance Workshops

It is known that agricultural productivity is increased with the help of mechanized agricultural technology when it is to be used effectively by the farmers. So, there should be the availability of production and maintenance institutes or workshops that help to develop, maintain and adapt mechanized technology through best design which is coming from different research centers and universities. Because of the unavailability of these relations in our region, the majority of the respondents replied that the products are poor in quality and ergonomics as well as the price of the products is too expensive. Besides this, the local manufacturers have no practice to check the prototype testing on the field.

From burea zuriea woreda agricultural office expert said: "when the farmers need to have repaired their damaged mechanized agricultural technology by workshops, because of there is no production and maintenance workshop near to them, Farmers can't get any repairing service nearby, due to these problems in the area, they forced to through it immediately and they become hopeless on relay on mechanized technology." (36 years old male respondents)

2. No Accessibility of Distributors and Suppliers of Mechanized Agricultural Technology

The second big issues which were raised by respondents were: there were no wholesalers and retailers of mechanized technology with spare parts in a zone as well as in regions level when they need to purchase.

Most of the respondents replied that there is no distributors and suppliers on woreda, zonal and even in regional to supply mechanized agricultural technology with spare parts.

From danegela zuriea woreda kebele agricultural development agent said: "If the farmer needs to change damaged mechanized technology or spare parts immediately, they can't get it easily from the market since there is no any distributors and suppliers which are supplied mechanized technology with spare parts near to woreda and even zonal area. The only alternatives for the end-users are to throw it from their own working site." (25 years old male respondent)

3. Shortage of Finance

The third big issue that was raised by respondents: there is no credit institute and farmers' association union that support and consolidate the end-users with financial to purchase mechanized agricultural technology in the study areas.

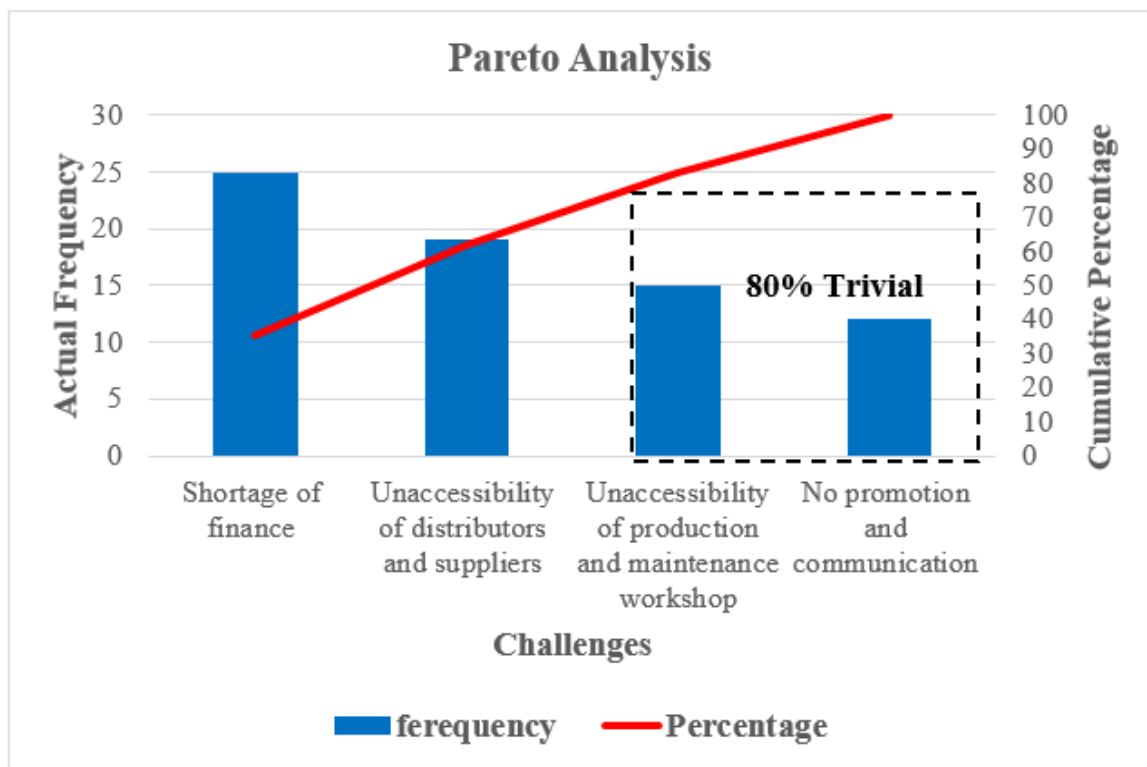
From bair- dar zuriea woreda kebele, the agricultural development agent said: "even though credit institute is available, they only lend about 3000 Birr for farmers who satisfy the criteria for the institute. But most of the farmers can't fulfill this criterion which is set by the credit institute as a result, they can't get money from the institute, so the majority numbers of end-users can't use other alternatives to get money for purchasing purpose for mechanized technology or spare parts in the study area." (28 years old male respondent)

4. No promotion and communication is made

The fourth big issue that was raised by the respondents were: no promotion and communication are made between end-users and DAs about mechanized technology in the study areas.

From bahir-dar zuriea woreda agriculture office expert said:” farmers couldn’t get enough promotion and communication about the use of MAT on their area, due to a large number of agricultural development extension agents aren’t educated in technical aspect rather, they are educated in animal and plant science fields.” (35 years old male respondent)

Figure 5 Challenges for Farmer’s Use of Mechanized Technology



From Pareto Diagram data analysis show that it should be focused on the challenges of 20% of the causes since it is the causes for 80% of the problems which were happened in the study areas. Therefore, the causes of 20 % are identified and focused to eliminate the rest of 80% of the problems in the following ways:

1. Shortage of finance: the Government should give great attention to establish credit institutes, hire services and subsidize the end-user with financial. And hence, the challenges that were faced for end-users regards to financial shortage can be eliminated.
2. Inaccessibility of distributors and suppliers: the government should encourage suppliers and distributors, especially those who are distributed and supplied mechanized technology with spare parts for the end-users, by establishing and creating a better working environments example: working on infrastructure establishment on rural roads as well as on taxes that make them free from it. So, the problems that faced for end-users about mechanized technology with spare parts distributors and suppliers can be eliminated.

