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DETERIMINANTS OF FARMER PARTICIPATION TO WHEAT CLUSTER FARMING AND ITS SOCIO-ECONOMIC ROLE IN SODO WOREDA, EAST GURAGHE ZONE, CENTERAL ETHIOPIA

M.Sc. THESIS

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GIRMA KOTO GUDA

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Determinant of Farmer's Participation to Wheat Cluster Farming and Its Socio-Economic Role in Sodo Woreda, East Guraghe Zone, Central, Ethiopia

A Thesis Submitted to School of Graduate Studies, in Partial Fulfillment of the Requirements for the Degree of Master of Science in Agribusiness and Value Chain Management

Girma Koto Guda

Major Advisor: Dessalgn Gachena (.PhD.)

Co-Advisor: Yonnas Addis (Assist. Prof.)

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Wolkite, Ethiopia

APPROVAL SHEET

WOLKITE UNIVERSITY

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As thesis research advisor we hereby certify that we have read and evaluated this titled "**Determinant of Farmer's Participation to Wheat Cluster Farming and Its Socio-Economic Role in Sodo Woreda, East Guraghe Zone, Central, Ethiopia**" prepared under our guidance by Girma Koto Guda .We recommend that it be submitted as fulfilling the thesis requirement for the award of MSc. degree in Agribusiness and Value chain management defense

1. Dessalgn Gachena (.PhD.) _ 10/April/2024
   Major Advisor Signature Date
2. Yonnas Addis (Assist. Prof.) _____ _____
   Co-Advisor Signature Date

As member of board of examiner the Master of Science thesis open defense examination, we have read and evaluated this thesis prepared by **Girma Koto Guda** and examine the candidate we recommended that the thesis be accepted as fulfilling the requirement for the degree of Master Science (M.Sc) in Agribusiness and Value chain management.

1 Zekarias Shumeta (PhD, Associate prof) _____ _____

Name of external examiner Signature Date

2 Bizualem Assefa (Ass.prof) _____ _____

Name of internal examiner Signature Date

3 _____ _____ _____

Name of Chairman, DGC Signature Date

4 _____ _____ _____

SGS approval Signature Date

DECLARATION

I declare that this MSc thesis **entitled "Determinant of Farmer's Participation to Wheat Cluster Farming and Its Socio-Economic Role in Sodo Woreda, East Guraghe Zone, Central, Ethiopia"** is my original work and has not been presented for any degree of at any other university ,and all sources of material used for this thesis have been properly acknowledged

Name: Girma Koto Guda signature: ----------

Department of agribusiness and value chain management

Date of submission: ----------

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LIST OF ABBREVIATION AND ACRONYMS

AC	Agricultural Cluster
ADLI	Agricultural Development Leads Industrialization
AGP	Agricultural Growth Programs
AGRA	Alliance for green revolution in Africa
AGTP	Agricultural growth and transformation plans
ATA	Agricultural Transformation Agency
CF	Cluster farming
CSA	Central Statistics Agency
GDP	Gross domestic product
MoA	Ministry of Agriculture
PASDEP	Plan for Accelerated and Sustained Development to End Poverty
SDPRP	Sustainable Development and Poverty Reduction Program
SSA	Sub Saharan Africa

TABLE OF CONTENT

Contents **page number**

LIST OF TABLES

LIST OF FIGURES

LIST OF TABLES IN THE APPENDIX

Appendix Table

LIST OF FIGURES IN THE APPENDIX

Appendix Figure

ABSTRACT

Cluster farming is an agricultural practice that involves organizing and grouping together farmers within a specific geographic area based on proximity of their farm plots and it increasingly recognized as a viable means of improving smallholder economy in money developing countries .Ethiopia's farming system is dominated by Smallholder farmers who accounts for 96 percentage of total cultivated area generated 95 percent of total production. Agriculture has not been used to its full potential for development in Ethiopia due to low productivity and low-level of value addition of smallholder. Enhancing productivity and value addition among smallholder farmers is broadly perceived as a main strategy which is achieved through promoting agricultural cluster farming approach. This thesis is focused on studying determinants farmers' participation decision of wheat cluster farming and its role in Sodo Woreda of Eeast Guraghe zone of central Ethiopia. In this study both primary and secondary data were used. The primary data were collected from a sample of 274 household heads randomly selected by using two stage sampling techniques. Descriptive statistics include mean, standard deviation, ratio, frequencies, and range. Econometrics models such as Binary probit and *OLS model were employed to analyze the data. Variables, sex of house hold headed, farm size, training access and mechanization use were significantly affect wheat cluster farming in the study area. Lastly this study recommends that actors should invest on linking farmers of both sexes to enhance wheat cluster farming participation of farmers. Mechanization use positively influenced wheat cluster farming participation decision and extent of cluster participation level the government and concerned body should organize farmers and facilitate credit facilities for them to buy different agricultural tools. Training access significantly influenced farmers 'participating in wheat cluster farming so the concerned body should train farmers to bring a good result.*

Keywords: farmer's participation decision and cluster farming

1. INTRODUCTION

1.1 Back ground of the study

The agricultural sector plays an important role in many developing countries. However, Africa‘s agricultural sector performs weakly and its huge potential remains unused. Over the past four decades, the average agricultural productivity growth in sub-Saharan Africa is merely 2.4%, while the productivity of the rest of the developing world improved by 4 % (Dzanku, p. 2019).The greater part of smallholder farmers found in developing countries produce their most of food consumed but their productivity growth has slowed down due to declining soil fertility, low input purchase ability, lack of market accesses (FAO, 2020).

In developing countries like Africa and India, there are many more constraint owing to lower down productivity level of the crop like scattered land holding .One of the most important threat to agriculture production system is small land holding with scattered and the second lack of risk bearing ability as most of farmers are cultivating their crop for subsistence , they are unable to adapt new technological intervention as risk of crop failure or their risk related to socio economic feasibility and increasing population pressure of the countries has been a serious problem which thereby causing shrinking of the land whereby more challenge to harvest and produce from a unit area and time (Singh et al., 2016)

Agriculture in Ethiopia contribute for national growth domestic product b/n 2015 and 2022 36.06%, 34.7%, 33.78%, 31.22%, 33.63% 35.56%, 37.58% and 37.64% respectively and 80% of employment, 70% of raw materials for industry, 85% of food supplies to the country, and 81% of foreign earnings and also agricultural sector is considered to be the main source of livelihood for the majority of Ethiopians as it accounts more than 14 million smallholder farming households has based on these sector *(NBE, 2022)*. Ethiopian agriculture is dominated by smallholder farmers who accounts for 96 percent of total area cultivated land and generated 95 percent of total production for the main crops cereals, pulses, oilseeds, vegetables, root crops, fruits, and cash crops (Alemayehu et al., 2020).

The government of Ethiopia was adopted and started implementing a strategy to improve agricultural production and productivity such as Agricultural Development Leads

Industrialization (ADLI),growth and transformation plans (GTPI and GTPII),Agricultural Commercialization Clusters (ACCs) since 1991.The aim of strategy was improving agricultural extension services, promoting better use of land and water resources, enhancing access to financial services, improving access to domestic and export market and providing rural infrastructure (Demese et al., 2021).

The method of the Ethiopian Agricultural cluster was at first occurred by the wish of the prime minister of Ethiopia in 2014 was to seek out a way that helps for the combination of geographically targeted interventions and to make sure quick, continuous and inclusive development of agricultural trade goods price chain. On the Ethiopian situation, Agricultural commercialization Cluster (ACC) may be a system that brings farmers along and produces an identical agricultural product on selected ecology or farming field *(*Adzawla *et al*., *2022).*

In Ethiopia the Agricultural cluster farming (ACf) was also started with the aim of commercializing smallholder Agricultural farmers for the contribution of different key Goals these key goals are increase agricultural productivity, value chain increasing the incomes of smallholder farmers, increasing industrialization, creating off-farm employment opportunities and increasing exports , substitute imports and developed domestic market (Bondarenko et al., 2016).

In Ethiopia, cluster farming involves about 30–200 smallholder farmers with adjacent farm plots who voluntarily pool a portion of their land to benefit from targeted government support and cluster economic agglomeration (ATA, 2019a: Tabe-Ojong&Dureti,2023). Farm households participating in the clusters are required to contribute at least 0.25 ha of land, and the cumulative land per cluster must be at least 15 ha to harness the full benefits of participation. In these clusters, farmers commit to cultivating cluster priority crops and adhere to the best farm agronomic recommendations.

Beyond farmers, cluster farming approach involves many stakeholders directly or indirectly at each stage along the cluster crop value chain (research, inputs, production, transportation, storage, marketing, and consumption) and fosters back-ward and forward-linkages cluster households are expected to benefit from economies of scale such as greater affordability of modern technology (e.g., sharing the overhead costs of purchasing tractors), stronger bargaining

power (e.g., negotiating favorable prices for their products), and stronger market linkages to serve bulk buyers or a large-scale buyer (e.g., contract farming with large processors) (Dureti, et al., 2023).

Cluster farming approach applies on several cereal crops among that Wheat is grown in the study area. Due to rising incomes and rapid urbanization, wheat is increasingly becoming an important raw material in Africa and sub-Saharan Africa, but sub-Saharan Africa and Africa as a whole meet only about 30% and 40% of their domestic needs, respectively. This leads to high dependence on imports and makes the region highly vulnerable to global market and supply shocks (Negassa et al., 2020).

Ethiopia is the second largest wheat producer in sub-Saharan Africa, after South Africa with a potential of wheat is one of the most cereal crops in terms of the area of land allocated 2.1 million hectares, (1.7 million ha rain feed and 0.4 million ha irrigated) annually with the total production of 6.7 million tons of grain at an average productivity of 3 and 4 t/ha under rain feed and irrigated condition respectively during 2021/22 (Habte, 2022).

The highlands of the central, south-eastern and northwest parts of the country are the main wheat growing areas of Ethiopia; and regionally, wheat production comes from Oromiya (57.4%), Amhara (27%), SNNP (8.7%) and Tigray (6.2%) of the national production *(*Abebe et al.,2020*).*

In Ethiopia, the wheat grain is used to prepare a number of traditional foods it is an important food staple crop in country, and it comprises about 18 percent of the country's total cereal production. The Government of Ethiopia is implementing an ambitious wheat self-sufficiency plan by increasing wheat yields through mechanization, introducing a cluster farming agriculture extension program, and expanding wheat area with irrigation farming in lowlands wheat is an important market-oriented commodity and the main source of income for many wheat farmers in Ethiopia (Demeke and Di Marcantonio, 2013).

The impact of wheat cluster farming on smallholders' asset welfare is crucial this helps to assess whether the income gained from producing wheat under cluster farming could be used to improve the livelihood standards of smallholders through asset accumulation (Getachew, 2023). Therefore, identifying the factors that affect the participation of farmers on wheat cluster in

farming of smallholders' farmer asset building is very essential to produce sufficient household food consumption. Thereafter, it is important to identify factors affecting the participation of wheat cluster farming in the study area.

1.2 Statement of the problems

Consumption of wheat is growing faster than that of all other major food grains in the country, especially pasta and bread, and is expected to continue to increase in the future (Alemu, G et al., 2022). It is a staple diet of many Ethiopians and accounts for about 15% of the daily calorie intake of more than 90 million people in the country (FAO, 2018). Although grain production has increased significantly over the past two decades thanks to various government programs and efforts to improve the country's agricultural development and food security, self-sufficiency in domestic grains and flour is still far from achieved (Gebreselassie et al., 2017). However, the country has significant wheat production potential, which is not yet fully exploited due to various production problems.

One of Ethiopians main challenges in the recent year is increasing wheat production and productivity, by designing and implementing an appropriate wheat policy the country has a wheat supply and demand gap forcing the country to spend a substantial amount of foreign currency for wheat import which are primarily derived from coffee and oilseed export so the increasing imbalance between supply and demand for wheat presents seriously policy issue (Zewdie et al., 2021)

According to (Hei et al., 2017) found that a lack of improved varieties, poor seed supply systems, producers' reliance on local seeds, high fertilizer and seed costs, poor agronomic practices, weeds, pests, and diseases, conflict, weak farmers organizations, poor market information systems, and little research support to increase yields and climate change are major constraints to Ethiopian wheat production. On the other hand, Ethiopian wheat output markets are characterized by an insufficient transportation network, a small number of traders, insufficient capital facilities, high handling costs, an insufficient market information system, farmers' poor bargaining power and underdeveloped industrial sectors (Mohammed and Addisu , 2017) .

Smallholder farmers benefit from cluster economies of scale such as cluster farming are to consolidate smallholder farmers' produce to deliver in bulk to save on transport and transaction costs and greater affordability of modern technology (e.g sharing the overhead costs of tractors), stronger bargaining power (e.g negotiating favorable prices for their products), stronger market linkages to serve bulk buyers or large- scale buyers (e.g., contract farming with large processors) faster dissemination of best practices and extension services among farmers (ATA, 2019).

So many studies have been conducted on factor that affects wheat production and wheat value chain analysis in various part of Ethiopia. However the performance of this new and up to date program service is not studied carefully in the study area in East Guraghe zone Sodo woreda in particular and also what is the socio economic role of clustering farming and the reason for the participation and not participation of farmer on specifically wheat cluster farming is not yet investigated. Wheat demand is rising quickly in Ethiopia despite efforts to improve wheat production.

Recently to balance the demand or consumption (food security),to reduce import of food grains the government of Ethiopia has set up a cluster farming system for high-potential crops like wheat as a means of improving productivity and maximizing the income of smallholder farmers. Therefore, this study aimed to estimate factors affecting smallholder farmers' decision to participate in cluster farming identify existing cluster crop production challenges and also show what are the benefits or the role of wheat cultivation in cluster farm.

It has been few years since Sodo district started wheat cluster farming which indicates that the beginning is good and the farmers have benefited from wheat cluster farming. About 20 to 30 farmers are working together to for a cluster. Cultivation of wheat in clusters is mainly useful for the farmers to use different resources at the same time and to make control work convenient for them. It also increases production and productivity. According to this, they were able to produce up to 45 quintals of wheat per hectare.

