ADDIS ABABA UNIVERSITY
COLLEGE OF DEVELOPMENT STUDIES
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IMPACTS OF AGRICULTURAL GROWTH PROGRAM II *TEF* INTERVENTIONS ON THE LIVELIHOOD OF RURAL HOUSEHOLDS: EVIDENCE FROM CENTRAL ETHIOPIA

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Impacts of Agricultural Growth Program II *Tef* Interventions on the Livelihood of Rural Households: Evidence from Central Ethiopia

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In our capacity as members of the examining board for an open defense of Solomon Zewdu Leul's dissertation, "Impacts of Agricultural Growth Program II *Tef* Interventions on the Livelihood of Rural Households: Evidence from Central Ethiopia", we testify that it was submitted in fulfillment of the requirements for the Degree of Doctor of Philosophy in Development Studies (Rural Development) and complies with the University standards.

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DEDICATION

In honour of my parents, Zewdu Leul Tesemma and Mulu Sime Anbessie, who have laid the foundation for my continued educational career.

Statement of author

I, the undersigned, hereby declare that I am the author of the dissertation entitled "Impacts of Agricultural Growth Program II *Tef* Interventions on the Livelihood of Rural Households: Evidence from Central Ethiopia". I solemnly declare that this dissertation has not been submitted to any other institution to receive an academic degree, diploma, or certificate, aside from the articles in the dissertation, which were submitted to journals in partial fulfillment of the requirements for the Ph.D. degree at Addis Ababa University. I have appropriately cited and credited all sources used in this work per the generally accepted standards of practice. I am aware that failing to uphold the standards of academic honesty and integrity and misrepresenting or fabricating any idea, data, fact, or source will be sufficient grounds for the university to take disciplinary action.

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Biographical sketch

The author was born on April 20, 1988, in *Tulu Milky*, a town in the Northern *Shewa* zone of the *Oromia* regional state, 170 kilometres from Addis Ababa. Since 1993, he has attended *Tulu Milky* Primary and Junior-Secondary School for his elementary education. Since 2001, he has attended *Garba Guracha* Senior-Secondary and Preparatory School for his secondary and post-secondary education. In 2006, he enrolled at the University of Gondar to pursue his BA in Sociology. After receiving his degree in 2009, the author joined a private institution where he worked as a Sociology instructor. He served as a project and capacity-building expert for the Addis Ababa city administration after a year. In the same office, he also served as the coordinator for the women and youth departments, where he managed numerous projects and programs to empower women and young people. In 2014, he graduated from Addis Ababa University with a Master's in Social Work. He then began working for *Debre Berhan* University in 2015 as a lecturer before returning to the doctoral program there in 2018 to pursue his Ph.D. He also pursued a second Master's degree at the same university's School of Commerce in Project Management. In the interim, several consulting organizations have employed him, and he holds several research positions, many focused on social development.

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Solomon Zewdu Leul

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Acronyms

ABCD: The Asset-Based Community Development
ADLI: Agricultural Development-Led Industrialization
AGP: Agricultural Growth Program
AGRA: Alliance for a Green Revolution in Africa
ANOVA: Analysis of Variance
ATA: Agricultural Transformation Agency
ATE: Average Treatment Effect
ATT: Average Treatment Effect on the Treated
CIA: Conditional Independence Assumption
CIG: Common Interest Group
C: Contingency Coefficient
CSA: Central Statistical Authority
CSC: Common Support Condition
DA: Development Agent
DHS: Demographic Health Survey
EIAR: Ethiopian Institute of Agricultural Research
ERHS: Ethiopian Rural Household Survey
ETB: Ethiopian Birr
EVE: Entrepreneurship and Vocational Education
FDRE: Federal Democratic Republic of Ethiopia
FGD: Focus Group Discussion
FTCs: Farmer Training Centre (s)
GDP: Gross Domestic Product
GO: Governmental Organization
GPS: Generalized Propensity Score
GTP: Growth and Transformation Plan
HCI: Household Commercialization Index
ILO: International Labor Organization
KII: Key Informant Interview
MoA: Ministry of Agriculture
MoANR: Ministry of Agriculture and Natural Resource
MoFED: Ministry of Finance and Economic Development
MICS Multiple Indicator Cluster Surveys
NGO: Non-Governmental Organization
OECD: Organization for Economic Cooperation and Development
PASDEP: Participatory and Accelerated Sustainable Development to Eradicate Poverty
PPS: Probability Proportional to Size
PSM: Propensity Score Matching
PSNP: Productive Safety Net Program
SDGs: Sustainable Development Goals
SDPRP: Sustainable Development and Poverty Reduction Program
SIDA: Swedish International Development Cooperation Agency
SMEs: Small and Medium-sized Enterprises
SWOT: Strengths, Weaknesses, Opportunities, and Threats
TFP: Total Factor Productivity
VIF: Variance Inflation Factor