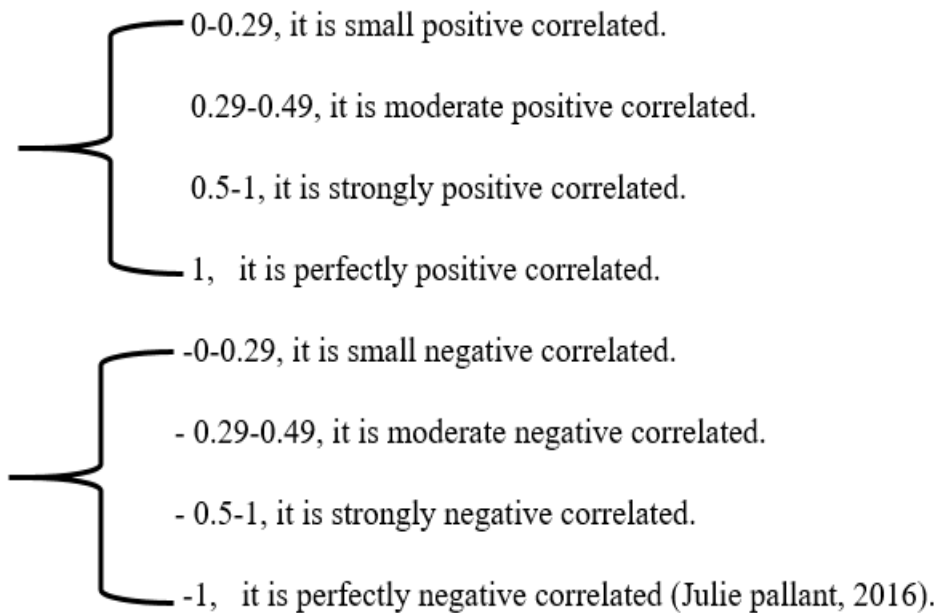
4.5 Inter Correlation Among the Study Variables

Correlation is able to perform a meaningful inter-correlation between variables. A correlation was arranged to analyze the correlations of all items with each other. Each variable should have correlated with other variables, but in contrast, it should not correlate too highly. Because each variable should have a unique contribution to the factor solution (Netemeyer et al., 2003). Therefore, correlation coefficient should be used to show whether the variable is small positive correlated, moderate positively correlated, strongly positive correlated, perfectly positively correlated, small negative correlated, moderate negative correlated, strongly negative correlated and perfectly negatively correlated or not. Finally, when the variables are negatively correlated which implies that the variables are indirectly proportional to one of the others. Which means, when one variable is increased, the other variable is decreased. And when the variables are positively correlated which means that the variables are directly

proportional to one to the others. Which implies that when one variable is increased, the other variables are increased too.

From this point of view, the data obtained from the study area can be analyzed in the following ways:

If the value of the correlation coefficient is:



From the above data analysis methods, the study variables will be discussed in detail about the relation coefficient between any variables.

4.5.1 Correlation between Dependent Variables

There are different dependent variables that were obtained from the Pareto chart data analysis. It needs to analyze the correlation coefficient of the variables by running the correlation tools on SPSS. Therefore, each dependent variables are correlated with each other from the following table shown below.

Table 9 Correlation of Dependent Variables

	1	2	3	4	5	6	7	8	9	10
1 Gender										
2 Demand	0.45*									
3 Infrastructure	.185	0.51*								
4 Land holding size	.073	0.58*	.345							
5 credit institute	.058	0.421*	0.43*	0.54*						
6 Training	.410	0.60**	.320	0.40*	0.42					
7 Hire services	.149	.353	0.543*	0.67**	0.52*	.325				
8 Quality	.001	0.71**	.013	0.51*	.017	0.45*	.017			
9 Prototype testing	.042	0.671**	0.521*	.038	.169	0.52*	0.312	0.561*		
10 Promotion	.029	0.56*	0.541**	.014	.003	0.466*	0.41*	.587**	0.511*	

Note: N=100. *P<0.05 ; **P<0.01

From the above table show that all variables are the factors that affected the farmers' use of mechanized technology and hence the data analysis result will be discussed in the following ways:

Demand: its correlation is strongly positive significant with infrastructure, landholding size, training, and promotion at *P<0.05 and having a correlation coefficient of 0.51, 0.58, 0.6 and 0.56 respectively. The data analysis indicated that when the infrastructure establishment is increased in the study area, the farmers demand mechanized agricultural technology is also increased.

When landholding size for the end user is increased, then the farmers demand mechanized technology also increased. When the demand for mechanized technology is increased, the farmers' need for training about how to maintain and operate will be

increased too. And finally, when the promotion of mechanized agricultural technology is increased in the study area, the farmers demand mechanized agricultural technology is also increased.

Infrastructure: its correlation is strongly positive significant with promotion at $**P < 0.01$ and having a correlation coefficient of 0.541. The data analysis showed that when infrastructure (example road construction is built) establishment is increased, then the promotion about mechanized technology will be increased in the study area too.

Landholding size: its correlation is strongly positive significant with hire service at $**P < 0.05$ and having a correlation coefficient of 0.67. The data analysis indicated that when landholding size for the end user is increased, the opportunity to get and use hire services about mechanized technology in the study area will be increased.

Credit institute: its correlation is strongly positive significant with hire services at $*P < 0.05$ and having a correlation coefficient of 0.52. The data analysis indicated that when the credit institute supports the end-users by lending money for hire service purpose, the hire service users can be also increased. Moreover, when the end-users capability of purchasing is increased, the use of hire service for the farmers are also increased.

Training: its correlation is strongly positive significant with quality, prototype test and promotion at $*P < 0.05$ and having with a correlation coefficient of 0.45, 0.52 and 0.446 respectively.

The data analysis indicated that when the quality of mechanized technology is increased, the end-user training will be also increased. And also, when the prototype testing mechanism is increased on the field, the training of prototype for the end-users are also increased. As a result, the knowledge for the end-users on how to maintain and operate will be increased effectively in the study area. Moreover, when the

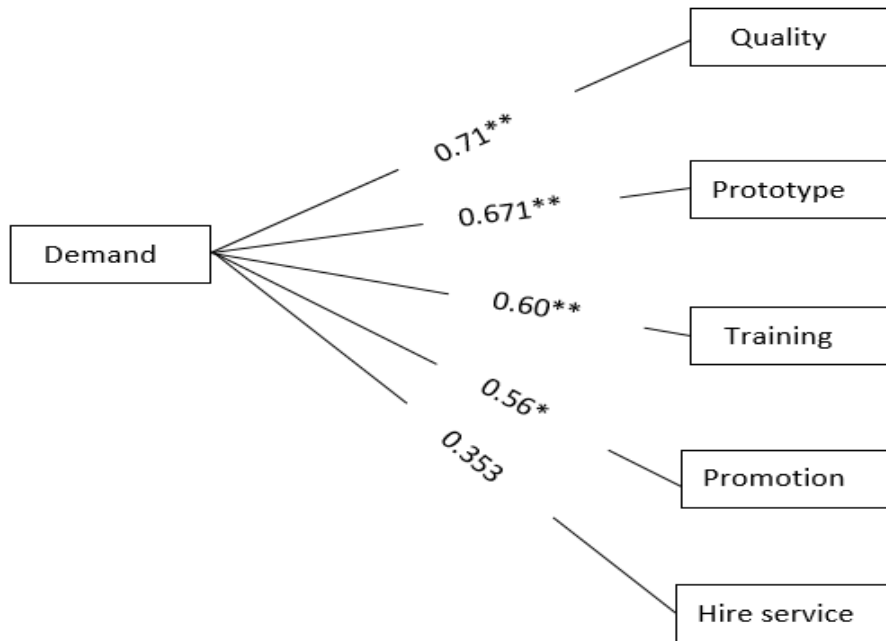
promotion of mechanized agricultural technology is increased, the training needed by the end-users are also increased.

Hire service: its correlation is strongly positive significant with promotion at $*P < 0.05$ and having a correlation coefficient of 0.41. The analysis data indicated that when more promotion about mechanized technology is made, the opportunity to be used hire service of mechanized technology by the end-user in the study area will be also increased.

Quality: its correlation is strongly positive significant with prototype testing at $*P < 0.05$ and having a correlation coefficient of 0.561. The output data analysis indicated that when the quality of mechanized technology is increased, the prototype testing mechanism on the field will be increased in the study area.