What prompted me to do research on this topic is that although there is a good start of cluster farming in the district, what is the main reason why cluster farming is not sufficient in the district in terms of its capacity and potential of the woreda, and to show what are the economic and social benefits of wheat cluster farming? In general, most of the studies were done using crop clusters, that is, they did not study a single crop, but this study focused only on wheat, and the

main reason that made it different from other studies was that the participation rate was also studied for these OLS model for the participation rate is used.

1.3 Objective of the Study

1.3.1 General objective

- To determine farmer participation decision to wheat cluster farming and its socio-economic roles in the study area.

1.3.2 The specific objectives

- To define the determinants of farmers' participation decision in wheat cluster farming in the study area.
- To assess the socio economic role of wheat cluster farming in the study area.
- To assess the factors that affecting level of participation decisions farmer in wheat cluster farming

1.4 Basic Research Question

- ✓ What were the determinants of farmers' participation in wheat cluster farming in the study area?
- ✓ What was the socio-economic role of wheat cluster farming in the study area?
- ✓ What were the factors that affected the level of participation of farmers in wheat cluster farming?

1.5 Significant of the study

The thesis shows a useful information and evidence to government, policy makers, researchers and public community in order to practices cluster farmers benefit, effectiveness and possible future improvement for better use. As well also shows the existing cluster farming practices in the study area and will lead the farmers to decide and use better farming practices. In addition to this the study shows the role of wheat cluster farming on socio and economic as well as identifying it gives know how to benefit from cluster farmer participation in wheat farming practices. Furthermore, it may also serves as a reference material for further research on similar topics and other related subjects

1.6 Scope of the study

This study was conducted at Central Ethiopia, East Guraghe zone Sodo district. The focus of the study was to assess the role and farmer participation decision of wheat cluster farming. The study was also focus to see the different factors that determine the implementation of cluster farming and its socio economic role in the study area. The Study was conducted in 4 sampled Kebele of the district with the involvement of farmers participated in cluster farming and farmers who didn't participated in cluster farming.

1.7 Limitation of the study

Since the issue under investigation, even the AC is introduced newly in the study area, these lead difficult to get relevant reading materials easily for deeper insights. At the beginning the farmers were unwilling to give the information due to peace instability but after a while the problem is solved. The study mainly focuses on the wheat farmers rather than the whole farmers in the study area. And this leads difficult to the researcher to make a decision for the other crop cluster farmer practice in the area as a general. Even the better users of the farmers were not happy to share practice in the AC and a fear of government influence to apply their production because of the price of this year's wheat is much lower than the previous year price so the other non cluster farmers are not willing to produce wheat widely unless the government solve the problem.

1.8 Organization of the Thesis

The thesis is organized into five chapters. Chapter one contains the background of the study, statement of the problem, objectives of the study, research questions, significance, scope, and limitations of the study. Chapter two deals with a literature review on topics related to the study. Chapter three presents the research methodology part, including a description of the study area, data types, sources, and methods of data collection, sampling technique and sample size determination, and methods of data analysis. Chapter four presents results and discussions of both descriptive and econometric analysis. The last chapter, Chapter 5, contains conclusions and recommendations.

2. LITERATURE REVIEW

2.1 Theoretical analysis

2.1.1 Historical back ground of cluster farming

The modern concept of agribusiness development cluster emerged in the 1960s around traditional commodities such as coffee cotton and coca, but the emphasis has shifted over time to non-traditional agricultural exports and horticulture crops such as fruits berries, vegetables and cut flower. This is because agriculture is the greatest potential for sustainable growth in many developing countries (Zavyalov et al., 2017).

Michael Porter was the first to use the term cluster in an economic context. Introduction of the term “competitive advantage of nations” (1990). The term cluster is also known as a business cluster, industrial cluster, competitiveness cluster or Porter cluster.

A cluster is a geographically localized group of interconnected companies and related institutions in a particular area, linked by similarities and complementarities. Clusters take different forms depending on their depth and complexity, but most include end-product or service companies; Suppliers of specialized raw materials, components, machinery and services; Financial institutions and companies in similar industries (Endalew et al., 2018).

The Agricultural Marketing Cluster Initiative concept was introduced in Ethiopia during GTP I as a mechanism to integrate interventions identified as priorities in the transformation agenda in specific geographical areas, targeting a limited number of high-value products. The approach emerged from a request originally made by the Prime Minister in 2006 E.C to identify a means through which geographically-targeted interventions could be integrated to ensure rapid, sustained, and inclusive development of priority agricultural commodity value chains (Ali, M et al., 2016).

2.1.2 Definition of cluster and cluster farming

According to (FAO, 2017) clusters are geographic concentration of inter connected companies specialized suppliers services producer and associated institutions in a particular field that are presented in nation or region and also it is concentrations of firm or business that are located in

relatively close proximity. Agro-based cluster is simply a concentration of producers, agribusinesses and institutions that are engaged in the same Agriculture or agro-industrial sub-sector and connect and create value networks by addressing common challenges and exploiting common opportunities. Cluster farming is a farming practice /program which creates a real profit by merging several smallholder farmers (satellites) attached to a mother farm is called (hub farm) to solid entrepreneurial group is called cluster which capable of sharing both the revenue /benefit as production cost / burden. Hub farm is a mixed farm and consists of a nursery for various local crops livestock breading, fish farm (cat fish and tilapia) and production station for animal feed the hub farm acts as supplier of crop, young animal, feed, fertilizers (Sicuro, B. 2021).

A cluster approach is a sub-system farming aiming at sustainable productivity of smallholder farmers and transforming the country‘s agricultural sector by changing the traditional way of farming. For this reason in Ethiopia in general and in the study area in particular farmers are organized according to their proximity to their adjacent farms. These clusters are established in which farmers are expected to apply full package recommended by agricultural research recommendation, willing to share knowledge to other farmers and permit their farm for field day. In the study area Sodo Woreda, geographic based cluster farming started in 2009 e.c mainly focusing on wheat crop. Clusters established consist of 30 to 60 farmers, total land area 15ha to 30ha with a minimum farm size 0.25 ha per farmer. These clusters enable farmers and expected to practice new approaches, appropriate input and application, ploughing, line sowing, recommended agronomic practices, crop protection, post-harvest and benefited from market linkage, consequently increase productivity and commercialization (SWAO, 2019).

2.2 The role of cluster farming

Clusters allow smaller groups to achieve larger-scale economies and diffuse costs related to skills training, research and knowledge dissemination, certification and quality standards processes, which can be quite expensive and involve a higher risk for farmers acting individually. A cluster allows stakeholders to discuss key strategic barriers and facilitators of an industry‘s competitiveness and strategize effective solutions cohesively. In the process, trust is built along the value chain together with the ability to coordinate and cooperate (Satyarini et al, 2021).

Clusters make easy technology adoption through creating market access. Access to market information affects adoption of improved seed, inorganic fertilizers, and crop diversification positively. This is again conceivable because the availability of market information will reduce transaction costs to farmers in the search to find markets for farm produce and inputs (Ahmed et al., 2017).

Farmer clusters play a significant role in successful technology adoption among group members. There is significant difference between adoption efforts of individual and group these group assist farmers to obtain latest technologies and also allow them to enjoy economic of scale, it helps establish networks with suppliers and provides guidelines for natural resource management and farmers' group has been found to support fellow farmers in the group in adoption of new technologies (FAO, 2017).

In Ethiopia, clusters seek to enable farmers to sell their products at a competitive price to viable markets and increase agricultural productivity in a sustainable manner. Boosting the agricultural productivity and market orientation of smallholder farmers is a high economic development priority for the country and greatly contributes to increasing farmers' income and creating new jobs in agro-processing. The clusters can become geographic innovation to move from subsistence farming toward productive, inclusive environmentally sustainable and commercial forms of farming. Clusters enable increase productivity and strengthen value chains for priority commodities in Agricultural Commercialization Clusters, better input usage, higher yields, and more marketed surplus are essential to move subsistence farmers into commercial operations with greater incomes (Agenda, 2020).

2.3 Challenges in cluster farming approach

Even through Cluster farming is the main strategy to link agriculture and agro processing industries according to (Awan, S et al,2021) report this mode has some criticisms. Environmental related risk like frost, ice rain and moisture stress can damage all farm crops grown in the village and have negative impact on producer farmers who have no alternative farm or means of income. The emergence of newly introduced diseases and pests can lead to crop failures for the entire farm. Example The newly emerging faba bean gall diseases at North Shewa affect the whole cluster and cause huge grain loss during 2007 E.C. Unexpected price failure on selected

crop may leads to automatic rejection of the producers from their business. Cluster farming on specific crop for commercial purpose may lead to nutrition insecurity compared to mixed farming where farmers use domestic consumption from different nutritious crops by their own farm.

According to (FAO,2016) report quality controlling problems like small seed mixture had great impact on product supply to agro processers. Example, In North Shewa Highlands malt barely cluster, during 2009/10 E.C more than 450 quintals of malt barely (Holker variety) was produced for malt production purpose. But lastly, due to the mixture of little amount of other unwanted barley variety during harvesting and trashing, the malt factory was not interested to buy the product. As a result, huge administrative conflict was created with farmers on for whom they should sell their product. Ultimately, through numerous agreements with the factory owners, administrative authorities in the region, the research center and other relevant organizations, the problems were solved without affecting farmers.

2.3.1 Small plot size

Due to the introduction of cluster farming and other new technologies and practices, farm size is a major challenge for Ethiopian smallholder farmers due to increasing population pressure and limited availability of unused land, the amount of arable land per capita is decreasing and farm size plays a key role in cluster farming and the implementation of new technologies. Farmers with larger farms were more willing to adopt and use agricultural policies and technology; Smallholder farmers, in turn, are reluctant to adopt these practices (Josephson et al., 2014).

2.3.2 Lack of sufficient knowledge and information transfer

The lack of adequate knowledge and skills poses a serious obstacle to the implementation of cluster farming and other new technologies and practices in Ethiopia. There are five agro ecological zones in Ethiopia based on climatic factors such as temperature, amount and distribution of rainfall and for which completely different recommendations are required to take into account different agronomic practices. Some practices are more important in temperate and humid climates with higher yield levels for example Integrated Nutrient Management. However, others are more effective in dry and semi-arid conditions where soil moisture needs to be maintained, e.g. conservation tillage (Guja, H et al.2023).

Furthermore, changing rainfall patterns combined with warming trends make Ethiopian agriculture more risky, so new research and technologies must not lead to the neglect of indigenous knowledge, which is also necessary to make Ethiopian agriculture sustainable (Belay et al., 2017).

Another limitation is the ineffective transfer of knowledge, skills and technologies from government and development agencies to local farming communities, and small farmers are often afraid to adopt new practices before they have clear evidence, explanations for their successes and clear explanations of the benefits and risks of these practices see these Practices (Mohammed, E. 2016).

In Ethiopia, for example, the adoption of small-scale water harvesting and irrigation technologies remains a major challenge. This is partly due to farmers' lack of awareness and information about the benefits of small-scale irrigation, crop diversification, higher family income, employment opportunities and participation in community decision-making (Mengistie, D and Kidane 2016). Furthermore, the use of new technologies remains highly gendered, with most related initiatives aimed at men and women, who tend to have less access to new technologies, information and training (Zerssa et al., 2016).

2.3.3 Slow Return of Benefit and Lack of Financial Support

One of the major challenges that hinder the adoption of cluster farming and other new technologies and practices in Ethiopia is its slow return on investment. Many agricultural practices take time to provide tangible benefit to farmers but, due to the low status of the economy and lack of finance, most farmers need immediate benefit from a specific technology or practice as a result, the preference for the adoption of agricultural practices is often lower than that of other income generating activates with fast yield effects (Fuglie, K. O 2018).

Access to finance is a critical factor for smallholder farmers, financial support systems in Ethiopia can be separated into informal and formal institutions and informal financial support institutions are self-support groups for social development (Idhir/Meredaja Mahiber) and traditional voluntary cooperatives (Iqub), formal institutions are micro finance schemes, state-owned banks, and private commercial banks, however there is problems concerning finance and institutional support. Informal financial institutions often lend money at high interest rates, so

smallholder farmers face challenges paying back the loan on time. The formal finance providers support commercial farmers, but often ignore smallholder farmers **(**Abebe, A. 2020**).**

2.4 Agricultural Policies and Strategies in Ethiopia

The main objectives of the agricultural development plan are to increase the income and livelihoods of farmers and pastoralists and to end poverty by increasing agricultural productivity and competitiveness, play an important role in the structural transformation of the economy, in particular to meet the country's food and nutritional needs through the modernization of agriculture; Supplying the industry with raw materials; to provide adequate quantities of exportable agricultural products that have added value (FDRE, 2021). Coupled with policy directives, there have been several major interventions that have sought to accelerate agricultural production and productivity as well as provide a safety net for more vulnerable farmers.

Beyond major policy documents, the Ethiopian Government has sought to better facilitate their stated agricultural goals with at least three major interventions. The Agricultural Growth Programs (AGP1 and AGP2) seek to increase production and commercialization in targeted, high potential woredas. As part of the AGP, the Agricultural Commercialization Cluster (ACC) initiative created geographic clusters of primary agricultural commodities that are designed to support increasing production and productivity while better integrating commercialization activities of the locally targeted crops (FAO2021).

While both AGP and ACC seek to enhance production in relatively high potential areas, the Productive and Safety Net Program (PSNP) is designed to improve food security and resilience for more marginalized rural households by providing direct support to households vulnerable to food insecurity and hunger.

In the last 30 years, Ethiopian agricultural policy and interventions have transitioned from emphasis on increased productivity for poverty reduction to a more market-oriented approach that seeks to facilitate agricultural commercialization and diversification into high value crops as a way to raise income and improve the welfare of rural households (FAO2021).