General abstract

The government and other development actors in Ethiopia have promoted agricultural technologies like improved tef varieties to raise agricultural productivity and, in turn, the well-being of farmers. The impacts of these technologies, however, needed to be thoroughly examined. In order to investigate productivity and income, plot-level seed rate and productivity, commercialization, and welfare, 479 farm households from two farming systems in Central Ethiopia - one from users of the Agricultural Growth Program (AGP) II introduced Korra tef variety and the other from non-users - were randomly and proportionately sampled. The study also looks into the effects of the program's Common Interest Groups (CIGs) project on the livelihood of rural women and youth who benefit from it. This dissertation has seven chapters, one introductory and theoretical, five empirical, and one concluding (general conclusions and recommendations) chapters, covering the research issues mentioned. Each empirical chapter addresses issues important to the study's broader goal. The introductory chapter outlines the context, problem statement, pertinent literature, broad goal, and study methodology. Following the introduction, the second chapter examined how adopting Korra tef has impacted the productivity and income of the users. The quantitative data were analyzed using Propensity Score Matching (PSM) technique, and qualitative data substantiated the survey data. The amount of tef production per hectare was used to measure users' productivity, and their net income gains from tef were then calculated. The findings showed that adopting Korra tef has boosted tef productivity by about six quintals per ha^{1} and raised farmers' income by around 29500 Ethiopian Birr per ha^{1}. The third chapter investigated how plot-level Korra tef seed rate affected productivity. One-way Analysis of Vaiance (ANOVA) was used to examine the productivity results of seed rate users, and the Dose-Response model was used to look into the impacts of seed rate on productivity. The qualitative data was used for validation. The outcome showed that a seed rate of $20kgha^{-1}$, slightly beyond the recommended, was related to the highest average tef production. The fourth chapter examined how the use of Korra tef impacts users' commercialization status. The Household Commercialization Index (HCI) and the PSM were used to assess the level of commercialization and the impact of Korra tef use on commercialization, respectively. According to the HCI results, users and non-users were found in the categories of commercialized and semi-commercialized, respectively. The PSM result similarly showed a positive and significant impact, with users commercializing at a rate that was approximately 23.43% higher than non-users. The fifth chapter looked at how the welfare of the users was impacted by the use of Korra tef. Welfare was proxied by measuring consumption per adult equivalent. One-way ANOVA was used to estimate the farm households' expenditures at various commercialization levels. The PSM was then used to investigate how the Korra tef impacted users' welfare in comparison to non-users. A strong correlation was found between the users' spending and commercialization. The PSM outcome also showed that the use of Korra tef had a positive and significant impact on the users' spending. The the results of the effects of CIGs on rural women and youth livelihood is presented in the sixth chapter. A case-based qualitative study used Focus Group Discussions and Key Informant Interviews to evaluate the CIG's performances, effectiveness, strengths, limitations, opportunities, and threats. The data arrangement for this study was handled by the MAXQDA 2020 qualitative data analysis package. The data were analyzed using thematic, relational, and content analysis techniques in that order. Some of the positive aspects played by the CIGs were income and a strong social capital for members. The absence of market linkage, workplace, insufficient monitoring and evaluation, coordination among stakeholders, inadequate and improper use of money, and a lack of entrepreneurial education and skill training was on the list. Overall, the findings point to the necessity of encouraging the use of Korra tef variety to boost users' production and income as well as their commercialization and welfare. Users also must be encouraged to employ the suggested seed rates rather than merely adopting improved seed varieties. Finally, for the successful implementation of the CIGs and empowerment of rural women and youth, access to entrepreneurial skill training, coordination among key stakeholders, rigorous monitoring and evaluation, access to market linkage and workplace, and enough funding are advised.