Prototype testing: its correlation is significant with promotion $*P < 0.05$ and having a correlation coefficient of 0.511. The table data indicated that if there is more promotion is made about the prototype, which is manufactured in the local manufacturing companies, the prototype testing on the field will be increased too. From the above table data, the correlation coefficient of the dependent variables can be shown by the following illustrated figure below.

Figure 6 Correlation Coefficient Order for Dependent Variables



4.5.2 Correlation Between Dependent and Independent Variables

There are dependent variables and independent variables that should be correlated with each other in the following table 10. According to correlation data analysis, dependent and independent variables will be discussed in detail in the following ways:

Table 10 Correlation of Dependent and Independent Variables

	1	2	3	4	5	6	7	8
1 Demand								
2 Credit institute	0.421*							
3 Training	0.60**	0.42						
4 Hire service	0.35	0.52*	0.32					
5 Quality of the product	0.71**	0.017	0.45*	0.02				
6 Prototype testing	0.671**	0.169	0.52*	0.31	0.56*			
7 Promotion	0.56*	0.003	0.47*	0.41*	0.59*	0.51*		
8 Independent variable	0.51**	0.56**	0.49*	0.52	0.66**	0.61**	0.59**	

Note: N=100. *P<0.05; **P<0.01

According to the above table, the result showed that how the dependent variables are correlated with independent variables. From data analysis output, the dependent and independent variables will be discussed in the following ways:

Demand: its correlation is strongly positive significant with farmers' use of mechanized technology at $**P < 0.01$ and having with a correlation coefficient of 0.51. The data analysis indicated that when mechanized technology is increased according to the demand of the end-users, the end-users of mechanized agricultural technology are also increased in the study area.

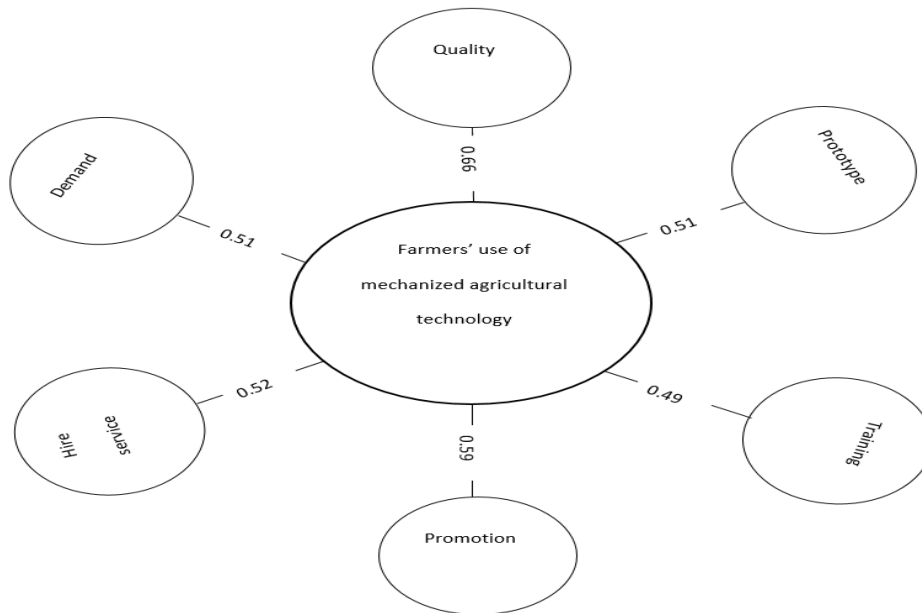
Credit institute: its correlation is strongly positive significant with farmers' use of mechanized technology at $**P < 0.01$ and having with a correlation coefficient of 0.56. From data analysis output showed that if there is the availability of a credit institute, which supported the end users to purchase mechanized technology with financial aspect, therefore, the number of the end-users of mechanized technology in the study areas also increased.

Quality: its correlation is strongly positive significant with farmers' use of mechanized technology at $**P < 0.01$ and having with a correlation coefficient of 0.66. The data analysis indicated that when the quality of mechanized technology is increased in the study area, then the number of end-users of mechanized technology are increased too.

Prototype testing: its correlation is strongly positive significant with farmers' use of mechanized technology at $**P < 0.01$ and having with a correlation coefficient of 0.61. The above table result indicated that when the number of prototype testing on farming site is increased, the end-users of mechanized technology will be also increased.

Promotion: its correlation is strongly positive significant with farmers' use of mechanized technology at $**P < 0.01$ and having with a correlation coefficient of 0.59. The data analysis indicated that when the promotion of mechanized technology is made in the study areas, the number of farmers to use mechanized technology will be increased. Therefore, the following figure will show how the dependent and independent variables are correlated with each other with their correlation coefficient.

Figure 7 Correlation Coefficient Between Dependent and Independent Variables



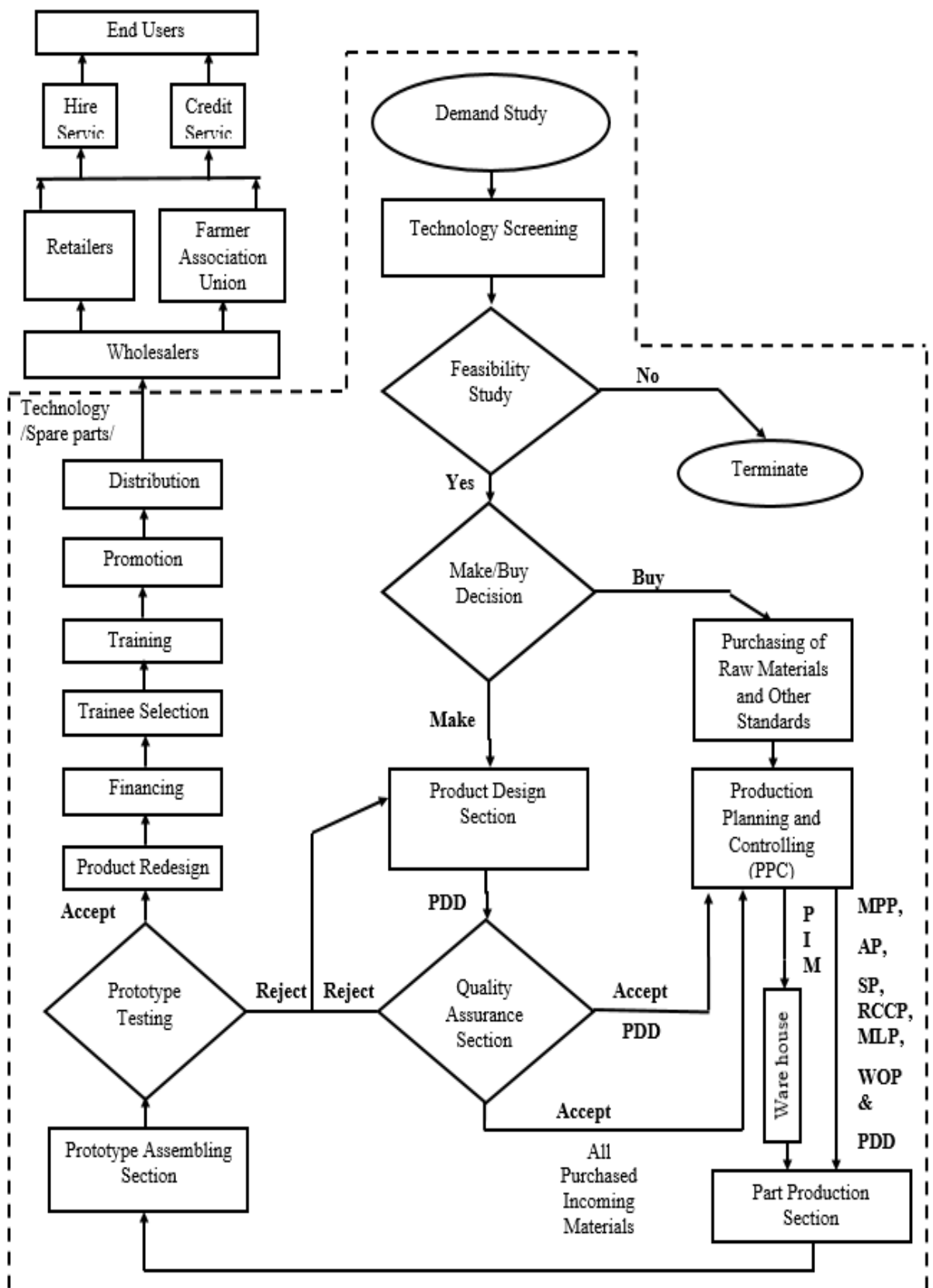
Finally, from the above Fig7 shown, since dependent and independent variables are positively correlated with each other. Therefore, all the identified variables should be included in the following generic production-distribution business model.