2.4.1 The Agricultural Commercialization Clusters Initiative (ACCs) in Ethiopia

The ACC contains 24 geographic clusters, spanning 252 woredas across the four major agricultural regions of Ethiopia: Amhara, Oromiya, SNNP and Tigray (see Figure 1). These clusters are considered to play the role of Centers of Excellence, and are being supported in expanding their production and productivity, and in integrating their commercialization activities. Therefore, these areas are meant to serve as 'models for learning' in the process of implementation of the ACC approach and scaling up best practices across the country. In particular, in these clusters the ACC initiative targets 10 prioritized commodities: wheat, maize, sesame, malt barley, teff, tomato, onion, banana, mango, and avocado (Bachewe et al.2014).

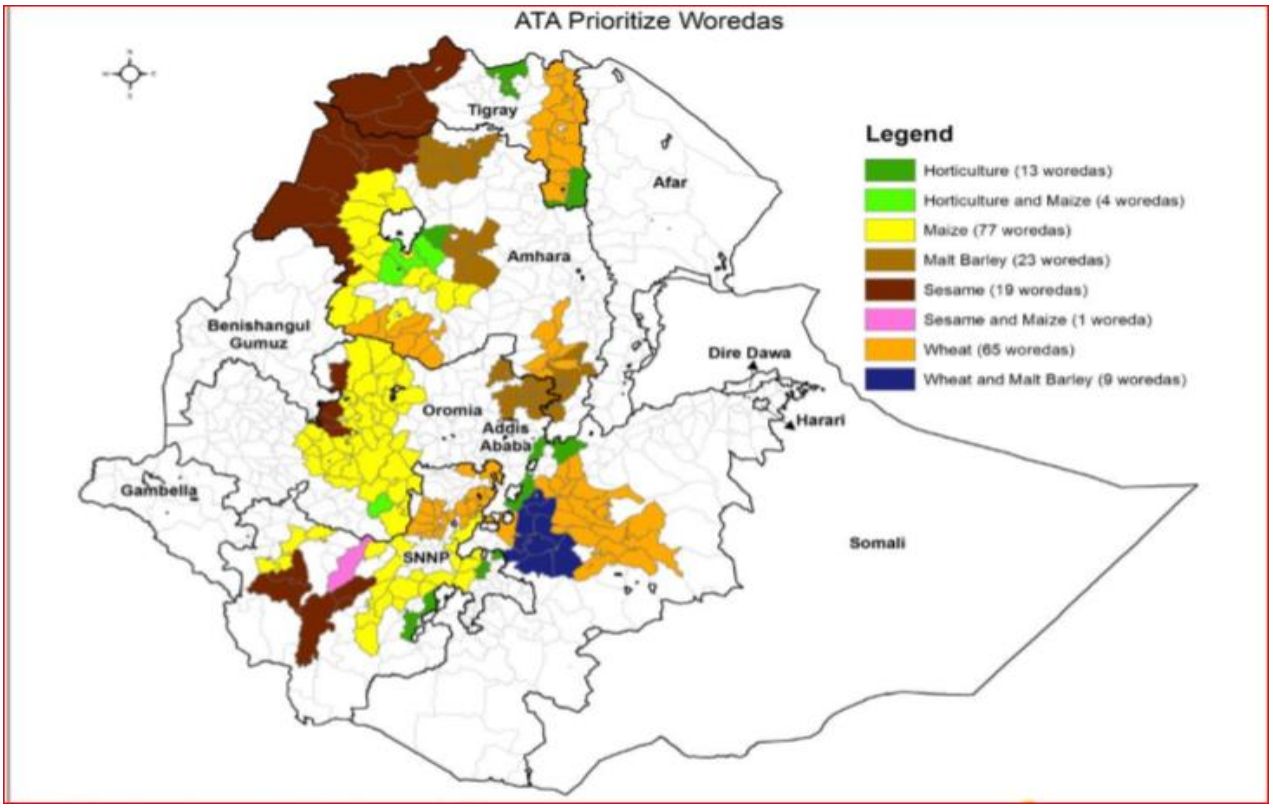

Figure 1 The ACC prioritized woredas in 2018 and 2019

Source: Ethiopian Agricultural Transformation Agency website, www.ata.gov.et

Commercialization of agriculture involves a gradual increase in the proportion of agricultural production that is sold rather than directly consumed by the farm. Smallholder marketing includes both inputs and outputs. As for inputs, as agriculture becomes more commercialized, farmers purchase inputs from the market instead of using their own inputs. This means that the

farmer purchases inputs such as fertilizers, labor, seeds, farm equipment, etc. In the market, the farm owner also becomes the farm manager instead of acting as a farmer in his agricultural area or taking on external tasks to achieve results additional income. On the production side, this suggests that farmer's sell most of their production on the market it is a key element of the agricultural transformation process (Samuel et al., 2016).

The immediate causes include rising agricultural productivity, generating a surplus which can be sold, and improvements in infrastructure which facilitate the sale of agricultural output. It is widely assumed that shifting from low-value staple food crops to higher-value commercial crops raises farm household income and focus on ten major commodities, the ACCs 'aim to develop integrated, end-to-end, geographic value chains supported by vibrant stakeholder alliances to enhance commercially driven output production and processing of high-value crops, thereby offering a consistent supply of sufficient quality, raw materials for processing and value addition' (ATA, 2017).

The objectives of Agricultural Commercialization Clusters are (i) drive specialization, diversification and commercialization of smallholder agriculture in priority value chains; (ii) enhance production and productivity, quality outputs, aggregation, value addition and market linkages; (iii) promote an integrated plat form to implement multiple priority interventions across the value chain and across sectors; and (iv) improve focus and coordination among public sector, private sector, donors and NGOs (Louhichi et al.2019)

In Ethiopia, the existence of the prevailing marketing problems such as lack of competitiveness, price fluctuations, inadequate price information and weak bargaining power of producers increase the transaction cost of the farmers , reliable information on production and market condition assist farmers to form better price expectations and to improve their production decisions (Rahman, A et al , 2019).

2.5 The potential and importance of wheat in Ethiopia

Ethiopia has a diverse agro-ecology potential to grow various crops. Maize, wheat, teff, sorghum, barely, millet and sesame are the most common cereal crops grown in Ethiopia. The wheat growing environment of Ethiopia can be classified in to two major high land wet area and (>1500m rain fed) and low altitude warm dry area most of the wheat crop produced during the

main rainy season June to September , although some area produce wheat during the short rain from march to May and by irrigation.

Wheat is an important food staple crop in Ethiopia, and it comprises about 18 percent of the country's total cereal production. The Government of Ethiopia is implementing an ambitious wheat self-sufficiency plan by increasing wheat yields through mechanization, introducing a cluster farming agriculture extension program, and expanding wheat area with irrigation farming in lowlands. The cluster farming extension system targets smallholder farmers and it aims to increase wheat yields by providing adequate supplies of modern agricultural inputs, such as improved seed varieties and fertilizers, as well as taking steps to mechanize agricultural practices throughout the country (Minot et al., 2019).

Wheat is grown primarily by subsistence farmers under rain fed conditions and ranks fourth in area after teff, maize and sorghum and third in total production of the major cereal crops in the country. To meet annual domestic needs, Ethiopia relies on wheat imports from abroad. Therefore, the Ethiopian government is making active efforts to improve wheat production and productivity through the Agricultural Growth Program to increase domestic supply (Anteneh, A, & Asrat, D. 2020).

Most of Ethiopia's wheat is grown primarily in the Amhara, Oromiya, Tigray and Southern Nations, Nationalities and Peoples (SNNP) regions. These regions account for more than 90% of national wheat production. Currently, wheat is mostly grown under rain-fed conditions. According to the annual report (Brown, B., & Zulauf, C. 2021) for the 2013/14 production season, 4.8 million farmers, or about 53, grow wheat.1 million hundredweight of wheat on 1.78 million hectares of cultivated land, making it one of the most important grain crops in the country. Most farms produce grain every year, but this is still not enough to meet the country's annual domestic needs.

According to the Annual Grain and Feed Report FAO 2014, self-sufficiency in grain production in Ethiopia is only 75% and the remaining 25% of grain has to be imported for commercial purposes and food aid. Therefore, large quantities of wheat are imported every year to meet the growing needs of domestic consumers (Sheehy et al., 2019).

Table 1 Area of production and yield of crop in 2021/2022 or 2014 E.C

Rank	Crop	Area in Hectares	Production in quintals	Yield (Qt/Hec)
1	Teff	3,101,166.56	57,357,101.87	18.50
2	Maize	2,271,442.47	96,283,366.23	42.39
3	Sorghum	1,827,244.34	52,633,478.01	28.80
4	Wheat	1,789,305.87	53,152,703.28	29.71

Source: - cropping seasons (MOA, 2014 e.c)

2.5.1 The potential of crop Production in Former SNNPR

Blessed by the diverse climatic condition, variety of products such as coffee, maize, wheat, teff, pulses, oil seeds, enset, root crops, fruits, vegetables and spices are produced in the region. In addition to that, coffee production accounts for 40% of national production, and spice production is also significant. SNNPR has a considerable portion of the national crop production. Regarding cereals and pulses, the production shares of SNNPR are 8.6% and 9.3% respectively. In the case of vegetables and perennial crops like coffee, fruits and enset, the region accounts for the largest portion of the national production; 45.6% and 49.9% respectively (SNNPRA O2021).

The SNNPR is the third biggest wheat producing region of the country. Major production zones are Hadiya, Silitie, Guraghe and KembataTembaro. Sales rates of Hadiya, Silitie zones and Alaba special woreda are more than 40%. Other zones are less than 30%, which means mainly used for captive consumption (Abuye, F, & Haile, W. 2021).

2.5.2 Wheat commercialization

Commercialization is means of improving smallholder farmers' incomes, and living standards. Wheat is the main industrial and food grain, which ranks second among the most important cereal crops in the world, after rice and traded internationally .It covers a total cultivated land area of 1.6 million hectares, 3.9 million tons of production and 4.7 million farmers engaged in its production with the average productivity of 2.4 tons per hectare in Ethiopia (Falola et al., 2017).

The highland parts of central, southeastern, and northwestern Ethiopia are the main wheat-growing areas. Most of the national wheat production come from Oromia (57.4%) followed by Amhara (27%), SNNP (8.7%), and Tigray (6.2%) (CSA, 2014). A large amount of wheat, except few government-owned large-scale (state) farms and commercial farms, is predominantly produced under rain-fed conditions in the country the area coverage, production, and productivity of wheat are increasing but with fluctuation (Demeke and Di Marcantonio , 2013).

Wheat is also an important market-oriented commodity and a major source of income that provides the livelihood for many smallholder farmers in Ethiopia the total wheat production is sold in the market while 60% of it is used for human consumption, and the remaining 20% is used for seed, in-kind payments for labor, and animal feed (Dibaba, R. (2019).

2.6 Empirical review

2.6.1 Impact of cluster farming on farm productivity and commercialization

A study in Nigeria using Ordinary least square (OLS) to examine the effect membership of group farming cooperatives on food production and productivity of farmers showed membership of group farming cooperative helped to increase food production and productivity (Adekunle, 2018).

Productivity and commercialization focuses on sustainable increases in productivity and profitability of smallholder farmers to improve their livelihoods (ATA 2019b). As a result, improved access to market is one of the outcomes of cluster farming to enhance smallholder farmers' livelihoods through a market-oriented production system (Tafesse 2022).

Worldwide, cluster farming have obtain due attention of policy makers in the last two decades, because it has been considered as potential driver of competitive agriculture (Balcha et al., 2014). The farming technique boosts local farm products which also enhanced agricultural production and accomplishment of food security. The system also results in better productivity and output which in turn reduce import and accelerate food sufficiency in Africa (African hervesters, 2020). The device has also become a viable factors for the agriculture in the 21stcentury to address globalization, high-value production, distribution and packaging innovation, and more efficient production (Karina et al., 2021).

Cluster farming have shown to increase profits of smallholder farmers through bulk purchase of inputs and output sales, as well as easy access to agricultural information and new agricultural techniques and innovations which is an hedge compared to non-cluster farming (Montiflor et al., 2018). The absence of extension services, inadequate and bottlenecks in accessing credit, poor infrastructure, and access to markets among others are many hindrances non-cluster farmers faced that can be overcome by providing extension agents, input providers and market access through cluster farming (Oakeshott, 2016). Therefore, cluster farming is identified as one of the farming techniques required to enhance productivity.

Schulte et al. (2023), discussed that an increase in commercialization level also reduces multidimensional poverty of farmers. Accordingly, World Bank (2012) suggested a cluster-based approach to enhance agricultural productivity to reduce poverty. A cluster approach is a sustainable farming practice to transform subsistence crop production into a market-based production system (Otsuka and Ali 2020). As a result, agricultural clusters are popular both in developed and developing countries to improve productivity, commercialization and income of farmers (Galvez-Nogales 2010; Ping and Koziol 2011; Rasulov et al. 2020).

In Ethiopia, agricultural production is dominated by subsistent and smallholder farmers (Boere et al. 2016; Getahun 2020). As a result, smallholder commercialization is a driving force to transform subsistence agriculture in Ethiopia (Getahun 2020). The government of Ethiopia is striving to improve smallholder farmer's productivity and commercialization. Accordingly, different development interventions have been launched to realize the commercialization of smallholder agriculture. Thus, cluster farming is the main agricultural development intervention that has several advantages in transforming traditional agriculture through vertical and horizontal linkages with value chain actors (ATA 2015; Endaznow 2020; Mamo 2019).

It focuses on sustainable increases in productivity and profitability of smallholder farmers to improve their livelihoods (ATA 2019b). As a result, improved access to market is one of the outcomes of cluster farming to enhance smallholder farmers' livelihoods through a market-oriented production system (Tafesse 2022). Consequently, high-value commodities are targeted by cluster farming to transform subsistent production to market driven production through market linkages with value chain actors in the four cluster farming priority regions of Ethiopia

such as Amhara, Oromia, Southern Nations, Nationalities and People's (SNNP) and Tigray (Abate 2021; Louhichi et al. 2019; Pauw 2017). As a result, approximately 3.05 million quintals of high-value commodities (sesame, maize, wheat, malt barley and teff) were sold through contracts signed between farmers and value chain actors in the 2020/21production season (ATA 2021).