Keywords: *Agricultural Growth Progam II; Korra tef; Users; Non-users; Impact assessment; Common Interest Group; Rural women and youth, Central Ethiopia*

CHAPTER ONE

1. GENERAL INTRODUCTION

This chapter serves as the dissertation's general introductory section. It presents the background and justification, a concise literature review, a problem statement, research questions, objectives, significance, scope, and limitations of the study. This chapter also encompasses an outline of the methodology applied throughout the dissertation and a summary of the organization of the chapters. It begins with the following section, which discusses the study's context and justification.

1.1. Background and justification of the study

Most of the world's nations have first built a prosperous basis on agriculture before developing a diverse, modern economy (Chikwama, 2014). Agriculture has contributed significantly to the economic prosperity of industrialized nations, and its role in the economic advancement of less developed nations is crucial (Omofa, 2020; Praburaj et al., 2018). This contribution is particularly true for Africa, where smallholder farmers working on plots of land that are, on average, smaller than 2 hectares make up close to 70% of the population (Alliance for a Green Revolution in Africa (AGRA), 2017). Its significance is heavy in an agrarian economy like Ethiopia (the subject of this research), which mainly depends on subsistence agriculture (Derso et al., 2016). Crop production typically contributes 60% of Ethiopia's agricultural sector's outputs, while animal production accounts for 27%, and other sectors provide 13% of the total agricultural value added (Diriba, 2018b). Smallholder farmers provide most of the nation's total output; they also provide 90% of the country's foreign revenues and 70% of the raw materials used in industry (Ministry of Agriculture and Natural Resource (MoANR), 2016).

Ethiopia's agricultural productivity is low, and subsistence production predominates despite its significance, partly because of the limited use of advanced technologies in farm activities (World Bank, 2015). Most farmers in the nation are smallholders who use family labor, engage in rain-fed mixed farming using traditional tools and systems for crop cultivation and animal husbandry, and use a low-input, low-output production system. Besides, these farmers have limited access to newer production technologies like seed, fertilizer, mechanization, and markets (Derso et al., 2016; Diriba, 2018a; Gebre-Selassie & Bekele, 2012).

The facts mentioned above demonstrate that agricultural development in Ethiopia has a significant direct impact on improving the lives of people living in rural areas experiencing poverty. This, in turn, highlights how important it is to keep the rural population and agricultural sector as active as possible by providing them with cutting-edge agricultural technologies in general and crop technologies, in particular, to increase crop productivity and commercialization and maintain a steady supply of food and non-food items. The Ethiopian government views smallholder agriculture as the most significant subsector in its efforts to develop agriculture. It believes raising smallholder farmers' productivity is essential to reducing poverty, transforming agriculture, and ultimately changing the economy's overall structural makeup (Agricultural Transformation Agency (ATA), 2017). The government's advocacy of Agricultural Development-Led Industrialization (ADLI), which primarily promotes smallholder agriculture and its transition into commercial agriculture using agricultural technologies, was based on this supposition (Zewdie, 2015). ADLI's core notion of 'new agricultural technologies offer opportunities to increase production and productivity' attracted agricultural development programs which succeeded it (ATA, 2017).

The Growth and Transformation Plans (GTPs) are the most recent development programs in which the government has demonstrated a commitment to creating an economy with a modern, productive agriculture sector with improved technology and an industrial sector that plays a leading role in the economy (Ministry of Finance and Economic Development (MoFED), 2010). The programs were successively implemented with the names 'GTP I' and 'GTP II'. GTP II's agricultural development strategy included a change to cultivating high-value crops with a focus on potential high-productivity areas and an intensified commercialization effort. Agriculture was seen as the main driver of economic growth in these programs (MoFED, 2015). This indicates that the main driver of agricultural growth has continued to be the commercialization of smallholder farming. In both GTPs, the government introduced three areas of agricultural development: smallholder agricultural development (which is the major focus of this dissertation), pastoral development, and private sector agricultural development, and has remained committed to sustaining an inclusive and pro-poor development strategy (Diriba, 2018a; MoFED, 2010). Since smallholding is the main character of Ethiopian farmers, most intervention programs designed to improve their standard of living start by promoting the use and use of improved agricultural technologies, among which the Agricultural Growth Program (AGP) is one.