4.6 Generic Production-Distribution Business Model

A business model is the conceptual structure model that supports the viability of a business by including its purpose, goals and ongoing plans for achieving. In this thesis, a generic business model is used to express the production and distribution of mechanized agricultural technology process activities at the same time. So that there is no generic production-distribution a business model that shows how to manufacture and distribute mechanized technology for the end-user as a regional level. This has happened even at the national level. At this level, the government didn't give great attention to addressing mechanized agricultural technology for smallholder users or individual farmer. But the government gave great attention only for seed and fertilizer technology by considering that it brings high agricultural productivities in the country

(Kelemu, 2015). In recent years, ATA collaborated with MOA developed a draft document which has value chain procedures about MAT. It has the following procedures which are started from design- import- assembling- distribution up to after-sales maintenance services (MoA, 2014). But it lacks the process activities of how to produce and distribute mechanized technology for the end-users. Moreover, it doesn't offer a particular responsibility of stakeholders for each arrangement tasks. Therefore, so as to bring development for both agricultural and industrial sectors together as Amara regional level, there should be proposed and developed a better generic business model of production and distribution system together. Generally, the developed generic production-distribution business model is used to link different manufacturing industries with agricultural sectors firmly. It enhances poverty reductions, increase and consolidate industry and farm incomes by adding important values on the end products. Therefore, this business model design is considered only on the survey problems result which was identified by Pareto data analysis in the study area such as quality, demand, prototype testing, promotion, training, and hire service. Positive related and correlated variables are included in the generic production-distribution business model. Finally, this generic business model is developed by considering that all parts of mechanized agricultural technology are manufactured in local manufacturing companies.

Figure 8 Generic Production-Distribution Business Model



4.6.1 Generic Production-Distribution Business model Process Descriptions

There are different steps of production-distribution business model process activities that indicate the whole process description and the responsibility of each process that show from demand study up to the end-users. Therefore, each process activities and responsibilities will be described as follows:

1. Demand study

It is the first and the major steps for the processing activity of the generic business model. On this process, the need of the farmers about mechanized agricultural technology is distinguished. On this stage, great attention should be given to make all farmers use mechanized agricultural technology effectively in the study areas. Therefore, the demand study should be conducted before distribute mechanized agricultural technology for the farmers. But if we make and distribute mechanized technology without farmers demand, they will never use it since it is observed perfectly at a practical level. In this process, demand study should be facilitated and conducted by Private sectors, stakeholders and NGO's. This can be done by collaborating with Amara region state of the agricultural bureau. Therefore, the demand of the farmers about mechanized technology can be known by different gathering tools such as:

- ✓ By conducting focus group discussions between farmers, who have some concepts about mechanized technology.

During focused group discussions, their demand can easily be distinguished what the farmers need to have. As a result, by the help of a scientific approach, data on demand can be collected from them.

- ✓ By preparing semi-structured interview questionnaires, it can be gathered the demand data of the farmers about the type of mechanized agricultural technology which is needed in the areas and finally,
- ✓ By collecting data from the previous mechanized technology used complains.

2. Technology Screening

The second step for this processing activity is to select the appropriate technology from the inappropriate one. Because the demand of the farmers is to get more in types and quantities of mechanized technology. Since they may not select the appropriate mechanized technology from inappropriate technology which is according to the property of farmland. Therefore, it needs further study to select the appropriate mechanized agricultural technology by using scientific approach or methods such as:

- ✓ Considering and selecting important types of mechanized agricultural technology which is available and appropriate for the study area.
- ✓ Considering and selecting appropriate mechanized agricultural technology according to operation methods, that means, is it needed automatic or manual operations systems to be used in the study area?
- ✓ Considering and selecting the appropriate source of power to be used in the area, does it use fuel engine motor or electric motor?
- ✓ Making decisions about whether mechanized agricultural technology is manufactured from abroad or local.
- ✓ Considering and selecting whether mechanized agricultural technology is having spare parts which are available in the market or not.

- ✓ Considering and selecting mechanized technology is easily movable from one place to the other place.
- ✓ Considering and selecting the quality and the cost-effective of mechanized technology in the study area and etc.

Therefore, the technology screening process responsibility should be done and analyzed by only Amara regional agricultural bureau. Since they are experienced to select whether the mechanized agricultural technology is appropriate according to the land type and the type of agricultural productivities or not in the study areas.

3. Feasibility Study

The third step for the generic production-distribution business model process activity is the feasibility study. It is an evaluation and analysis of mechanized technology that somebody has proposed. And it is also known as a feasibility analysis. Moreover, the feasibility study is focused on an economic feasibility study (which is situated about the cost-profit analysis), technical feasibility study (which is situated about the risk assessment and solutions), operational feasibility study (which is situated about controlling, efficiency and services) and finally schedules feasibility study (which is situated about timeline estimations and optimizing resources). The study of this processing activity is tried to determine whether agricultural mechanized technology is technically and financially feasible or not. During economic feasibility study that needs to be considered are annual cost methods, total life average methods, payback period methods and rate of return method of mechanized agricultural technology, in this context, means whether the mechanized technology is feasible within the estimated cost. The feasibility study, which is conducted on this processing activity, should also determine whether a

mechanized agricultural technology makes good business sense, i.e., will it be profitable to increase with respect to agricultural productivities or not.

And finally, the technical feasibility studies that need to be considered the methods as like as financial feasibility study are the quality of the product, the manufacturability of the product, availability of spare parts in the market, maintainability of the product easily and etc. It is also tried to determine how profitable or unprofitable it might be in the study area. Therefore, if the feasibility study is accepted, it leads to the next step to address mechanized technology for the farmers that is according to their need. This feasibility study process can be facilitated and conducted by the responsibility of private sectors stakeholders and NGO's that are collaborating with Amara regional agricultural bureau.