2.7 Factors that Determinates the participation of farmers in Cluster farming

According to (Mafwilaet al., 2019) there were approximately 2 billion people which rely for their livelihoods on 500 million smallholder farms in the whole world. The same source also explains of the total food consumed in Asia and sub-Sahara Africa, 80% is produced by these small farms. Most of these smallholder farmers focus on a subsistence level of production in which they produce only for self-consumption.

As source indicates the issue of commercialization of smallholder farmers, especially in developing countries, could have a positive impact on performance and on livelihood generation, (Muriithi and Matz 2014:85). Even though the commercialization that is implemented on smallholder farmers land, with the support of the government has a positive impact on the life of the small holders' there are various factors that determine the participation of the farmers in cluster farming.

2.7.1 Farmers' awareness level

As it was explained by (Padhy et al., 2015) argue that farmers with more education have more knowledge of improved agricultural technology and are therefore more willing and more likely to apply technology in their farming faster than the uneducated or less educated once. So Education that helps for the creation of awareness for the farmers is the most important factors that highly determine the willingness of an individual either to accept or reject new ideas and innovation.

2.7.2 Market efficiency

An efficient system guarantees the farmers better prices for farm products and induces them to invest their surpluses in the purchase of modern inputs so that productivity and production may increase (Minakov, & Nikitin 2019).

During the visit by the former Prime Minister of Ethiopia, Haile Mariam Dessalgn and the higher government officials‟ that was done in December 2017 at the woreda under study farmers were expressing their problem related to market linkage with the production of large amount of products. In the interview with the journalist one of the farmers express the issue as follows:

“The other problem was absence of market linkage. This is because we grow wheat seed called 'Dendewa'. Since we did all agricultural activities as per the lesson we took, we will expect satisfactory yield. But now we are thinking mostly to have surplus production, however the price of wheat may fall down.”

According to the same source the North shewa zone agriculture district head explained as wheat is the one among the crops that faced problems related to market. During the 2015/16 production season, the price of wheat was down to 600 Birr per quintal. Thus, without adding some value, selling such products is not profitable. On the other hand the study done in SNNPR Konta special woreda, (Bachewe et al., 2016) explains as market actors were facing increasing marketing inefficiency in the local market.

2.7.3 Infrastructure

Besides providing essential agricultural production conditions such as roads, telecommunications, powers and irrigation system, rural infrastructure also provides education and medical services related to Improving the quality of work in rural areas, such as cultural and educational institutions, vocational/technical schools, medical institutes, etc (Fungo et al., 2017).

A study conducted in the Philippines (Ahmad, M., & Islam, P.2019) showed that a good Irrigation infrastructure and facilities improve farm profitability and productivity. They point out that nitrogen fertilizers, pesticides and irrigation are positively correlated with yields influences this significantly. However, road construction impacts the higher price of urea fertilizer is expensive in areas with poor roads due to the higher transportation costs of

purchasing this raw material. Farmers tend to use more nitrogen fertilizer because the price is lower due to lower transportation costs. All of these problems arise from the lack of inadequacy of infrastructure in a particular area, which negatively affects the implementation of the cluster farm.

2.7.4 Sources of capital or financing

The level of access to financial credit remains a major challenge for smallholder farmers in most developing countries. The problem is often seen as limited access to production credit for the purchase and use of farm inputs, as well as for payment of non-family farm labor and other farm maintenance costs.

According to (Balana et al., 2022), the reasons why the financial system does not meet the demand of the agricultural sector include seasonality with a longer gestation period, Burden of systematic risks, limited collateral, higher transaction costs and bank competition Priorities.

As to the study that was done in Merit and Adamitullu Jido Kombolcha districts in Oromiya regional state of Ethiopia (Zewdie, T. D.2015), credit constraint status of households is defined broadly across all types of credit suppliers.

2.7.5 Mechanizations

Food and Agricultural Organization (FAO) show that Africa has less than two tractors per 1000 ha of arable land. In 2012, average tractor use in sub-Saharan Africa was about 1.3 per 1,000 hectares of arable land, compared to about 9.1 in South Asia and 10.4 in Latin America (Baudron et al., 2015).

According to the Ethiopian National Strategy for Mechanization of Agriculture (Challa, T. G. 2016), the use of mechanization in Ethiopia in the Agriculture sector is by far less than other African countries due to Lack of agricultural mechanization policy and strategy; and institutional capacity, land size and topography, lack of physical machinery available and lack of awareness of agricultural machinery.

2.8 Conceptual Framework

2.8.1 Factors for farmer's participation in wheat cluster farming

There are various determinant factors for the participation of farmers in wheat cluster farming among those the major determinant factors are listed in detail.

The farm size of Farmer determine the participation farmer with large land size or more farm make them more likely to participate in wheat cluster farming, mechanization also another determinate factor for their participation the availability of mechanization has increased the possibility for farmers to cultivate wheat in cluster as it is useful for them to cultivate crops in cluster and to collect their crops in time. Experience is another important factor and the more experience, the more they deiced to farm and work together in cluster

Money or financial sources is an important determinant factor for farmers, for the proper supply of various inputs, i.e. soil fertilizer, various chemicals, land rent, to buy the beast seeds, to hire man power, in general from land preparation to harvesting, the sources of money has play an important role in sowing wheat in cluster broadly then farmer decides highly participate in wheat cluster farming. Education or training access has a positive effect on wheat cluster farming the more farmers are educated or trained ,the more likely they are to use technology .when they use technology ,their production and saving habit such as time and money saving increase in addition ,when the farmer receive training ,they improved their land management or land care.

Age is also is an important determinant factor for farmer's participation on wheat cluster farming it is expected that increase in age have a positive impact on productivity and market participation. Thus, age of members is assumed to have positive effect on participation of wheat cluster farming. Household size is among the important socio economic factor which influence crop participation decision on wheat cluster farming because a fairly large family size implies more family labor available for the household farm activities. Marital status is also a positive and significant influence on participation of farmers on wheat cluster farming marital status of participants who had married had more likely to participate in wheat cluster farming than those who are single.

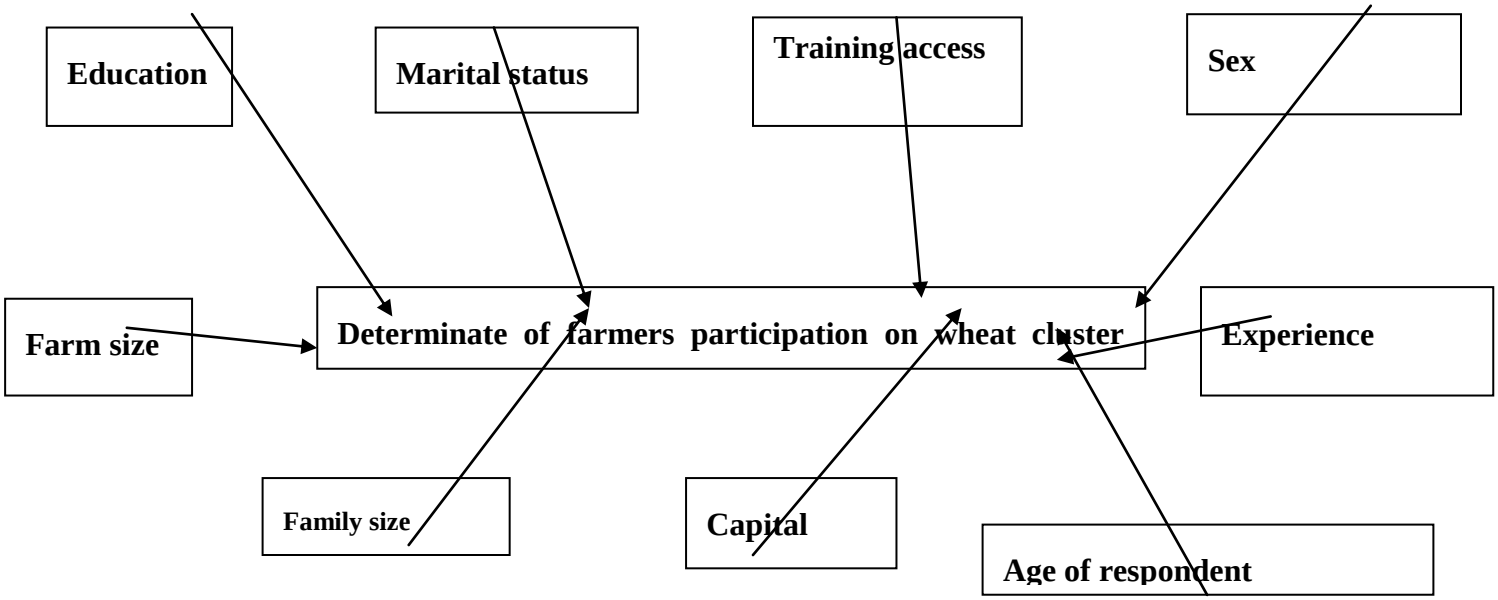

Figure 2 Farmer wheat cluster participation decision

2.8.2 Socio economic role of wheat cluster farming

Cluster farming has many advantages in Ethiopia and Africa, one of them is social and economic advantage. One of the economic advantages is that it creates a convenient environment for getting credit services. By cultivating wheat in a cluster, the chances of farmers getting a loan together are higher because they do the farming together, so they become guarantors or borrowers for each other. Finance organization will create a favorable environment for giving loans to farmers and farmers will also benefit.

Another economic advantage is that the income of the farmers will increase. By cultivating wheat in clusters, the amount of production and the amount of leftovers or biomass production will increase and make them more profitable. Another economic advantage is that it helps them to create market linkages. The farmers are able to deliver the produce produced by plowing wheat in clusters to the farmers. Because of his diligence, the union will go to the fields and store the product in the warehouse without wasting the produce they have produced.

Looking at the social benefits of cluster farming, it allows their children to go to better schools and get quality education when they move to the second preparatory education, they can sit in their houses in the city and buy them the necessary resources another social advantage is that they build quality housing and make separate houses for their animals in addition, the farmers will be healthy, because their income will increase by plowing wheat in clusters, and they will be treated with better health it also keeps them healthy by eating nutritious food.

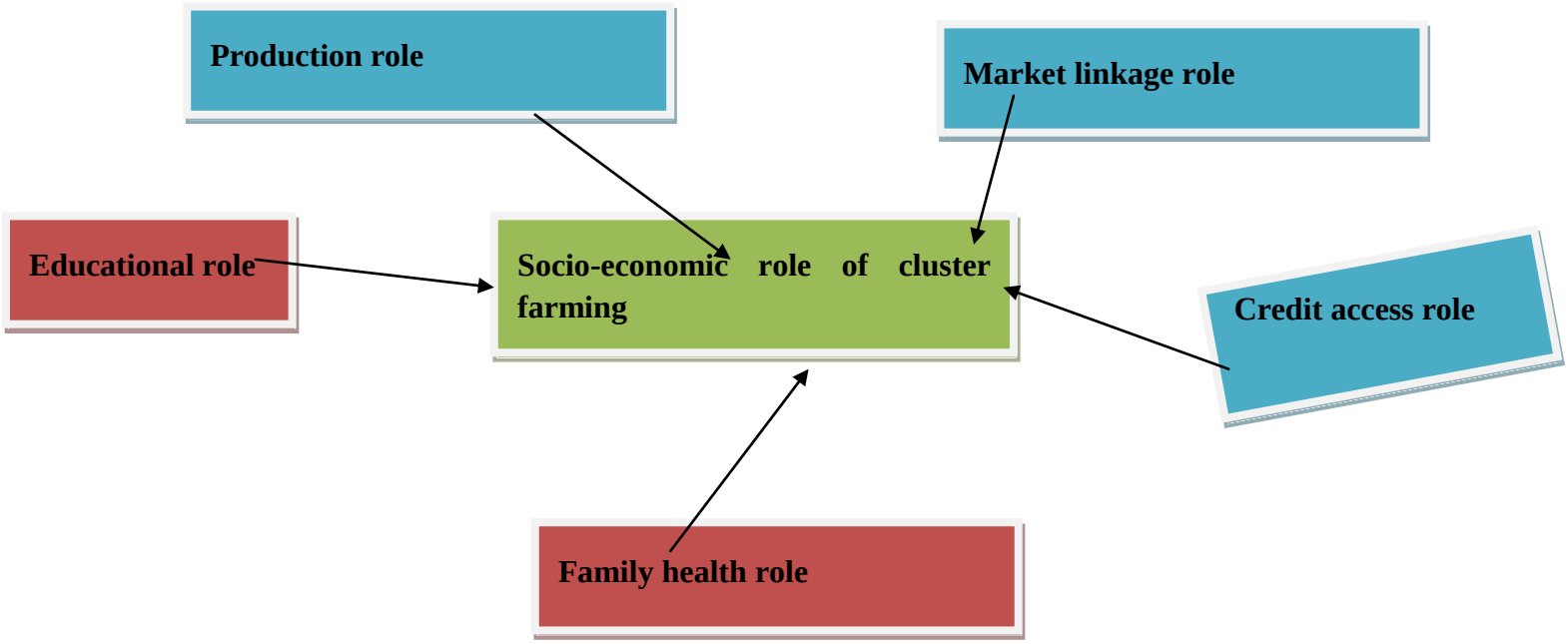

Figure 3 Socio-economic role of cluster farming

3. RESEARCH METHODOLOGY

3.1 Description of the study area

The study was conducted in Sodo woreda of East Gurage Zone in central Ethiopia. The Region as a whole and the study area in particular is known for its agricultural production predominantly in smallholder agricultural activity. Sodo woreda is one of the woreda in East Guraghe Zone. It is bordered at the south direction by the South Sodo woreda at the west direction by Seden Sodo woreda (Oromiya region) at the north direction Sodo Dachi (Oromiya region), and at the east direction by Dugda bora woreda (Oromiya region) (SWPEDO, 2021).