AGP is a program supported by multiple donors[1] to foster sustainable agricultural growth in the country. It encourages the development of agriculture in selected, underdeveloped, but potentially affluent *woredas*[2]. The main focus areas of the program are enhancing agricultural production and promoting commercialization by strengthening institutions, expanding the implementation of best practices, fostering market growth and agribusiness, and improving rural infrastructure. This includes initiatives aimed at small-scale agricultural water management and the development of market infrastructure. It was started in 2010 to address the major obstacles to agricultural development, promoting overall economic growth and change. The program was implemented in 96 *weredas* in four regional states - *Oromia*, *Amhara*, *Tigray,* and Southern Nations Nationalities and Peoples Regional State - during its initial phase (AGP I). During this phase's lifespan (2011-2015), it served around 1.9 million households in 2116 *kebeles*[3] (Ethiopian Institute of Agricultural Research (EIAR), 2018).

The program's second phase was introduced around the middle of 2016 to maximize its impact. Since then, it has been under operation in 157 *woredas* chosen from seven regional states and one city administration with the highest growth potential, primarily based on agro-ecological conditions and market access. The program typically includes five components: project management, capacity building, monitoring and evaluation; public agricultural support services; agricultural research; smallholder irrigation development; and agriculture marketing and value chains. These components include a variety of initiatives aimed at enhancing the standard of living for smallholder farmers in intervention areas. Utilization of agricultural technologies by beneficiary farm households and increases in agricultural productivity, income, commercialization, and welfare continue to be the junction points for the mentioned components of the program. Its particular emphasis on the productivity and commercialization of smallholder farmers through the promotion of various agricultural technologies drove us to study the prevailing thesis that states, "the promotion of smallholder farmers' use of agricultural technologies augment their productivity and income, which in

[1] *The funding for the AGP comes from various international organizations and agencies, including the Agencia Española de Cooperación Internacional para el Desarrollo (Spanish Agency for International Cooperation and Development), the Canadian International Development Agency (Government of Canada), the Food and Agriculture Organization of the United Nations, the Embassy of the Kingdom of the Netherlands, the United Nations Development Program (UNDP), the United States Agency for International Development (USAID), and the World Bank Group*.

[2] *Woreda refers to local government above the kebele and below the zone in Ethiopia, except the capital, Addis Ababa*.

[3] *Kebele refers to the smallest administrative unit in Ethiopia, except the capital, Addis Ababa*.

turn determines their commercialization status and consequently, their welfare." On the other hand, the program introduced the Common Interest Group (CIG)[4] as a mechanism to enhance the livelihood of youth and women without access to farmland. Due to this, we chose to investigate the impacts of crop technology use on smallholder farmers who own farmland and the effects that the CIG initiative has brought on the livelihood of rural women and youth who do not have farmland to cultivate in Central Ethiopia, *Oromia* regional state.

Tef[5] is chosen as the crop to be studied because it is being cultivated in all agro-ecological zones and altitudes of the study area and is one of the crop varieties that has been given priority for intervention by the program in the area, as demonstrated by the introduction of the new *tef* variety known as "*Korra*". Despite the crop's importance in Ethiopia in many ways, including for home consumption, cash crop, fine straw used for animal feed and construction material, high resilience capacity as it withstands periods of drought and flood because it attracts few insect pests and diseases, and minimal post-harvest loss, it is an "orphan crop"[6] and is still relatively understudied when compared to wheat, maize or rice. These may result from the worldwide crop research agendas' propensity to emphasize research on high-yield cereal crops cultivated abroad (Fufa et al., 2011; Minten et al., 2018). This implies that *tef* has not yet reaped the rewards of decades of research to increase its yields. There is still much to learn about its productivity and income, commercialization, and impacts on growers' well-being. Therefore, the first objective of this study was to examine how adopting the *Korra tef* variety impacted the productivity and income of the users. After that, it investigated how plot-level *Korra tef* seed rate affected its productivity. It also looked into how adopting *Korra tef* could impact commercialization and welfare. Finally, the effects of CIGs on rural women and youth livelihood were investigated. Through these interrelated impact analyses, the study, in general, will contribute knowledge to rural development policies and strategies necessary to support effective and long-lasting interventions to achieve secure rural livelihood.