4. Make or buy decisions

Make or Buy decision involves whether to manufacture all parts of mechanized technology in the manufacturing companies or to purchase standard raw materials, standard parts and auxiliary parts of mechanized technology from the other suppliers. The outcome of this analysis should be a decision that maximizes the long-term financial outcome for the manufacturing companies. When we make a decision about whether to buy or make mechanized technology on manufacturing companies, it should consider its profit whether the operational cost of the parts to be manufactured is good or not.

If the local manufacturing companies need to manufacture standards and auxiliaries components, it will take a long time for the manufacturing process. Besides this, the manufacturing cost may be very high. Therefore, the local manufacturing companies should purchase those components from the suppliers rather than to manufacture the above-mentioned parts of the technology. But the majority part of mechanized

technology can be manufactured with a minimum cost in the manufacturing companies.

By considering and thinking the alternatives at minimum costs, the manufacturing companies can make a decision whether it can make or buy. But the main thing that the manufacturing companies should consider before putting a decision about the make, it should be considered the following points:

- ✓ The availability of production machinery capabilities.
- ✓ The availability of skilled operators.
- ✓ The availability of high production speed
- ✓ The availability of purchased incoming materials from the market should be checked. And finally, both make and buy decisions are made with the following procedures as follows :

4.1 Purchasing process

After deciding the decision about to purchase, it should be facilitated a purchasing process by production planning and controlling (PPC) sections. After preparing the necessary PR according to engineering conventions, the purchasing requisitions should be prepared by this section to purchase standards, auxiliaries and standard raw materials from the known suppliers. Therefore, according to Amara regional state purchasing regulation, all items will be purchased according to its specification.

4.2 Make process

After deciding the decision to make, it should be facilitated and accomplished the product design documents on the design section. Therefore, to put decision whether to make or purchase, the responsibility of this process will be for local manufacturing companies by collaborating with ARAB.

5. Quality Assurance

The maintenance of the desired level of quality, which is starting from product development and for every manufacturing process activities, should be assured by the quality section.

They play a crucial role in business by ensuring that products meet certain thresholds of acceptability. They plan direct or coordinate quality assurance programs and formulate quality control policies. They also work to improve an organization's efficiency and profitability by reducing wastes. Therefore, they check every design documents, each manufacturing process activities and plan, prototype testing, all incoming materials, standards, and auxiliaries. Therefore, their goal is a way of preventing mistakes and defects in manufactured products and avoiding problems when delivering solutions or services to customers: which ISO 9000 defines as "part of quality management focused on providing confidence that quality requirements will be fulfilled". Moreover, if all incoming materials are checked and acceptable, therefore, it will be sent for PPC section and this section will send checked incoming materials for the temporary warehouse and the production center will take the raw materials, standards, and auxiliaries from the warehouse to manufacture mechanized technology effectively. And also if product design documents are checked and accepted then, this section will transfer this documents to PPC to prepare the production planning such as AP, MSP, LB,ML,BoQ,MPP and then it will be sent for the production center to ahead the manufacturing process activities, if it is rejected, the design documents will be sent again for the design section to see it in details about their faults. Moreover, the purchased incoming materials, standards and auxiliaries will be sent again for PPC to return all purchased materials back again for the suppliers. So, all this process can be facilitated and the responsibility for local manufacturing companies.

6. Production Centers

It is a fundamental manufacturing processing centers that have different part manufacturing sections such as fabrication process section (in which all sheet metals and plates are rolled, bend, shear and cut), machining process section (in which round bars are cutting, facing, grooving, turning, shouldering, threading, gearing and knurling are made), foundry and wood pattern making section (in which wood patterns with different shape is made and casting for none ferrous and ferrous are melted according to the shape of the product design) and electrical production center (in which control boards and motors windings are made) and finally the Part assembling section (in which all manufacturing parts of mechanized technology are finally assembled and tested). Therefore, to proceed the parts manufacturing process, all the production planning together with design documents should be sent by PPC for the production center that helps to manufacture parts of mechanized technology effectively such as aggregate plan, master schedule plan, rough-cut capacity plan, manufacturing process plan, machine loading plan, and work order plan. In production center, all quality engineers should be involving for each manufacturing process activities to check whether each part has a quality or not according to the design documents. These all the above processes are the responsibility of local manufacturing companies.

7. Prototype Testing

It is an early sample, model, or release of a product built to test a concept or process or to act as a thing to be replicated or even learned from. On this process, the quality engineers are involving to test whether its mechanism is working and well-

assembled according to the design document. If it is accepted, therefore, it will be redesigned and put as a document for the next mass production systems.

Whereas missed parts which were obtained especially during the manufacturing process will be included during the product redesign process. If it is rejected, it will be sent the design documents again to the design section to amend and revise the whole design documents. Therefore, Prototype testing has several benefits: the product designer and implementer or the customers that can get valuable feedback from the users early in the product developments. Moreover, the client and the contractor can compare if the product made matches the product specification. Therefore, the manufacturing and the prototype testing will be the responsibility for local manufacturing companies.

8. Financing

The financing process for the training purpose should be facilitated by the Amara regional agricultural bureau, private sectors and NGO's so as to give aftersales maintenance services on the study area. Therefore, financing strategy is integral to an organization's strategic plan for Amhara regional agricultural bureau and others.

It sets out how the organization plans to finance its overall operations to meet its objectives now and in the future. The financing strategy summarizes target and action to be taken over three to five year period to achieve the targets for it. So, finding the finance for training purpose is the responsibility for Amhara agricultural bureau by collaborating with other NGO's, stakeholders and private sectors.

9. Trainee Selection

Amhara regional agricultural bureau should set criteria's to select the trainees from where the area in which mechanized agricultural technology will be distributed. Because the main aim of giving such training is to address aftersales maintenance service in the area. Selection of trainees can be additionally facilitated by other

Privet sectors, stakeholders and NGO's according to the criteria which are set by ARAB.

The other issue is to consolidate small and medium workshops and blacksmiths by giving different types of training about maintenance, part production, operation and assembling of mechanized agricultural technology effectively by the manufacturing company. Moreover, the trainees are selected from the manufacturing company so as to get training about how to produce parts of the technology with the help of different production types of machinery too. Therefore, the responsibility of trainee selection will be for ARAB, NGO's, Private sectors and AMIMTDE.

10. Training

It is a process of learning in theoretical and practical training that should be really given for small and medium workshop institutes, blacksmiths and end-users. Therefore the trainees should be selected by Amhara regional agricultural bureau, Private sectors, NGO's, stakeholders and local manufacturing companies. The training process should be focused on the practical aspect about how to manufacture, maintain, operate and assemble of mechanized agricultural technology which is distributed for the end-users. Therefore, the training process activities should be responsible for local manufacturing companies.

11. Promotion

The objectives of any marketing promotion are based on the goals and strategies of the manufacturing company launching the technologies that can manufacture. In general, the marketing objectives of promotional efforts are aimed at attracting new customers, increasing sales, creation of a corporate image, raising awareness, or expanding market penetration. Because of the above reasons, the local manufacturing companies should introduce their prototype for the end-users.

Therefore, this process activities are the responsibility for local manufacturing companies.