Sodo woreda located 103 far from Addis Abeba, which is the capital city of Ethiopia and about 30 km far from Butajira, which is the zonal city of East Gurage zone. The Woreda lies between 38° 39′ 58.99″ E longitude and 8° 19′ 60 .00″ N latitude with an area of 64910 ha (SWSEO, 2021). The total population of the woreda is 145,616 respectively. Total surface area of the district is 64910 ha or 649.1 km2, the woreda have 36 kebele and also Major cereal crops in Sodo Woreda include Wheat, Teff, Maize, Barley. Previously farmer were cultivating and harvesting on individual plot but now cultivation of wheat in cluster has been recently implemented in Sodo district wheat crop has been also highly cultivated than other crop in the study area (SWAO, 2021).

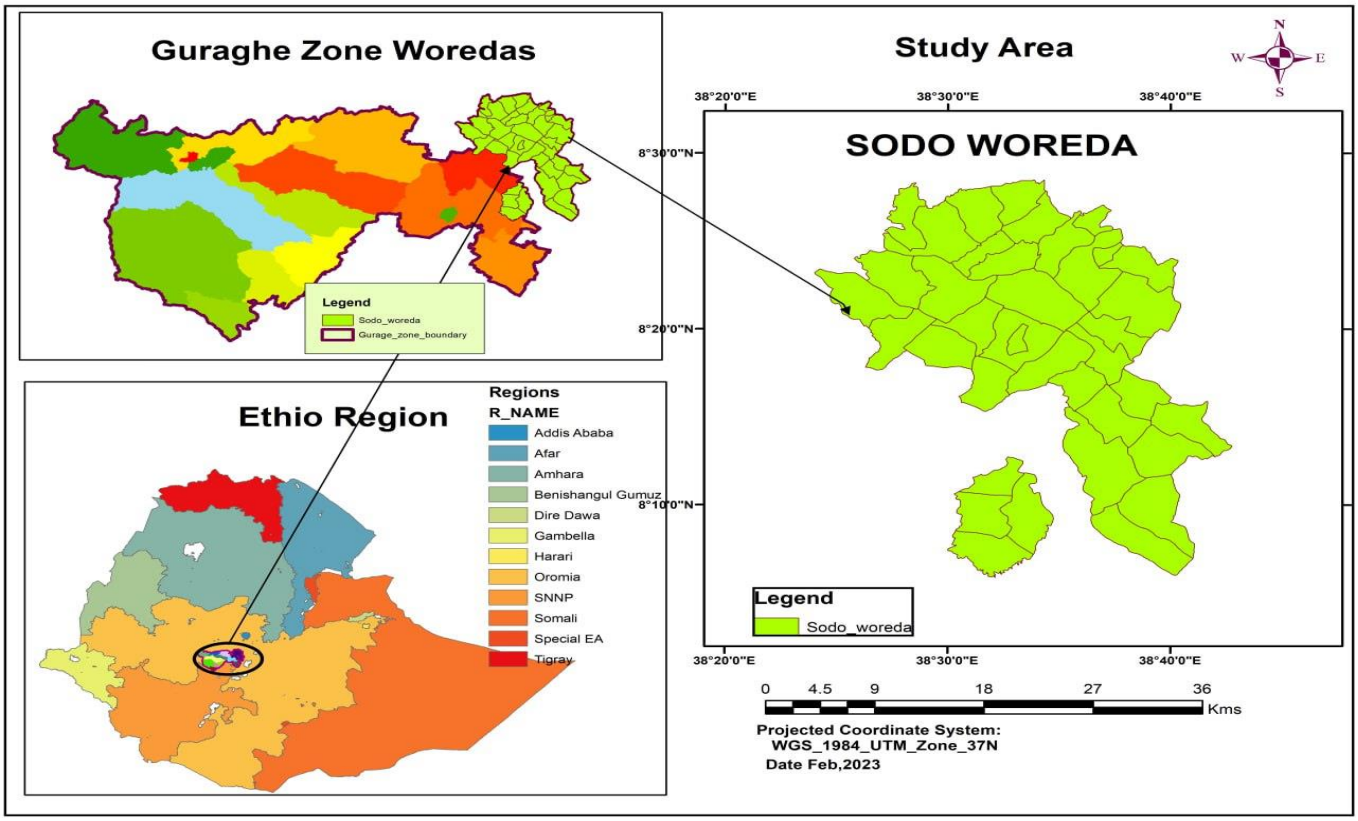

Figure 4 Administrative map of the study area

3.2 Soil of the study area

Wheat can be grown in various types of soil the common types of soil found in the woreda are black soil verti soil, and ultisoil according to Sodo district office of Farming and Natural Resources Development 2013, the black soil is one of the beast soils for the wheat production soils of the research site are predominantly nitisols and black at the lower altitudes and lepto sols at the higher elevations which is suitable for the production of various crop (John *et al*., 2020).

3.3 Climate of the study area

Sodo district includes three agro ecological climatic zones that are locally known as Kola Wayne Dega and Dega. The woreda is divided into 25% Kola 40% Dega and 35% Woyna Dega (Sodo woreda Farming and Natural Resources Development, 2013). The altitude ranges from 1800m to 3040m above sea level. The mean annual rainfall and temperature of the area ranges from 801mm to 1200mm and from 10°C - 25.15°C, respectively. However, the specific research sites is warm semi-arid with temperatures ranging from 18 to 26 °C and annual precipitation between 800 and 1,025 mm (John et al., 2020).

There is a meteorological station at Buee town, which is the nearest to the study area. Based on 10 year rainfall data analysis, the area is characterized by a unimodal rainfall pattern with peaks in July and August with annual average of 1109.2 mm. About 80–90% of the rainfall falls in the main rainy season (Kiremt), this starts in June and extends to August/September. The mean monthly minimum and mean maximum air temperature of the study area were 16.1 and 19.2$^{o}_{C}$, respectively (HMB, 2013).The dry months are between November and March locally known as Bega. Thus, the watershed is under the category of Dega agro-ecology zone (>2500 ma.s.l).

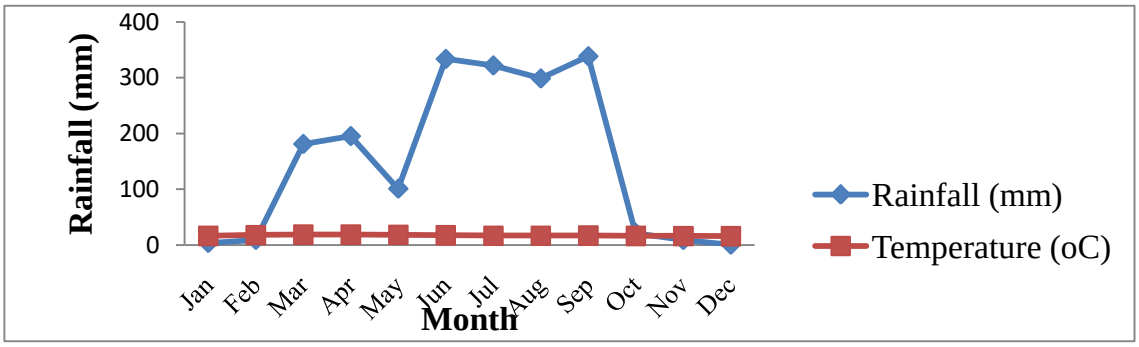

Figure 5 Mean annual rainfalls and mean annual maximum and minimum temperatures of Sodo Woreda

3.4 Sampling technique and sample size

The purposes of this study was to conduct the role of cluster farming on farmer's wheat productivity, commercialization and their participation decision in Sodo woreda of East Gurage zone of central Ethiopia. Two stage sample procedures was adopted to collect the data even though there are different woredas are applying cluster farming both in the regional and zonal level, in terms of its distance, the woredas were selected purposely by using purposive sampling technique. The target population of this study was both farmers who practice cluster farming and those who didn't practice it as per the information obtained from the woreda office of agriculture, in the first stage there are a total of 36 rural Kebeles in the woreda which produce wheat in cluster and then after four kebeles were selected by using lottery method .In the second stage then using random sampling, farmers from those kebeles were selected. In total, 274 respondents (165 respondents under cluster farming and 109 non cluster farming participants) were selected using simple random sampling from both participant and non participant.

Total sample size of smallholder farmers was determined using the simplified formula provided by using Cochran (1977) formula. The total number of wheat cultivators were 954 from these total wheat cultivator 576 are wheat cluster farm applied the other 378 are not applies wheat cluster farm

$$n_o = \frac{z^2 Pq}{e^2} \quad n = \frac{n_o}{1+\frac{n_o-1}{N}}$$

Where;

n_o =desired sample size.

n = number of sample size.

z=is 95% confidence limit i.e. 1.96

p= 0.5 (proportion of the population to be included in the sample i.e. 5%)

q = 1-0.5 i.e. (0.5)

N= is total number of population

e =is margin of error or degree of accuracy desired (0.05)

Using this formula, the sample size was calculated as

$$n_o = \frac{z^2 Pq}{e^2} = \frac{(1.96)^2 x 0.5 x .x o.5}{0.05^2} = 384$$

According to data obtained from Sodo district agricultural office, the total number of cluster and none cluster wheat farming households of the selected kebeles (2023) there are 954 households (N) out of these more than 60% (576) were used wheat cluster farming and the rest 40% (378) were for none cluster farming.

To determine the sample size of cluster farming and to non cluster farming farmer's household $n = \frac{n_o}{1+\frac{n_o-1}{N}}$

The sample size n was calculated for the two groups as;

• $\mathbf{n}$ • $= \frac{384}{1+\frac{384-1}{954}}$ =274

Hence, the total simple size of the research for the two groups of respondents will be 274 households.

To represent an equal proportion of sample households in each association, William (1977) formulas were utilized. Hence, it were done by dividing the targeted sample households (274) with the total number of households in the sample kebele on (954) and multiplied by the total number of households in each kebele farmer association.

Mathematically Ps=n/N X **(**no of households in each sample kebele) Where Ps = Proportional allocation to size, n=Total household sample size (274).

N = Total number of households in the four selected sample kebele 954 (576 CFP +378 NCFP)

Thus, Ps of CFP=n/N x number of members of CFP in each kebele house hold =165/576 x no of households in each kebele = 0.286 x no of members of each cluster farmers in kebele association

Ps of NCFP=n/N x number of members NCF Pin each kebele household = 109/378 x no of households in each kebele = 0,288 x no of members of each non cluster farmers in kebele association

Table 2 Sample size distribution of different kebeles

Name of kebele	Total wheat producers	CFP	NCFP	Sample		
				CFP	NCFP	Total
Soloke	380	273	107	78	31	109
Ejersa	220	127	93	36	27	63
Berber	204	96	108	28	31	59

Gedam	150	80	70	23	20	43
Total	954	576	378	165	109	**274**

Sources Sodo Woreda agricultural office 2023

3.4 Methods of data collection and source

The data for this study were collected from both primary and secondary sources. Cross-sectional data collected from the survey of randomly selected sample farmers. To address the role of cluster farming on farmers 'productivity and commercialization, both qualitative and quantitative types of data were used. To collect primary data, household surveys, key informant interviews, questionnaire, were used. The information to be collected focuses on household characteristics, farm production, productivity, and commercialization of cluster farming participants and nonparticipant status of the area and also direct filed observation for the status of wheat clustered farm.

To collect the household survey semi structured questionnaire that includes open and closed-ended questions were prepared for 274 households; the questionnaire format comprises both qualitative and quantitative questions. Before data collection, the questionnaires were tested. This led to a further revision of the questionnaire to make sure that important factors were addressed well. The field observation also was carried out to have a general view about the study area. Key informant interview from 5 Woreda agriculture office experts and 4 development agents. Secondary data were collected to enhance the concept of agricultural cluster, its role in improving agricultural productivity, and commercialization from reports of Sodo woreda agricultural office, Sodo woreda plan and Economic Development office, journals, and books.

3.6 Method of data analysis

Both descriptive and econometric tools were used to analyze the data collected for this study. The data that were from respondents in the questionnaire were analyzed using Spss version 24 software.

3.6.1 Descriptive Statistics

Descriptive statistics were used to analyze demographic and socio-economic characteristics of the farm households. From the descriptive statistics such as means, proportions and standard deviation were carried on to describe economic and physical characteristics associated with respondents.

3.1.1 Econometric Analysis

Binary probit and OLS model were employed to investigate the determinants influencing farmer's participation on wheat cluster farming and to assess the factors affecting level of participation decisions farmer in wheat cluster farming.

3.6.3 Model specification and selection of variables

Different variables expected to affect household's participation decision, level of participation in the study area. We have two dependent variables one of dependent variable is farmer's participation in cluster farming. The other should be level participation in terms of hectare of land**.**

Dependent variable 1

Farmer's participation decision (CLFP):- The dependent variable in this model is a dummy variable representing farmers' cluster farming participation; taking a value of 1 if farmers are participant in wheat cluster farming and 0 if not so to analysis this objective binary probit econometric model were used

Independent variable

Age of household head in years (Agehh): Age of cluster farm members is expected that the more mature a farmer, the better understanding of cluster benefits. It is expected that older member of the household, which are necessary for the welfare of the household and produce more, take major decisions. It is expected relationship between cluster participation and age is positive with increased production comes from older farmers (Sebatta et *al.*, 2019). It is expected that increase in age have a positive impact on wheat cluster farming participation. Thus, age of members is assumed to have positive effect on participation.

Sex of household head (Sexhh): Male farmers have the tendency of working in groups compare to female farmers due to man-power of male farmers and time consumed in group farming that female farmers will not be able to spare because of the time needed to raise their families. Sex of the household head being female expected to negatively influence the level of participation in cluster farming (Addisu*et al*., 2019).

Family size (Famsize): Household size is among the important socio economic characteristics which influence cluster participation because a fairly large family size implies more family labor available for the household farm activities (Yotopoulos *et al.,* 2016). Family size hypothesized to affect participation. It's a continues variable; the meaning of labor is expenditure of physical or mental effort especially when difficult or compulsory. This variable is measured the number of individual persons who works in the cluster farming at house hold level.

Educational level in years (Eduhh): Education level is very useful in technology adoption and cluster farming participation (Atinafu *et al.,* 2022) assert, an increase in educational status of farmers positively influence the adoption of improved technologies and practices it is assumed that formal education would positively affect the wheat cluster farming participation to enable them adopt new technologies.