[4] *CIG is an informal group of 10–20 members from the same village who voluntarily agree to work together on a profit-oriented agricultural activity that focuses on value chain activities such as the production of crops or livestock, post-harvest handling, storage, processing, and marketing. Active natural resource conservation or sustainable use of these natural resources also qualifies.*

[5] *Tef is a staple food crop for millions of people in Ethiopia. It is the most important crop by area planted, production value, and in generating income as well.*

[6] *Orphan crops are indigenous and grown by small and marginal farmers under subsistence farming systems, rich in nutritional profile and adapted to suboptimal growing conditions. Examples of orphan crops include finger millet, groundnut, tef, yam, and cassava. These crops are poised to make a major impact on global food security, but the breeding technology for orphan crops is lagging way behind modern technology.*

1.2. Review of the literature

The basis for the other sections of this study is laid out in this section. Its goal is to discuss and evaluate the relevant conceptual and empirical research that has been done on the topics of crop technology use, production, income, seed rate, commercialization, welfare, and interventions comparable with the CIG scheme. This section presents very general and concise literature, with the notion that details of the pertinent literature are discussed under each objective when deemed necessary.

1.2.1. Basics of agricultural technology

There are many different definitions for the word 'technology'. It is a corpus of knowledge committed to developing tools, processing actions, and extracting materials (Ramey, 2013). Technology was also described by Rogers et al. (2014) as a collection of "new ideas." According to Enos (2008), it is the general knowledge or information that enables certain jobs to be completed, specific services to be provided, or some products to be produced. For Abara and Singh (1993), the actual application of knowledge is how 'technology' is generated. Thus, technology, at its most theoretical level, is the application of knowledge to practical ends (Anderson & Feder, 2007). It is also apparent that technology's primary goal is to make the work of the entity to which it was applied easier. Most technologies are, therefore, consequently labelled 'labor-saving', 'time-saving', 'capital-saving' or 'energy-saving' and so forth. To economists, this implies saving on scarce resources (Emerick & Dar, 2017).

Hybrids, greenhouse technology, genetically modified food, chemical fertilizers, insecticides, tractors, and the use of other scientific knowledge are all examples of agricultural technology (Matunhu, 2011). They are the production elements that have experienced some modification from their initial state to improve their performance (Melesse, 2018). For Swanson et al (1997), there are two main categories of agricultural technologies: (1) material technology, where knowledge is embodied in a technological product like tools, equipment, agrochemicals, improved plant varieties or hybrids, improved breeds of animals (such as semen from progeny-tested sires used for artificial insemination), and vaccines; and (2) knowledge-based technology, which includes technical knowledge, management skills, and other processes that are in use in agricultural technology. The focus of this study is on components from both categories.

1.2.2. The use of agricultural technology

Provided that a significant percentage of people experiencing poverty in developing countries live in rural areas, the agricultural sector is crucial for promoting economic growth, eradicating poverty, and improving food security in a large portion of the developing world. Agriculture still remains the primary source of income and employment in these rural areas, despite the trend toward increasing urbanization (Diriba, 2018b). Therefore, agriculture and poverty reduction are intricately intertwined. However, low usage of modern technology and low production are common in many areas where agriculture is under practice (Duflo & Suri, 2010; Foster & Rosenzweig, 2010; Suri, 2011). For smallholder agricultural productivity and food security, modern farming techniques are essential (Kasirye, 2013), and the use of more advanced agricultural methods has been linked to better nutritional status, lower poverty, and higher incomes (Kassie et al., 2011; Kumar & Quisumbing, 2011; Minten et al., 2007). Therefore, enhancing agricultural growth will only be possible by creating and implementing technologies that increase yields at a reasonable cost.