12. **Distribution**

It is a process which is concerned with ensuring mechanized technology have been delivered to targeted customers directly in a cost-efficient manner. Distribution is the process of making a product or service available for the consumer or business user who needs it. This can be done directly by the producer or service provider or using indirect channels with distributors or intermediaries [Merriam-Webster Dictionary,<https://www.merriam-webster.com/dictionary/wholesaler>].

Typical intermediaries involved in distribution model include:

Retailer: A merchant intermediary who sells direct to the public.

Distributors: this method may be used by either of NGO's, private or Governmental Offices.

Agent: An intermediary who is authorized to act for a principal in order to facilitate exchange. Unlike merchant wholesalers and retailers, agents do not take title to goods, but simply put buyers and sellers together. Agents are typically paid via commissions by the principal. From this point of view, the following distribution process activities are described in the following ways:

The distribution process activities of mechanized agricultural technology with spare parts should be done by the responsibility of local manufacturing companies.

13. **Wholesalers**

A merchant intermediary who sells chiefly to retailers, other merchants, or industrial, institutional, and commercial users mainly for resale or business use. Wholesalers are typically sold in large quantities. [Merriam-Webster Dictionary, <https://www.merriam>

webster.com/dictionary/wholesaler]. They buy mechanized agricultural technology with spare parts in large quantity from local manufacturing companies and finally, they sell it for retailers as well as for FUA at a minimum cost. Therefore, this processing activity will be the responsibility for private sectors.

14. Retailers

It is a private sector that buys different mechanized technology with spare parts from wholesalers. And also, they sell it for the end-users or customers either through hire or credit services. In this distribution business model, the retailers can buy different mechanized agricultural technology with spare parts from the wholesalers only and they can sell mechanized technology for farmer's association union as well as for individual farmers. Therefore, this processing activity will be the responsibility for private sectors.

15. Farmers Association Unions

These are the groups of farmers that are working on different business activities together. So, thus association union can purchase mechanized agricultural technology from either distributors or wholesalers. Finally, they distribute/sell/and address mechanized technology for individual/grouped farmers either by hire service, credit service or direct selling mechanized technology at minimum cost. Therefore, the responsibility for this processing activity will be for the farmer's association unions.

16. End users

Those are farmers who are responsible for using mechanized agricultural technology in the study areas. The farmers should obtain mechanized agricultural technology either through credit services, hire services or directly purchased from farmers' association union, distributors, and retailers. Therefore, the responsibility of this processes activity will be for an individual farmer or grouped farmers.

Table 11 Process activity and Responsibility

Input	Activities	Output	Responsibility
Research Input	Demand study	Gathering technology demand scientifically	Regional Agricultural Bureau, Privet Sectors and NGO's
Different types of mechanized agricultural technology	Technology screening	Appropriate mechanized agricultural technology on the area	Regional Agricultural Bureau(RAB)
Appropriate mechanized agricultural technology in the area.	Feasibility study	Decisions making about the relevance of mechanized agricultural Technology	Regional Agricultural Bureau, Privet Sectors and NGO's
The relevance of mechanized agricultural technology in the area.	Yes	Selecting only the relevance mechanized agricultural technology on the area.	Regional Agricultural Bureau
Irrelevant of mechanized agricultural technology for the study area.	No	Terminate the activities and findings on the other alternative mechanized agricultural technology	Regional Agricultural Bureau
Standards, auxiliaries and raw materials for mechanized agricultural technology	Make or Buy decisions	Made decisions either of the two alternatives according to the production capacity	Local manufacturing companies
Standards, auxiliaries and raw materials for mechanized agricultural technology	Buy/ Purchase different raw materials and standards	Purchasing the necessary incoming raw materials, axillary and standards for mechanized agricultural technology	Local manufacturing companies
All purchased incoming raw materials, standards and axillaries for mechanized agricultural technology	Check the Quality of raw materials, standards, and axillaries according to design document specification	Checked incoming raw material, standards, and axillaries according to the design document specifications	Local manufacturing companies
Rough design documents	Prepare and sketch a design document for different manufacturing parts	Final design documents for manufacturing parts	Local manufacturing companies
Final design document for mechanized agricultural technology	Checked the quality of final design documents	Quality and checked design documents	Local manufacturing companies
Quality and Checked Design Documents	Plan each manufacturing parts	Finished aggregate plan(AP), Master Schedules Plan(MSP), Rough-Cut Capacity Plan(RCCP), Machine	Local manufacturing companies

	Process activities by PPC	Load Plan(MLP), Manufacturing Process Plan (MPP), Bill of Quantities (BoQ)and Work Order Plan(WOP)	
AP,MSP,RCCP,ML,BoQ,WOP and Design Document	Make manufacturing parts through different production process activities on production center	Finished the process of manufacturing parts according to the design document and production process plane	Local manufacturing companies
Manufactured parts of mechanized agricultural technology	Quality Checking each manufacturing parts and production processing activities and plan according to the document	Checked manufacturing parts in details according to the design document	Local manufacturing companies
Checked manufacturing parts of mechanized agricultural technology	Assembling all the completed manufacturing parts according to the design document	Assembled prototype	Local manufacturing companies
Assembled prototype	Checked the quality of the assembled prototype according to the design document and production process plan	Finished the checking process of the prototype according to the design document or not	Local manufacturing companies
Finished prototype	Testing the mechanism of the finished prototype according to the design document	Accepted prototype testing according to the design document	Local manufacturing companies
Finished prototype	Testing the mechanism of the finished prototype according to the design document	Rejected prototype testing according to the design document	Local manufacturing companies
Rejected prototype	Amend the whole design document	Rejected the manufactured prototype	Local manufacturing companies
Accepted prototype	Redesign the design document which is obtained an error during the manufacturing process	Accepted and corrected according to the manufactured prototype	Local manufacturing companies
Financial requirement for training purpose	Financing	Financing support	RAB, Private Sectors, NGO's and Local manufacturing companies
Selection criteria	Trainee selection	Trainee selected from the mechanized technology distribution area	RAB, Private Sectors and NGO's
Trainees	Training Process	Skilled trainees about how to maintain and operate mechanized agricultural technology	Local manufacturing companies
The end product of mechanized agricultural technology and spare parts	Distribute mechanized agricultural technology and spare parts	Distribute for wholesalers	Local manufacturing companies
Mechanized agricultural technology and its spare parts	Selling end products of mechanized agricultural technology and its spare parts	Selling for retailers and farmers union association	Wholesalers

Mechanized agricultural technology and its spare parts	Selling end products of mechanized agricultural technology and its spare parts	End-user can use mechanized technology and its spare parts through hire or credit services or direct purchasing mechanism	Retailers and FUA
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CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In this thesis, descriptive statistics and correlation tools were used to analyze the collected data. Both tools were very important to know the level of agreement of the respondents as well as the relation of each dependent and independent variables which are positively significant at different p-values. And also, Pareto chart data analysis, which is a scientific tool, was used to know and identify the causes of the problem in the study areas. Therefore, all parts of mechanized technology should be manufactured by local manufacturing companies using a developed generic production-distribution business model. But standard parts such as bearings, bolts, washers, and nuts as well as auxiliary parts such as motors, engines, and hydraulic components should be bought from abroad manufacturing companies since it costs high for its manufacturing process. There are different identified factors and challenges such as lack of trainings, poor quality of the technology, inaccessibility of after sales maintenance services, hire services and credit institutes, shortage of finance and inaccessibility of production and maintenance workshops on the study areas that need to focus and work strongly to eliminate all the above problems which hinder not to use effectively about mechanized agricultural technology for the end-user. Mechanized agricultural technology, which was collected through need assessment

study such as maize Sheller's, motor pump, rope pump, seed planter and tractors should be addressed for the end-users on the study areas. The design documents and for each manufacturing process activities and steps in the manufacturing companies should be checked continuously by the quality assurance department as a rule.