Access to credit (Credit): Households with access to credit may help farmers in obtaining the capital required for adopting the higher profit production technologies and therefore increase productivity and cluster participation (Asogwa *et al.,* 2014). Availability of adequate and timely credit help farmers in expanding the scope of operation and adoption of new technology as well as enhancing the purchase and use of some improved inputs. Therefore, credit is expected to have a positive sign on participation.

Farming experience (**FEXP)**: This variable measures the number of years a farmer has been engaged in farming. It can be hypothesized that farmers with more experience are likely to allocate resources efficiently which then can result to higher crop yield due to cluster participation and enhance more revenue from the output sales. Thus, there is a positive correlation between farm performance of cluster and farming experience. According to Aman

and Tewodros (2016) farm experience affect adoption and intensity adoption of improved varieties positively. Hence experiences expected positively affecting participation.

Access to market information: It is measured as a dummy variable taking a value of one if the farmer had access to market information and zero otherwise. The better the market information the farmers will have about the products marketing, the more output would be sold. Moreover, farmers marketing decisions are based on market price information and information influence farmers cluster participation.

Farm size (Farmsize): The larger farm will enable the farmer to produce more and increase the quantity to participate in cluster farming. (Efa *et al.,* 2016) reported farm size is expected that large farm size will be positively related to level of participation. Land fragmentation will have negative effects. Fragmentation restricts agricultural cluster farming participation.

Dependent variable 2

Level of participation on wheat cluster farming: - The dependent variable in this model is a continues variable representing farmers cluster farming participation level in terms of hectares so to analysis this objective OLS econometric model were used .

Independent variable were

Training: training is one of the means by which farmer's acquire new knowledge and skill. It is Dummy variable which increase training, the farmer will be participated on cluster farming. Farmers who participated on training their probability of adoption and intensity of adoption new technologies increase (Wuletaw and Daniel, 2015), which has an effect level of participation. Hence, access to training is expected to positively influence adoption of improved maize, increase in yield and commercialization of wheat.

Off-farm activity or other annual income: It is continues variable which enhance agricultural production and level of participation by relaxing liquidity and credit constraints to purchase productivity enhancing agricultural technologies such as improved seed, fertilizer, machineries, and hiring labor Haile, S. (2018). The above independent variable that include under first dependant variable also would include in these second stage.

Table 3 Hypothesis and description of explanatory variables used in the Heckman two stage models

Variable	Distribution	Types of the variable	Expected effect on participation decision	Expected effect on role
AGE_HH D	Age of the household head in years	Continuous	Negative	Positive
EDU_HD	Education of the household head (1=cannot read & write,2 read & write, 3 above grade 4	Categorical	Positive	Positive
SEX-HD	Gender of the household head (1=male, 0=female)	Dummy	Positive	Positive
LND_HLD	Total farm size in hectares	Continuous	Undetermined	Positive
FMSZ	Number of family members in the household	Continuous	Positive	Positive
INCOME	Annual income	Continuous	Positive	Positive
LABACC	Labor access	Continuous	Negative	Positive
TRAINACC	Training accessibility	Dummy	Positive	Positive

4. RESULTS AND DISCUSSION

4.1 Demographic and Socio-Economic Characteristics of Wheat producers in cluster farming

4.1.1 Demographic Characteristics of Farmers

This chapter deals with the analysis of the survey data and interpretation of the results of analysis. Specifically the characteristics of wheat cluster farming of the selected Woreda sampled households were analyzed and discussed using descriptive statistics.

Table 4 demographic characteristics of wheat producer for dummy variable

Dependent variable			Independent variable		Total
			Labor access		
			no	yes	
Cluster participation	no	frequency	46	63	109
		percentage	47.4%	35.6%	39.8%
	yes	frequency	51	114	165
		percentage	52.6%	64.4%	60.2%
Total		frequency	97	177	274
		percentage	100.0%	100.0%	100.0%
Dependent variable			sex of respondent		Total
			female	male	
Cluster participation	no	frequency	23	86	109
		percentage	76.7%	35.2%	39.8%

	yes	frequency	7	158	165
		percentage	23.3%	64.8%	60.2%
Total		frequency	30	244	274
		percentage	100.0%	100.0%	100.0%
Dependent variable			marital status		Total
			Single	Married	
Cluster participation	no	frequency	47	62	109
		percentage	56.0%	32.6%	39.8%
	yes	frequency	37	128	165
		percentage	44.0%	67.4%	60.2%
Total		frequency	84	190	274
		percentage	100.0%	100.0%	100.0%
Dependent variable			mechanization		Total
			No	yes	
Cluster participation	no	frequency	74	35	109
		percentage	97.4%	17.7%	39.8%
	yes	frequency	2	163	165
		percentage	2.6%	82.3%	60.2%
Total		frequency	76	198	274

		percentage	100.0%	100.0%	100.0%
Dependent variable			Own land		Total
			No	yes	
Cluster participation	no	frequency	14	95	109
		percentage	38.9%	39.9%	39.8%
	yes	frequency	22	143	165
		percentage	61.1%	60.1%	60.2%
Total		frequency	36	238	274
		percentage	100.0%	100.0%	100.0%

Source: - Own survey data analysis results, 2024

Table 4 above presents the descriptive statics of dummy variables. The participant's sex, the total female were 30 among them 23 or 76.7% had not participant in wheat cluster farming only of 7 or 23.3% of them were participate in wheat cluster farming, the total male were 244 among them 86 or 35.2% had not participant in wheat cluster farming however 158 or 64.8% of them were participate in wheat cluster farming this implies that males were highly participated in wheat cluster farming than female. From the total sample 97 of them were not getting the access of labor from these 46 or 47.4% of them were non cluster participant and the other 51 or 52.6% were wheat cluster participant, and also the rest 177 of the respondent were can got the access to labor from these 63 or 35.6% cluster non participant and 114 or 64.4% cluster participant these implies that wheat cluster participant had more get labor access. The marital status of respondent there were total of 84 single or unmarried from those 47 or 56.0% of them were non participant the rest 37 or 44.0% were participant and also there were a total of 190 of the respondent were married from those 62 or 32.6% of them were non participant the rest 128 or 67.4% of them were wheat cluster participant these implies that wheat cluster participant had more married than non-participant. Mechanization use of respondent there were total of 76 not use mechanization from

those 74 or 97.4%% of them were non participant the rest 2 or 2.6 % were participant and also there were a total of 198 of the respondent were used mechanization from those 35 or 17.7%of them were non participant the rest 163 or 82.3%of them were wheat cluster participant these implies that wheat cluster participant had more used mechanization than non-participant. Own land of or the land status of respondent there were total of 36 not have not own land from those 14 or 38.9% of them were non participant the rest 22 or 61.1%were participant and also there were a total of 238 of the respondent were have own land from those 95 or 39.9%of them were non participant the rest 143 or 60.1%of them were wheat cluster participant these implies that wheat cluster participant had more own land than non-participant.

Table 5 demographic characteristics of categorical variable

Dependent variable			**Education level**			Total
			Cannot read and Wright	Can read and Wright	Above grade 4	
Cluster participation	no	frequency	81	14	14	109
		percentage	99%	16%	13.5%	39.8%
	yes	frequency	1	74	90	165
		percentage	1%	84%	86.5	60.2%
Total		frequency	82	88	104	274
		percentage	100%	100%	100%	100%

Dependent variable			**Training access**				Total
			No access	One time	Two time	Three timer	
Cluster participation	no	frequency	78	9	11	11	109
		percentage	100%	41%	16%	10.5%	39.8%

	yes	frequency	0	13	58	94	165
		percentage	0%	59%	84%	89.5%	60.2%
Total		frequency	78	22	69	105	274
		percentage	100%	100%	100%	100%	100%

Table 5 above presents the descriptive statics of categorical variables. Educational level of respondent there were a total of 82 respondents cannot read and Wright from these 81 or 99 %of them were non participant and the rest 1 or 1% of them were participant, there were a total of 88 respondents can read and Wright from these 74 or 84% of them were participant and the rest 16 or 14% of them were non participant, there were a total of 104 respondents above grade 4 from these 14 or 13.5%of them were non participant and the rest 90 or 86.5 % of them were participant.

Training access of respondent there were a total of 78 respondents cannot get training access from these 78 or 100 % of them were non participant and there were not wheat cluster farming participant, there were a total of 22 respondents can get training access one time from these 9 or 41% of them were non participant and the rest13 or 59 %were wheat cluster farming participant, there were a total of 69 respondents can get training access two time from these 11 or 16% of them were non participant and the rest 58 or 84% were wheat cluster farming participant, and alsothere were a total of 105 respondents can get training access three time from these 11 or 10.5% of them were non participant and the rest 94 or 89.5% were wheat cluster farming participant.

Table 6 Demographic characteristics of Wheat cluster farmers

	N	Range	Minimum	Maximum	Mean	Std. Deviation
farming experience	274	22	5	27	15.32	5.348
farm size	274	5	1	6	3.17	1.312
annual income in birr	274	325000	75000	400000	192799.27	89022.941
yield per hectare	274	27	18	45	35.45	7.864
age of respondent	274	38.00	22.00	60.00	41.0292	8.94136
household members	274	8.00	2.00	10.00	5.5547	1.70507
Valid N (list wise)	274					

Source: - Own survey data analysis results, 2024

Table 6 shows continuous variable result. The mean farming experience of wheat cluster farming participation decision was 15.32 years, the minimum and maximum farming experience of farmers was 5 and 27 years respectively. The mean farm size of wheat cluster farming participation decision was 3.17 hectares, the minimum and maximum farm size of farmers was 1 and 6 hectares respectively. The mean annual income of wheat cluster farming participation decision was 192799.27 ETB, the minimum and maximum annual income of farmers was 75000 and 400000 ETB. The mean yield per hectare of wheat was 35.49Q/hectare, the minimum and maximum yield per hectare of farmers was 18 and 45 quintal. The mean age of wheat cluster farming participation decision of farmers was 41 years, the minimum and maximum age of farmers who participating in wheat cluster farming was 22 and 60 years respectively. The mean house hold size of wheat cluster farming participation decision was 6 house hold members, the minimum and maximum household size of farmers was 2 and 10 house hold members respectively.

4.2 The Role of wheat cluster cultivation

This part presents the role of Wheat cluster in East Gurage zone Sodo woreda central Ethiopia. The role was assessed by considering productivity, credit access, marketing linkage access and

other social role descriptively.

Table 7 productivity role ,market linkage role, credit access role of wheat cluster farming

Productivity role	**Answer**	**Frequency**	**Percent**
Involvement in cluster farming increase production	Disagree	40	14.6
	Undecided	40	14.6
	Agree	90	32.8
	Strongly agree	104	38.0
	Mean= 3.94	**Standard deviation=1.054**	
	Total	**274**	**100.0**
Involvement in cluster farming helps to increase the amount of bio-mass production that gain from	Strongly disagree	2	.7
	Disagree	12	4.4
	Undecided	60	21.9
	Agree	95	34.7
	Strongly agree	105	38.3
	Mean= 4.05	**Standard deviation=.918**	
	Total	**274**	**100.0**
Credit access role			
Involvement in cluster farming help to get credit access for either in cash or kind	Strongly disagree	2	.7
	Disagree	19	6.9
	Undecided	51	18.6
	Agree	88	32.1
	strongly agree	114	41.6
	Mean= 4.07	**Standard deviation=.972**	

	Total	**274**	**100.0**
Involvement in cluster farming helps to access different Agricultural tools based on needs.	Strongly disagree	2	.7
	Disagree	12	4.4
	Undecided	60	21.9
	Agree	95	34.7
	strongly agree	105	38.3
	Mean= 4.05 Standard deviation=.918		
Market Linkage (ML) role			
Involvement in cluster farming helps to sell products at the farmer union.	Strongly disagree		.4
	Disagree	21	7.7
	Undecided	44	16.1
	Agree	86	31.4
	Strongly agree	122	44.5
	Mean=4.1 St. Deviation=.967		
	Total	**274**	**100.0**
The cost of farmers union established for purchasing my products is fair.	strongly disagree	1	.4
	Disagree	16	5.8
	Undecided	51	18.6
	Agree	93	33.9
	strongly agree	113	41.2
	Mean =4.1 St. deviation=.926		
	Total	**274**	**100.0**
The farmers union buy products	strongly disagree	4	1.5

in timely manner	Disagree	48	17.5
	Undecided	25	9.1
	Agree	98	35.8
	strongly agree	99	36.1
	Mean =3.88 Sta. dev.=1.129		
	Total	**274**	**100.0**
The farmers union has enough storage to buy products.	strongly disagree	12	4.4
	Disagree	24	8.8
	Undecided	40	14.6
	Agree	76	27.7
	strongly agree	122	44.5
	Mean =3.99 St. dev.=1.158		
	Total	**274**	**100.0**

1=strongly disagree, 2=disagree, 3=undecided, 4=agree and 5=strongly agree

Source; - Own survey data analysis results, 2024

Table 7 shows the role of wheat cluster farming productivity result. Wheat farming involvement in cluster farming increase farmer's production and Productivity. The farmer's participation decision on wheat cluster farming increases most of farmer's wheat production. The decision of wheat cluster farming, the most farmers had agreed and above which shares 70.8% of the total respondents. Of the total participants 14.6% was undecided that productivity is weather cluster farming was important or not. Only 14.6% of the participants had answered that wheat cluster farming do not bring productivity.

Farmer's involvement in cluster farming helps them to increase the amount of bio-mass that gain from. The second productivity role of wheat cluster farming was byproduct that gains from wheat's residue. On the basis of urea treatment use, 73.0% of participant farmers had answered participation on wheat cluster farming have its own advantage on productivity and use animal feeds. Of the total 21.9% of farmers does not decide to use wheat cluster farming. The rest 5.1% of the participants do not decided (strongly disagree) to participate in wheat cluster farming to gain bio-mass. The grand mean of productivity role to wheat cluster farming was 3.99 that indicate farmer's participation decision was agreed.