The green revolution, which took place during the 1940s and 1970s, provides evidence of the potential benefits of adopting agricultural technology for reducing poverty and improving users' quality of life. The revolution has dramatically grown the agricultural industry in many emerging nations. Improved maize, wheat, and rice were widely utilized, along with fertilizer and investment in irrigation infrastructures. This resulted in significant gains in cereal output, enabling nations like Mexico, China, and India to markedly minimize food insecurity (Evenson & Gollin, 2003). Despite the significant benefits of using agricultural technology, adopting promising technologies has yet to be universal. The adoption and application of agricultural technologies in Sub-Saharan Africa have lagged behind those in Asia. For instance, in 2000, only 17% of the total area harvested in sub-Saharan Africa used improved maize varieties, compared to 90% in Asia and the Pacific (Gollin et al., 2005). Besides, even though the use of new, improved maize varieties increased at a rate of 3.5% points per annum overall in sub-Saharan Africa, it is not to the desired level (Vijesh et al., 2023). In ideal circumstances, a particular agricultural technique may significantly boost yields. However, more is needed to guarantee that it will actually be utilized because its use is, among others, frequently hampered by several market inefficiencies, including supply chains, financial availability, and psychological factors like risk aversion (Foster & Rosenzweig, 2010).

1.2.3. Crop technologies in Ethiopia

Rain-fed agriculture predominates in Ethiopia and has been featured by a high work intensity, low output, and lack of technology. The low agricultural output, on the other hand, is linked to traditional, low-tech, rain-fed farming methods, limited fertilizer use, and declining soil fertility (Das, 2016; Diriba, 2018a). Over the past 20 years, Ethiopia's agricultural development projects have introduced many new technologies, and the nation already has access to many promising technologies to address the issues mentioned above. Improved crop seeds, hybrid seeds, chemical packages, pesticides, enhanced on-farm storage systems, and fertilizer and small-scale irrigation techniques are among the most recently developed technologies (Melesse, 2018). Unfortunately, despite billions of dollars in investments, smallholder farmers' access to many promising technologies is limited in practice, even though they are available in theory (Boudot et al., 2013; Melesse, 2018). This calls for thorough studies to determine how a technology-based, multi-donor-supported agricultural growth program affects smallholder farmers' use of agricultural technology and the expected results. In light of this, this study has examined the impacts of adopting crop technology from one of the multi-donor-supported programs (*i.e.* AGP II).

1.2.4. Crop productivity and income

Productivity and production have been wrongly used synonymously. Production relates to the output volume, whereas productivity denotes output relative to resource expansion. Without improving productivity, the quantity of output can be increased by using more resources. The productivity per unit of output can be raised by using fewer resources at the same output level. Given this, agricultural productivity can be described as a gauge of the effectiveness of a system for producing agricultural products using resources like land, labor, capital, and other relevant resources (Das, 2016). Contrarily, other approaches in the literature describe crop productivity, including general output per unit of input, farm yield per crop, total output per hectare, and output per worker (Schneider & Gugerty, 2011). According to Wiebe (2003), productivity is the measurement of the agricultural output produced for a specific amount or set of inputs. The amount of output per unit of input (such as tons of wheat per acre of land) or an index of many outputs divided by an index of many inputs are examples of several techniques presented by Mozumdar (2012) to define and measure productivity.

Traditional productivity measurements are based on the comparison of output and input quantities. When output and inputs grow at the same rate, productivity remains constant. Conversely, if the rate of output growth surpasses the rate of input increase, productivity is deemed positive. These interpretations raise the question of what approach to measuring agricultural productivity. Nevertheless, it is generally acknowledged that productivity refers to a production system's capacity to create a greater economy and efficiency. These methodological arguments are no longer relevant in this study, and the productivity measure used in this study is farm yield by crop or total production per hectare. The total production per hectare is opted other than other measures of agricultural productivity like Total Factor Productivity (TFP) due to the supposition that the important factors such as labor, capital, and material resources employed in crop production in the study area are very much comparable. For this reason, we are neither accounting for the differences in quality of inputs or outputs, and nor considering the environmental impact of production. Thus, with the measure of total production by hectare, it is intended to capture the total amount of output produced per unit of land.