Moreover, the local manufacturing companies should promote and test their prototype on farmland to check whether the expected mechanism of the technology is effective or not. Finally, the regional agricultural bureau should conduct a demand study and give a manufacturing order for the local manufacturing companies to manufacture mechanized agricultural technology for the end-users.

5.2 Recommendation

The problems are identified which makes the end-user not to use mechanized agricultural technology fully and effectively on the areas. Therefore, appropriate intervention is being required to give solution of the problems which are happened in the study areas. So, to solve the problems which are related to production and distributions of mechanized agricultural technology for the farmers, the following recommendations will be forwarded:

- ↻ Strategic plan for mechanized agricultural technology should be formulated by discussing each other with stakeholders, NGO's, universities, private sectors, and manufacturers.
- ↻ Private producers, distributors, and suppliers should be encouraged exceptional by the government.
- ↻ The necessary infrastructure establishment for local manufacturing companies as well as rural roads should be given great attention by the government.
- ↻ The Amhara credit institute should support and increase a maximum limit to lending more money for the end-users in the study areas

- ↪ The government should subsidize the end-users with financial to increase their interest to use mechanized agricultural technology in the study areas.
- ↪ Design a mechanized agricultural technology that uses standardized parts which can be repaired and serviced at the village level.
- ↪ Quality assurance centers should be established as a regional for checking the quality of mechanized agricultural technology with spare parts, standards, and auxiliaries either it is coming from abroad or local manufacturers.
- ↪ Human resource development structure in the agricultural bureau and offices should be revised to include agricultural technical experts in the study areas.
- ↪ Universities should give advice and support for local manufacturing companies on the design and manufacturing process stage.

Finally, further research is needed to show and know in more depth from another point of view at different locations using different methodologies to understand how to manufacture or distribute mechanized agricultural technology for the end-users in Amhara Regional State.

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Annexes

Annex A. Questionnaires

SEMI-STRUCTURAL QUESTIONNAIRES FOR END-USERS, ENGLISH VERSION.

INSTITUTE OF TECHNOLOGY, BAIR DAR UNIVERSITY.

Thus questionnaires are prepared to undertake a study on mechanized agricultural technology which is used for in agricultural sectors. The purpose of this questionnaire is to gather information about what it looks like the mechanized agricultural technology practices about production and distributions systems used in west Gojjam zone, in Amara regional state and other important related information in agricultural activities. Dear respondents, the result of this study depends on your response that will help for different stakeholder and policymakers to formulate a strategic plan for mechanized agricultural technology about production and distribution system in the future. So your responses are confidential and secured that not to be revealed out for other bodies, therefore, you are gently requested to give genuine responses. Thank you for your time and cooperation.

A. SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE FARMERS

Direction 1: Choose your answer and circle /tick ✓ / it

1. Gender of the household head
 - A. Male Farmer
 - B. Female Farmer
2. Farmland size of the household
 - A. Below 0.5 hectare
 - C. greater than 1 hectare
 - B. (0.5,1] hectare
3. Technical experience of the household
 - A. One year
 - B. three years
 - B. Two years
 - D. Greater than three years
4. Education background of the households
 - A. Not literacy
 - B. Literacy
5. Family size of the households
 - A. below 5
 - C. Greater than 8
 - B. [5-8]

B. SEMI - STRUCTURAL QUESTIONNAIRES FOR FARMERS

1. Semi - structural questionnaires are given below according to the following

2. Likert- scale factors.

- Strongly agree=5
- Agree= 4
- Undecided= 3
- Disagree=2
- Strongly disagree= 1

Direction 2: Choose your answer and tick /✓/ it

COD	SEMI-STRUCTURAL QUESTIONNAIRES	RATING SCALE				
		5	4	3	2	1
A	Socio-Demographic Factors					
D1	Technical work experience affected the farmers' use of mechanized agricultural technology in the study area.					
D2	Family size difference affected the farmers' use of mechanized technology in the area.					
D3	Gender difference affected the farmers' use of mechanized agricultural technology in the area.					
D4	Education background difference affected the farmers' use of mechanized agricultural technology in the area.					
B	Socio-Economic Factors					
E1	Landholding size difference affected the farmers' use of mechanized agricultural technology in the area.					
E2	Do you think that you have purchasing power for mechanized agricultural technology in the area?					
E3	Do you think that there is the availability of aftersales maintenance services in the area?					
E4	Do you think that there is access to get hire services in the area?					
E5	Do you think that there is access to get credit institute which supports and encourages you to purchase mechanized agricultural technology in the area?					
C	Technical Factors					
T1	Do you think that the distributed mechanized agricultural technology is comfortable and easily handled during operation activity?					

T2	The distributed mechanized agricultural technology is good for its quality and durable during operation activity in the area.					
T3	Prototype testing is made to check whether its mechanism is working or not in the area.					
T4	Do you think that there is access to get production and maintenance workshop in the area during mechanized agricultural technology is failed down?					
T5	Do you think that there is the availability of mechanized technology with its type and quantity in the area?					
T6	Do you think that training about how to operate and maintain mechanized technology is given in the area?					

D	Distribution Factors					
D1	Mechanized technology is distributed according to farmers demand.					
D2	The price of distributed mechanized agricultural					

	technology is expensive.					
D3	Villages are located far distance from the working site.					
D4	There is the availability of infrastructure in the study area which helps to supply mechanized technology, spare parts and etc.					
D5	There is the availability of suppliers and distributors of mechanized technology, different spare parts, standards and auxiliaries in the study area.					
D6	There is promotion about mechanized agricultural technology and its spare parts in the study area					
D7	There is communication between farmers and DAs about the use of mechanized technology in the area.					

**STRUCTURAL QUESTIONNAIRES FOR FACILITATORS,
ENGLISH VERSION.**

INSTITUTE OF TECHNOLOGY, BAIR DAR UNIVERSITY.

Thus questionnaires are prepared to undertake a study on Mechanization Agricultural Technology which is used for farmland operators in agricultural sectors. The purpose of this questionnaire is to gather information about what it looks at the mechanization agricultural technology production and distribution systems used and other important related information about mechanized agricultural technology. Dear respondents, the result of this study depends on your response that will help for different stakeholder and policymakers to take appropriate measures and decisions on mechanized agricultural technology production and distribution system in the future. So your responses are confidential

and secured that not to be revealed out for another body, therefore, you are gently requested to give genuine responses. Thank you for your time and cooperation.