Access to credit involvement increases wheat cluster farming. Farmer's involvement in what cluster farming helps them to get credit access for either in cash or kind. The cluster farming guaranteed to farmers to repay the loan for their creditors. Of the total respondents 73.7% of were answered agree and strongly agree. Access to credit increase farmer's participation decision on wheat cluster farming to increases farmer's wheat production. On the participants of wheat cluster farming, 18.6% farmers had answered undecided of the total respondents. Of the total participants 7.6% was disagreed and strongly disagree that access to credit had not role in wheat cluster farming.

Farmers' involvement in wheat cluster farming helps them to access different agricultural tools based on their needs. The second role of wheat cluster farming was the use of different agricultural tools based on farmers need. Of the total participant of wheat cluster farming 73.0% of farmers respond as agree and above that the availability of credit increase different agricultural product. Of the total participants 21.9% of farmers do not decide the access of credit do not matter to wheat cluster farming. The rest 5.1% of the participants were answered disagree and strongly disagree in wheat cluster farming. The grand mean of access to credit role to wheat

cluster farming was 4.06, that indicate farmer's participation decision was agreed and above.

Market Linkage (ML) role; Farmer's involvement in cluster farming helps them to sell their products at the farmer union. Of the total respondents 75.9% of farmers could increase their wheat cluster farming by selling their products to farmers union. Sixteen percent had answered undecided that market linkage cluster farming does not any concern. The cost of farmers union established for purchasing farm products is fair. Due to this market linkage has an influence on to use on wheat cluster farming. In other word 75% of the respondents agreed and strongly agreed; the presence of market linkage could increase wheat cluster farming. The farmers unions buy farmers products in timely manner; on the issue of farmers unions 71.9% farmers were agreed and above. Nineteen percent of participant did not agreed on farmers union do not buy farmers product on time. And 9.1% of participants did /did not decide that market linkage (farmers' union) had influence on wheat cluster farming.

The other market linkage (ML) that helps "farmers union has enough storage to buy farmers' products" was 72.2% of the total respondents were answered agreed and strongly agreed. Of the total respondents 14.6% participants did or did not decide to participating that farmers had not had enough storage to their products. The rest 13.2% of the participants did not agreed that market linkage does not have an influence on wheat cluster farming. In general, the grand mean of market linkage to cluster wheat farming was 4.022, which mean that market linkage has a positive influence on wheat cluster farming.

Table 8 Other contribution roles of wheat cluster farming to the farmers

Other contribution (OC) role	Answer	Frequency	Percent
Involvement in cluster farming helps to build a separate house for castles.	Strongly agree		
	Disagree	34	12.4
	Undecided	36	13.1
	Agree	101	36.9
	Strongly agree	103	37.6
	Mean=4.00 Sta. dev.=1.004		

	Total	**274**	**100.0**
Involvement in cluster farming helps to deposit money	Strongly disagree	6	2.2
	Disagree	34	12.4
	Undecided	37	13.5
	Agree	98	35.8
	Strongly agree	99	36.1
	Mean=3.91 Sta. dev.=1.089		
	Total	**274**	**100**
Involvement in cluster farming helps to send children to school	Strongly disagree	16	5.8
	Disagree	33	12.0
	Undecided	25	9.1
	Agree	95	34.7
	Strongly agree	105	38.3
	Mean=3.88 Sta. dev.=1.213		
	Total	**274**	**100.0**
Involvement in cluster farming helps to improve families feeding habits.	Strongly disagree	22	8.0
	Disagree	43	15.7
	Undecided	9	3.3
	Agree	104	38.0
	Strongly agree	96	35.0
	Mean=3.76 Sta. dev.=1.297		
	Total	**274**	**100.0**
Involvement in cluster	Strongly disagree	23	8.4

farming helps to improve dressing habits.	Disagree	29	10.6
	Undecided	22	8.0
	Agree	96	35.0
	strongly agree	104	38.0
	Mean=3.84 Sta. dev.=1.272		
	Total	**274**	**100.0**
Involvement in cluster farming helps to follow up	Strongly disagree	26	9.5
	Disagree	29	10.6
	Undecided	16	5.8
	Agree	102	37.2
	Strongly agree	101	36.9
	Mean=3.81 Sta. dev.=1.295		
	Total	**274**	**100.0**
Grand mean =3.87			

1=strongly disagree, 2=disagree, 3=undecided, 4=agree and 5=strongly agree

Source: - Own survey data analysis results, 2024

Table 8 shows the role of other contribution to wheat cluster farming result. Framers' involvement in cluster farming helps them to build a separate house for their cattle. Of the total respondents 74.5% of farmers could increase their wheat cluster farming to build a separate house for their cattle. Farmer's involvement in cluster farming helps them to deposit money. This may due to the joined activities performed by credit unions and farmers and lead the farmers to deposit money. From the total respondents 71.9% of farmers were answered agreed and above. Therefore the majority of farmers deposit money to the purpose of wheat cluster farming. The other contribution of wheat cluster farming helps farmers to send their children to school. On farmers contribution to send their children to school was 73.0%, which holds agreed

and strongly agreed that wheat cluster farming contributes to the farmer. The fourth contribution of farmers to wheat cluster farming was "cluster farming helps to improve the farmer and their families feeding habits." Of the total respondents 73.0% farmers had answered agreed and strongly agreed. The fifth contribution of farmers on wheat cluster farming was helping to improve farmers dressing habit. On the basis of improving farmers dressing habit 73.0% was answered agreed and above. The sixth contribution farmers to wheat cluster farming were helping farmers to help farming follow up. Of the total respondent's 74.1% of farmers were answered agreed and strongly agreed. The mean other contribution of wheat cluster farming was 3.87. This indicated that other contribution has a positive impact on wheat cluster farming agreed and strongly agreed.

Table 9 Amount of Wheat produced by sample Cluster and non-cluster participant farmers

Amount of wheat produced											
Cluster participant Farmers						Non participant Farmers					
No of farmer	Total hectares of land for wheat cluster (**h**)	Total production from those clustered wheat (**p**)	Max	Mini	Productivity **p/h**	No of farmer	Total hectare of land for wheat non cluster (**h**)	Total production from those non clustered wheat(**p**)	Max	Mini	Productivity **p/h**
165	401.5	16256.7	45	32	**40.5**	109	319	8874.58	44	18	**27.8**

As can be seen from the table above (table 8), the highest amount of production per hectare of land practiced in cluster farming system was forty five (45) quintals of wheat and the smallest being thirty two (32) quintals of wheat per a hectare of land and productivity or production per a hectare of land was 40.5 Quintals. On the other and as it can be seen on the same table, the highest amount of production per hectare of land in the non cluster farming system was forty for

(44) quintals of wheat and the smallest being eighteen (18) quintals of wheat per a hectare of land and productivity or production per a hectare of land was 27.8 quintals.

So from this one can understand that of the total land used by sample respondent famers for wheat cluster farming which was 401.5 hectare, a total of 16884 quintals of wheat was produced which makes the average wheat production to be 40.5 quintals per hectare of land, and the total land used by sample respondent famers for wheat non cluster farming which was 319 hectare, a total of 8453 quintals of wheat was produced which makes the average wheat production to be 27.8 quintals per hectare of land which shows as there was an addition of 12.7 quintal of wheat per hectare of land for cluster farming system.

Table 10 Independent Samples t-test table

		Levine's test for equality of variance		t-test for equality of mean								
		mean	SD	F	sign	t	DF	Sig (2-tailed)	Mean difference	Std. error difference	95%CI difference	
											lower	upper
Yield per hectare	Non participant	27.8	6.57	55.38	0.00	-21.27	272	0.00	-12.7	0.596	-.138	-.115
	participant	40.5	3.19									

The above table 10 show there were a significance difference of wheat yield or productivity between cluster participant and non participant (t(272)=-21.27,p=0.00 in the score with mean score for non participant (m=27.8,SD=6.57) was lower than participant (m=40.5,SD=3.19) the magnitude of difference in the mean (mean difference = 12.7 ,95 % of confidence level : -13.8 to -11.5) was significant.

To check this increase in production farmers were also asked the same questions in different ways in the FGDs. All the FGDs, participant farmers agreed as there was an increase in the amount of production after they practiced cluster farming. From the information collected during the FGDs it was possible to conclude the idea of the farmers as there were increases in production from 10 quintals to 15 quintals per hectare. In the Interviews that were also

conducted with the woreda office of agriculture experts, as well as the developmental agent in the kebele, it was proved as the production in the whole woreda as well as in the kebele under study was increasing from year to year as compared to non-participant farmer ways of farming due to the farmers involvements in cluster farming.

As it was mentioned by sampled farmers, kebele DA and the woreda office of Agricultural experts‟, the main reasons for the increase in the amount of production of the farmers was related to their proper land preparation, usage of improved seeds and application of fertilizers as well as the positive competition created among the farmers. During the FGD with the farmers and the interview with the woreda experts and with the discussion with the staffs of farmers union at the kebele level, the researcher proved farmers were getting modern agricultural inputs either on credit or cash. By the researcher observation and discussion though these credit facilities were open for all farmers, cluster participant farmers were the one who get priorities than the non-participant farmers.

4.3 Econometrics Model Results

In this section factors affecting cluster farming participation and level of participation on wheat cluster farming are presented and discussed.

4.3.1 Determinants of participation and level

Factors that determine participation level of wheat cluster farming was estimated using binary probit and OLS models since all respondents used for this study participated and non participated in wheat cluster farming. The hypothesized variables that were assumed to influence participation decision level of cluster farming were: Access to training, sex of household, farm size, education level of households, access to credit service, farming experience, quantity produced of wheat, annual income of yield per hectare of wheat, own land access, family size, mechanization access, marital status and labor access.

Table 11 Binary probit result of the wheat cluster farming participation

Variables	Coef.	Std. Err.	Z	P>|z|	[95% Conf. interval]	
					Lower	Upper
Sexhh	.252	.2838	0.89	0.102	.3521	.5738
Eduhh	.128	.2494	0.52	0.006	.0282	.4082
Marstatus	.150	.2386	0.63	0.03	.0502	.27198
Laboacc	-.007	.1811	-0.03	0.975	-.0016	-.3817
Trainacc	.167	.2163	-0.81	0.005	.3668	.5885
Farmexp	-.015	.0245	-0.63	0.530	-.0152	-.2369
Farmsiz	.149	.1013	1.48	0.06	.0493	.2383

Mechaccs	.424	.1813	2.34	0.000	.6242	.81151
Landaccs	-.123	.3051	-0.40	0.687	-.1229	-.4849
Famsize	.342	.0556	0.61	0.02	.3420	.5409

Source; survey result of 2024 Number of obs = 274

chi2 = 2.94

Prob > chi2 = 0.0004

As presented in table 10 education level **(Eduhh)** of the participants had a positive and significant influence (p=0.006) as presented. The participants that could read and write could increase the participation of farmers in wheat cluster farming by .128 units. This implies that education has a positive and significant factor to make decision in wheat cluster farming in Gurage zone, Sodo woreda. The researchers justified that educated households with higher expectation of participating in wheat cluster farming are more likely to make decision.

Marital status (**Marstatus**) had a positive and significant influence as expected *earlier (*p=0.03). The marital status of participants who had married had more likely to participate in wheat cluster farming than those who are single. As marginal effect indicated in the table a married participants could increase the participation level of farmers by .152 units T h i s finding tallies with that of (Ogunlade et,al 2016) who observed that in Ethiopia when farmer's level of participating in wheat cluster farming could motivate in case of married than single farmer's participants' farmers.

As expected, training access (**Trainacc)** had positively and significantly influenced farmers' wheat cluster participation decision at (p = 0.005). Getting one additional training access of farmers' will increase the participation level of wheat cluster producing farming participation decision by . 167 units. Attending training on wheat cluster farming that could be used by farmers enhances farmers participation decision because cluster farming will motivate farmers to plan effectively on time and produce according to the market demand and hence increase cluster

participation decision. (Dagnew et,al 2023) noted that in Ethiopia access to training on cluster farming significantly influenced farmers' cluster participation decision.

As expected earlier mechanization uses **(Mechaccs),** had positively and significantly influenced farmers' wheat cluster participation decision at (p = .000). A shift from lack of mechanization use to mechanization use farmers' participation increased the probability of wheat cluster farming participation decision b y . 424 units. Availability of mechanization use on wheat cluster farming that could be used by farmers enhances farmers' participation decision because cluster farming will motivate farmers to plan effectively on time and produce the market demand and hence increase cluster participation decision.

As expected *a priori* **(famisize**), an increase in the number of house hold members significantly and positively affected farmers' wheat cluster participation decision (p = 0.02). The effect result indicated that an additional individual household would increase the likelihood of farmers participating in wheat cluster farming by .342 units. This could be attributed to the fact that an increase in the number of house hold would avail up to date information regarding agricultural technologies that might improve productivity and therefore increase the cluster surplus product. The finding corroborates that of (Shiferaw et al. 2013) who found that the more house hold members increased the likelihood of adoption of cluster in Sodo Woreda of Ethiopia south Region. The more family member's house hold provided in cluster farming than those who had less.

Table 12 OLS result for the level of participation

Model	Un standardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
constant	-1.594	.269		-5.923	.000
Mechanization	.440	.173	.145	2.535	.012

use						
yield per hectare	.021	.013	.124	1.659	.098	
annual income in birr	8.981E-6	.000	.589	11.664	.000	
Farm size	.116	.052	.112	2.206	.028	
Education level	-.022	.085	-.013	-.255	.799	
Training access	.096	.131	.022	.733	.046	

Model	ANOVA[a]						
	Sum of Squares	df	Mean Square	F	R Square	Adjusted R Square	Sig.
Regression	396.208	6	66.035	164.107	0. 787	0. 782	000[b]
Residual	107.437	267	.402				.
Total	503.645	.273	.				.