Numerous empirical studies examining how adopting improved crop seed varieties affect productivity have also considered the money generated from using the same improved crop seed varieties (Khan et al., 2019; Natnael, 2019a; Tesfaye et al., 2016; Tufa et al., 2019). These studies' consideration of the relationship between productivity and income is justified because, on the one hand, having a relatively high income makes farmers more resilient to various shocks and/or stresses, such as drought and inflation, and on the other, having a low income may make them more susceptible to various externalities and restrict their use of agricultural inputs and related technologies. Therefore, farmers' income may positively or negatively impact their productivity. This causal effect encourages productivity to be researched with the amount of their income to increase the possibility that a given study's outcome may be attributed to a treatment variable being considered. Based on this theory, program intervention effects on beneficiary farm households' crop productivity are quantified with their effects on crop-related earnings.

1.2.5. Crop productivity and plot-level seed rate

According to an agricultural sample survey on the area and production of crops, *tef* occupies about 20% of Ethiopia's cultivated land; *Oromia* produces about 48% of the country's *tef*, followed by *Amhara* with 39% (Central Statistical Agency (CSA), 2020). The rise in the area

of land planted with *tef* over the past few decades has also been linked to an increase in *tef* production (Demeke & Di Marcantonio, 2013). Besides, the studies show that seed rate significantly impacts the production and productivity of *tef*, and recommended using a different seeding rate for a higher *tef* yield (Abraham et al., 2018; Vandercasteelen et al., 2013; Wolde, 2021). For instance, Abraham et al. (2018) proposed a seeding rate of 25kgha^{-1} along with row planting for a higher *tef* production after evaluating the effects of seed rates and sowing methods on growth, yield and yield attributes of *tef* in Ada district, East Shewa, Ethiopia. To get the best yield of *tef* in the soil and climate of *Adet* (Northwest Ethiopia), Yechale et al. (2021) suggested a 5kgha^{-1} seed rate using the row planting method. In congruent with this, as to Abebe and Filmon (2018), growing *tef* at seed rates of 5kgha^{-1} in the study areas of *Konso* and *Arbaminch* (Southern Ethiopia) is most importantly inexpensive for smallholder farmers because it gives them the highest yield of *tef*. In *Shebedino*, Southern Ethiopia, Bekalu and Arega (2016) discovered that seeding *tef* at a rate of 5kgha^{-1} effectively achieves a higher grain production and economic advantage. Amare and Adane (2015) also advised a seed rate of 5kgha^{-1} *tef* for the Eastern *Amhara* areas.

A study conducted in *Assosa*, Western Ethiopia, indicated that using 10 kg of seed per hectare and spacing it 25 cm apart is a more practical method of achieving the highest grain yield for *tef* in the study location (Getahun et al., 2018). Another study also advocated using treatment combinations that combine a seeding rate of 10kgha^{-1} with the row method of sowing to produce *tef* in the sub-humid areas of *Tigray*'s central zone (Abraha et al., 2020). A study by Wolde (2021) at *Wolaita Sodo* (Southern Ethiopia) differs from other studies because it suggests treatment combinations of 2.5kgha^{-1} seeding rate along with row planting for *tef* production in the study area. For a firm recommendation, the study advised repeating the experiment in various soil types, climates, and locations. Generally, these studies identified the seeding rate as one of the key elements in determining the ideal degree of *tef* crop density. This shows how important it is to establish location-specific seed rates when introducing new *tef* varieties rather than to take for granted that using high-yielding *tef* varieties will increase productivity.

1.2.6. Agricultural [crop] commercialization

Agricultural commercialization is a complicated notion with several definitions. For Pokharel (2007), agricultural commercialization is more than just the marketing of agricultural outputs; instead, it occurs when decisions about the usage of household products and inputs are made

using the principles of profit maximization. According to Govereh et al. (1999), it refers to the portion of agricultural production that is commercialized. On the other hand, Sokoni (2008) described the commercialization of smallholders as a process involving the switch from production for subsistence to production for the market. These definitions place a strong emphasis on cash incomes while emphasizing the level of output market participation. A profit motivation is crucial to agricultural commercialization. For instance, Pingali and Rosegrant (1995a) pointed out that agricultural commercialization involves more than just selling in the output market; household marketing decisions should be based on maximizing profits for both the output and input selections. This implies commercialization can also happen by reorienting agriculture toward primary food crops than merely emphasizing high-value cash crops.