A. DEMOGRAPHIC CHARACTERISTICS FOR FACILITATORS

Direction 1: Choose your answer and circle /tick (/ it

1. Gender

- A . Male B. Female

2. Work experience

- A. Below 5 years C. [11,15] years E. Greater than 20 years
- B. [6, 10] years D. [16,20]

4. Education background

- A. Diploma and Certificate
- B. Degree and above

B. STRUCTURAL QUESTIONNAIRES FOR FACILITATORS

1. Structured questionnaires are given below according to the following Likert- scale factors.

- Strongly agree=5
- Agree= 4
- Undecided= 3
- Disagree=2
- Strongly disagree= 1

Direction 2: Choose your answer and circle /tick (/ it

COD	STRUCTURAL QUESTIONNAIRES	RATING SCALE				
A	Organizational Factors	5	4	3	2	1

Fo1	There is Gov't support for mechanized agricultural technology producers, distributors, and end-users in the study areas.					
Fo2	The training was given to the end-users about how to operate and maintain silly activities in the study areas.					
Fo3	The promotion was made in relation to mechanized agricultural technology and spare parts for the end-users in the study areas.					
Fo4	There is after-sales maintenance service which is given to the end-users in the study areas.					
Fo5	There is the availability of hire services in the study area.					
Fo6	There is a good production market linkage between manufacturer and agricultural offices about mechanized agricultural technology in the study areas.					
Fo7	There is the availability of infrastructures (such as electric power, water supply, roads and etc) on the area of the manufacturer for producing quality mechanized agricultural technology for end-users.					
Fo8	There is the availability of private or governmental producers and distributors for mechanized agricultural technology and its spare parts for end-users.					

Fo9	There is a distributor's channel in the agricultural office for distributing the mechanized agricultural technology and its spare parts for the end-users.					
Fo10	Demand study is conducted by the agricultural offices and bureau before mechanized agricultural technologies are distributed for end-users.					
Fo11	There is the availability of infrastructure in the rural area for the distribution of mechanized agricultural technologies for end-users					
Fo12	There are sprayers, wholesalers, and retailers that are working together with agricultural bureau and offices to distribute and supply the mechanized agricultural technology and its spare parts for end-users.					
Fo13	There is a controlling and managing system in the agricultural bureau and offices for distributing mechanized agricultural technologies for end-users.					
Fo14	There are adequate spare parts that are distributed with affordable price in relation to mechanized agricultural technology for end-users.					
B	Personal Factors					
Fp1	You have adequate knowledge about mechanized agricultural technology.					
Fp2	Your educational field study is related to know the concept of mechanizing agricultural technology.					

Fp16	You are taking training in maintenance and operations for any mechanized agricultural technology.					
C	Opened Ended Questionnaires					
1	What kinds of mechanized agricultural technology is the most demanded by the farmers? Would you list them clearly?					
2	What are the constraints for mechanized agricultural technology not to be used by end-users? Would you list them?					
3	What kinds of mechanized agricultural technologies were distributed for farmers still now? Would you list them?					
4	Which of the process owner is responsible to distribute the mechanized agricultural technologies for farmers in your office?					

**STRUCTURAL QUESTIONNAIRES FOR PRODUCERS, ENGLISH
VERSION.**

INSTITUTE OF TECHNOLOGY, BAIR DAR UNIVERSITY.

Thus questionnaires are prepared to undertake a study on Mechanization Agricultural Technology which is used for farmland operators in agricultural sectors. The purpose of this questionnaire is to gather information about what it looks the mechanization agricultural technology used by the farmland operators and other important related information in agricultural activities in this worded.

Dear respondents, the result of this study depends on your response that will help for different stakeholder and policymakers to take appropriate measures and decisions on mechanized agricultural technology production and distribution system in the future. So your responses are confidential and secured that not to be revealed out for another body, therefore, you are gently requested to give genuine responses. Thank you for your time and cooperation.

A. DEMOGRAPHIC CHARACTERISTICS FOR PRODUCERS

Direction 1: Choose your answer and circle /tick ✓ / it

1. Gender

A . Male B. Female

2. Work experience

A . Below 5 years C. [11,15] years E. greater than 20 years
B .[6, 10] years D. [16,20]

3. Education background

A . Diploma and Certificate

B . Degree and above

B. STRUCTURAL QUESTIONNAIRES FOR PRODUCERS

1. Structural questionnaires are given below according to the following

Likert- scale factors.

- Strongly agree=5
- Agree= 4
- Undecided= 3
- Disagree=2
- Strongly disagree= 1

Direction 2: Choose your answer and circle /tick ✓ / it

COD	STRUCTURAL QUESTIONNAIRES	RATING SCALE				
A	Organizational Factors	5	4	3	2	1
Po1	Inadequate infrastructures such as electrical power, water resource, and road on the production area influence the expansion of mechanized agricultural technology in the study area?					
Po2	The lack of production machinery influences on the expansion of mechanized agricultural technology in the study area?					
Po3	The lack of organization and communication culture influences the expansion of mechanized agricultural technology in the study area.					
Po4	Lack of financial bank and credit institution influences the productions and expansion of mechanized agricultural technology in the study area.					
Po5	Lack of production market linkage influences the production and expansion of mechanized agricultural technology in the study area.					
Po6	The existing of limited skilled manpower in manufacturing					

	production sectors that can operate and maintain the technology influences the expansion of mechanized agricultural technology in the study area.					
P7	Discouraging Gov't law, policy, rules, and regulation like bureaucracy, trade license registration, renewal processes, and excessive taxes influence the expansion of mechanized agricultural technology in the study area.					
P8	The end-users' altitudinal towards for local mechanized agricultural technology influence the expansion of mechanized agricultural technology on the study area.					

FOCUSED GROUP DISCUSSIONS GUIDELINE

1. Discussion between the relation of farmers and DA's communication about mechanized agricultural technology in the study area?
2. Discussion what it seems about mechanized agricultural technology training in the study areas?
3. Discussion about Which institute is going to give more training about mechanized agricultural technology in the study areas?
4. Discussion about the main role of Amara credit institute in the study area?

5. Discussion about suppliers and distributors of mechanized agricultural technology in the study area?
6. Discussion about the availability and unavailability of production and maintenance workshops near to study areas?
7. What activities should be done to increase the interest of end-user about mechanized agricultural technology in the study area?
8. Discussion about the institutes that introduced about a prototype testing in the study area?
9. Discussion about in what way that end-users can get mechanized agricultural technology in the study area?
10. Discussion about the interest of the end-users to use mechanized agricultural technology in the study areas.
11. Discussion about what kind of mechanized technologies are needed by the end users in the study areas?

OBSERVATION CHECKLIST

NO	VARIABLES	YES	NO	REMARK
1	There is the availability of suppliers and distributors of mechanized agricultural technology in the study area			
2	There is the availability of aftersales maintenance services in the study area.			
3	There is the availability of hire services in the			

	study area.			
4	There is the accessibility of credit services in the study area.			
5	There is the accessibility of infrastructure in the study area.			
6	There are production and maintenance workshops which are available near the study area.			
7	There are a demand study documents which is conducted by the agricultural bureau and offices experts about mechanized technology needs in the study area.			
8	There is data which is concerning about mechanized agricultural technology in agricultural bureau and offices.			
9	There is a data that shows training is given for agricultural development extension agents about mechanized agricultural technology in the study area.			
10	There are end-users that are used mechanized agricultural technology in the study areas.			
11	There is distributors, suppliers, retailers, wholesalers in the study area.			

The End