Source: own survey estimation result, 2024

As hypothesized prior farm size had positively and significantly influenced the farmers' on wheat cluster farming participation farm size (farmsiz) had a significant relationship with wheat cluster participation level (p =0.028). The farm size in cluster farming that a one hectare increase in farm size increased farmers' cluster farming participation level by.116 units. This finding tallies with that of (Dureti 2023) in Ethiopia who found that farm size encouraged farmers' cluster farming participation. In Ghana, (Martey et al.2015) found that local farming communities had positive effect on agricultural purposes and that increased farm size motivated the farmer to participate in cluster farming. In cluster farming among Philippines smallholder

wheat producers with an increase in the plot of land as the plots of land increased, farmer's wheat production would increase to participate in the cluster farming.

As expected earlier mechanization uses (mechaccs), had a significant influence on farmers' wheat cluster participation level at (p = 0.012). Lack of mechanization use for farmers' participation decrease cluster farming participation decision but mechanization use increased wheat cluster farming participation level by .44 unit. Availability of mechanization use on wheat cluster farming that could be used by farmers enhances farmers' participation decision level because cluster farming will motivate farmers to plan effectively on time and produce the market demand and hence increase cluster participation.

According to Yared (2023) stated that mechanization service costs, service relationships, clustering and land consolidation exhibit significant heterogeneity across the study areas. Cluster farming was found to be advantageous against diseconomies, rationalized by upgrading the mechanization scale. The household, land, crop, mechanization service, remoteness and location-related factors determine participation in mechanization clusters and willingness to accept land consolidation.

As expected earlier annual income (other annual income), had a significant influence on farmers' wheat cluster participation level at (p = 0**.000**) increasing a unit of annual income had leads cluster participation by 8.9 unit. (Martey et al.2015) found that income diversification had positive effect on agricultural purposes and that increased annual income motivated the farmer to participate in cluster farming by purchasing the basic input for their farm.

As hypothesized prior, training access (trainacc) had positively and significantly influenced the farmers' on wheat cluster farming participation at (p = 0.046). Getting one additional training on wheat cluster farming could increase the participation level of farmers' in cluster farming by 0.096 units. The researchers justifies that training attend gave the farmers more likely to participate in wheat cluster farming than those who did not got training. This implies that training availability led farmers to participate more in wheat cluster farming than those who did not got training. Accesses to training on farmers had an influence on increasing cluster farming practice and increase the livelihood of farmers in the rural area (Tsion et al., 2019).

5. SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Summary

In Ethiopia, cereal grains are important food and cash crops that play a crucial role in the country's economy. They improve farmers' food security, and are an affordable source of carbohydrate diet in the country. There is a wide range of common grains in Ethiopia. Wheat is the main commercial varieties with increasing market demand both locally and internationally today's era in Ethiopia. Although there is huge local and international demand for quality wheat production, the country is unable to meet the demand in international market whereas there is huge un-marketed production in the country. This is aggravated by low market participation of smallholder wheat producers.

The study was conducted in Gurage zone of Sodo Woreda of central administrative region. The District was chosen because of wheat cluster farming participation decision among different cereal crops producers despite its huge production. The main purpose of this study was to examine the factors determining the wheat cluster farming participation level of smallholder farmers, and the constraints of farmers in wheat cluster farming in the Woreda. A multi-stage sampling procedure was employed in order to draw a sample from wheat crop producers. In order to get the sample of farmers, stratified sampling was employed. Descriptive and econometric models were used to identify factors and to what extent those factors influenced farmers' likelihood to participate in wheat cluster farming participation decision in the Woreda.

The descriptive statistics revealed that among the sampled farmers, 60 percent were wheat cluster farming participants. Significant differences were recorded among wheat cluster farming participants and non-participants.

The major wheat cluster farming participants were males, educated (those who could write and read),single(unmarried) farmers, have less labor farmers, have access to training, those who have their own land and mechanization use participating more than those who didn't got the above mentioned variables and these variables were dummy for the respondents.

For continuous variables responses, farming experience, farm size, annual income, yield per

hectare, age of house hold headed and family size were a mean of 15.32 years,3.17 hectare,192,799.27 in ETB,35.49 quintal, 41.05 years and 5.56 individuals respectively.

In the study area productivity, credit access, market linkage and other contribution were having roles for farmers to practice wheat cluster farming in the area.

The first stage results of the probit model (participation decision) showed that out of the eleven variables hypothesized to influence wheat cluster farming participation decision, seven were statistically significant. The factors that significantly and positively influenced the likelihood of farmers participating education level, marital status, training access, farm size, mechanization use and family size. The result indicated that increase in the values of the variables also increased wheat cluster farming participation decision of farmers. Age of farmers negatively but significantly influenced wheat cluster farming participation, indicating that the more aged households were less likely to participate in wheat cluster farming than their young age counterparts.

In the second stage (extent of participation decision level), only four out of twelve factors were statistically significant. The positive ones were training access, farm size and mechanization use. Thus an increase in any of these variables increased the extent of wheat cluster farming participation level. Only sex of house hold headed negatively influenced extent of wheat cluster farming participation level among the survey respondents. This implies that an increase on female participation would reduce the extent of wheat cluster participation level.

5.2 Conclusion

In Ethiopia, there is huge potential for wheat production and cluster participation. In Sodo Woreda, Gurage zone, there was good starting in wheat cluster farming practice.

In Sodo Woreda Gurage zone, farmer's wheat cluster farming participation level constraints education level, marital status, training access, farm size, mechanization use age of house hold and family size were identified. Therefore, to increase wheat cluster farming participation decision the farmers had an influence to participating on cluster farming significant variables

The important roles of wheat cluster farming were explained through their significant influence on wheat cluster farming participation decision and the extent of cluster participation level,

indicating the need for enabling environment for increasing smallholders' ability to produce quality wheat product. Sex had a factor that influenced wheat cluster farming practices of farmers' participation decision level. This implies that males of farmers especially during planting could encourage farmer's decision to participating in wheat cluster farming. This is suggestion derives from the fact self-confidence of farmers was among the major challenges cited by farmers that constrain production decision.

Access to training, farm size and farm mechanization improves wheat cluster participation decision as well as the extent of participation level. Significant variables were identified an understandable manner is most valuable factors. Training access changes farmers' attitude and working culture to the modern wheat cluster farming practices to implement effectively. Farm size had an important influence to adopt cluster farming as well as mechanization could also increase the participation of farmers in wheat cluster farming to minimize the cost of production (such as ploughing and harvesting) time.

5.3 Recommendations

- There should be a strong emphasis on creating good cluster farming practices of farmers to reliable participation level decision. Both government and non-government actors should invest on linking farmers of both sexes to enhance wheat cluster farming participation of farmers'. Both sexes had equal access to use and should participate the use of in program profit. This can be done either by awareness creating to work at a fee for both sexes of farmers at the Woreda level or through registering the crop under the Ethiopian Commodity Exchange (ECX) to the benefits of wheat cluster farming importance's house hold headed level.

- This study showed that training access wheat cluster farming significantly influenced farmers' participating in the wheat cluster farming decision level. Thus, the government and/or private sector players (e.g., research centers, quality control authorities, etc.) should train farmers on quality standards of wheat farming demanded by consumers. Training on production and post-harvest handling techniques could address this challenge. Strong extension intervention is vital to assist farmers in producing high quality wheat product and increase production through consistent follow up, and keeping of farm records.

- During the survey, farmers who have large farm size were participating in wheat cluster farming than those who had less farm size in the area. Therefore, whatever the land of the farmers, there should be used based their plot of lands returns by weighing up the profit and cost analysis. There is an urgent need for government intervention with regard to wheat production at national level of requires. Based on the returns given from the product the small holder farmers should practices this cluster farming as advantageous.
- Mechanization use of wheat cluster farming practices positively influenced wheat cluster farming participation decision and extent of cluster participation level. Hence, policies that would improve farmers' wheat production capacity such as supply of improved seeds farm inputs to farmers should be explored.

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7. Appendices

A. Basic/general information

1 Age of the house hold head_____years

2 Sex of the house hold head 2 Male 1 Female

3 Educational level of household head

1) cannot read and write ,2) Read and write ,3) above grade 4

4 Marital status of household head: 1) married 2) single

5 Total number of household members_____male_____female1, (1-5) 2,(6-10) 3,(>10)

6 How many of your family members are working 1. Full time on farm, 2. Part time on farming

7 How many years have you engaged in agriculture? ----------

Resource profile of the respondent

1 Do you have own land? 1) Yes 2) No

2 What is the size of your land in _____timad(_____ha)

3 What is your household's major means of income generation? (Multiple answer possible) 1. Crop production 2.Livestock production 3. Hand crafts 4. trading

4. What types of crop on what size of land have you grown in the production?

Name of crop----------size in ha

5 Do you own oxen? 1) Yes 2) No

6 Do you have family labor shortage? 1) Yes 2) No a) if yes, for what were specific activities you have encountered labor shortage? 1) Land preparation period 2) cultivation period 3) weeding 4) harvesting Period) 5 threshing 6) other specify_____

7 Do you have financial problem for your agricultural activity? 1) Yes 2) No

a) If yes, do you have access for credit from financial institutions? 1) Yes 2) No

b) If yes, from which financial sources you accessed credit in the past? 1) Banks; 2) Saving and credit cooperatives; 3) informal lenders in the community;

C) If yes, can you use the credit to hire mechanization services 1) Yes 2) No

8 Have you received or got credit? 1) Yes 2) No

a) If yes, for what development activities have you received credit? 1) To purchase farm inputs 1) To rear livestock 3) To fatten livestock 4) to upgrade farming tools
b) b, If no, what are the main reason? 1) Due to high interest rate 2) Shortage of down payment 3) lack of land tenure right for collateral 4) lack of law and regulation for SHFs loan in financial institutions 5) absence of awareness 6) Inaccessibility to formal credit institutions

C Social interaction & perception of respondents

1 Do you participate in wheat cluster farming? 1. Yes 2. No

2 Why didn't you participants in cluster farming?

1. I didn't get awareness on it. 2. I have very small plot of land 3. I didn't have capacity to buy inputs.

3 How do you evaluate the difference in the amount of production per hectare of yours and your neighbors who participated in cluster farming?

1. Very high 2. high 3. there is no difference

4 If the change is very high and high, what do you think the reason for the participant's farmers to get more production than you?

5 Amount of wheat produced per hectare of land in Quintals_____.
6 Amount of biomass/Hey/ you get from the wheat farm_____.
7 Is there a difference in the amount of Hey /biomass/ between yours and your neighbors who participated in cluster farming? _____.

8 If there is an increase in the amount of bio mass/hey/ what do you think the reason would be? _____

9 can you access input (fertilizers, improved seeds, herbicides and insecticides training) 1 yes 2 no

10 Have you ever machined to plough or harvest your production? If No why?

11 what are the major factors that challenges you not to be involved in cluster farming_____

D. Product information

1 Production of grain, vegetable and other cash crops in 2014/2015E.c

Table 13 Production of grain, vegetable and other cash crops in 2014/2015E.c

Crop type	Total area in hectares	Total production in Qts	Store for home consumption	Store for seed	Sold Qts	Selling price	
						Maximum	Minimum
Wheat							
teff							
maize							
Barley							
Bean							

2 Why do you engage in wheat production?

1. High demand 2. Disease resistance 3. Resource suitability

4. High price 5. Being in contract farming 6

E Key informant interview guide

1. What are major crops produced in the area?

2. What is the total size of land area in the woreda covered by cluster farming?

3. How many hectare of land is potentially suitable for production of wheat in the Woreda?

4. What is the total land covered by farmers production cluster for the following crops in 20014/15 Ethiopian calendar cropping season?

5 What is the number of farming/ploughing frequency recommended by the wheat package?

6 What is the recommended amount of wheat seed type and amount per ha? Seed type

7 What is the recommended amount of fertilizer, seed type, fertilizer and application time and method?

8 What is cluster farming?

9 Why form cluster farms?

10How was the cluster formed and organized?

11 What was (were) the motivation/s to form the cluster?

12 Who organized these clusters?

13Why some farmers are not participating in cluster farming?

14 What is the benefit of cluster farming?

15 What are the disadvantages of cluster farming?

16 What would you consider to be the most essential elements for the success of the CLF?

17 What is your recommendation about sustainability of the cluster farming?

18 Do farmers have access to wheat market information (when, what amount, to whom, at what price to sale)?

19. What are the existing good opportunities that encourage wheat production and marketing in your area?

20. Did market linkage process helpful for farmers? 1. Yes 0. No

21. How do you see the integration or link of stake holder in improving productivity and commercialization of wheat?

22. What are the stakeholders who support wheat cluster farming? What is their role in wheat production and marketing?

Table 14 Likert scale questionnaire

variable		Item	(1)	(2)	(3)	(4)	(5)
Productivity (PR)	PR1	My involvement in cluster farming increase my production					
	PR2	My involvement in cluster farming helps me to increase the amount of biomass I gain from					
Credit access (CR)	CR1	My involvement in cluster farming help me to get credit access for either in cash or kind					
	CR2	My involvement in cluster farming helps me to access different agricultural tools based on my needs.					
Market Linkage(ML)	ML1	My involvement in cluster farming helps me to sell my products at the farmer union.					
	ML2	The cost of farmers union established for purchasing my products is fair.					
	ML3	The farmers union buy my products in timely manner					
	ML4	The farmers union has enough storage to buy my products.					
Other Contributions (OC)	OC1	My involvement in cluster farming helps me to build a separate house for my cattle.					
	OC2	My involvement in cluster farming helps me to deposit money					
	OC3	My involvement in cluster farming helps me to send my children to school					
	OC4	My involvement in cluster farming helps to improve mine and my families feeding habits.					
	OC5	My involvement in cluster farming helps to improve my dressing habits.					
	Oc6	My involvement in cluster farming helps to follow up					

Strongly disagree (1) ,Disagree (2) , Undecided (3) , Agree (4 and Strongly Agree (5)

Appendices-I photos on data collection season

Figure 6 Gathering preliminary data from Berber kebeles

Figure 7 Gathering preliminary data from Ejerssa kebele

Figure 8 thrashing cluster wheat by combiner from Ejerssa kebele

Figure 9cluster wheat from Soloke kebele

Figure 10cluster wheat from Berber kebele

Figure 11 cluster wheat from Gedam ena Sewate kebele