There are numerous ways that subsistence farming is commercialized. According to von Braun et al. (1994), it can take place on the output side with a more sold surplus, but it can also occur on the input side with increased purchased inputs. Commercialization, to them, means more frequent market exchanges to reap the rewards of specialization. In line with this, creating an enabling environment for open domestic and international trade is crucial for facilitating the development of market infrastructure, support services, and access to both existing and new market opportunities. Favorable policies and institutional arrangements play a vital role in ensuring a secure legal system that fosters these trade environments.

Despite the various definitions provided, it has been stated that for most developing nations that depend on the agricultural sector, commercializing smallholder agriculture is necessary for economic growth and development (Pingali & Rosegrant, 1995b; Timmer, 2005). This notion is very relevant for nations like Ethiopia, whose economy is based on agriculture and where smallholder farmers dominate the sector. This study has looked at the extent to which crop-related AGP II interventions caused smallholder farmers to generate excess crops because AGP II embraces the commercialization of agriculture as one of its primary components. In this case, a generalization about smallholder farmers selling some of their produce on the market should be avoided. Instead, we must distinguish between "marketable surplus" and "marketable subsistence". While the former refers to the farmer's produce that entered the market and was above his or her subsistence requirement, representing savings that could be used for investment (*e.g.* in agricultural technology) or wealth creation, the latter refers to a portion of the farmer's produce that enters the market in exchange for non-

agricultural goods or agricultural commodities that the farmer does not produce (Diriba, 2018a). In light of these definitions, this study bases its analysis of the commercialization framework on marketable surpluses of smallholder farmers concerning their main food crop, *tef*.

1.2.7. Welfare

Another research notion in this study is welfare. It is defined in many ways, ranging from the dictionary term to the definition used in economics. For instance, the Merriam-Webster dictionary defines welfare as being in good shape, particularly concerning luck, happiness, well-being, or wealth. According to Macmillan's definition, it is the health and happiness of individuals. The Business Dictionary describes it as the availability of resources and the conditions necessary for a reasonably happy, healthy, and secure life. Well-being, comfort, and safe living are the points where all these dictionary meanings converge. In contrast, from the economic point of view, welfare is defined as the degree of prosperity and standard of living of either a person or a group of people; it explicitly refers to utility earned via the acquisition of material things and services (Dutta & Pattanaik, 2003). The definitions of welfare used in this study are not less than or more than the dictionary or economic definitions.

Regarding its measurements, the terms ‘subjective’ and ‘objective’ measurements of welfare are used throughout the welfare literature to distinguish between the subjective experience of satisfaction, happiness, sadness, or any other emotional state, on the one hand, and the objective, material aspects of daily life, such as housing, child mortality, or nutrition, on the other. The contrast is not always crystal evident, though. Health, human freedom, and security are examples of concepts operationalized as objective categories yet interpreted as subjective qualities. Since these are contentious areas, we are not very interested in them; instead, this study uses consumption to gauge household welfare.

Economists have long regarded consumption as a proxy for living standards. It might be argued that consumption spending is arguably the most popular and preferred welfare indicator, even though many alternative indicators are available to undertake welfare analysis. The survey data in this study were used to determine the effects of AGP II's new interventions or technology on farm households' welfare and/or livelihood because household surveys are a crucial source of information on households' economic and social situations.

Even while indicators of consumption or income are typically used to gauge welfare, asset-based wealth indices have gained popularity as an alternative metric in recent years. Wealth indices are the sole means to examine distributional characteristics in intricately detailed large-scale surveys that lack data on consumption and/or income, such as Multiple Indicator Cluster Surveys (MICS) and Demographic and Health Surveys (DHS) (Howe et al., 2008). The wealth index has been viewed both theoretically and practically as an alternative measure of economic status to income and consumption (Rutstein & Johnson, 2004). In other words, wealth is thought to represent a more permanent status than does either income or consumption, and more accurately reflect long-term welfare, not short-term poverty, income, or consumption, because it is less volatile than both income and consumption; it is also thought to be better suited to analyze multi-dimensional poverty (Filmer & Pritchett, 1999, 2001); and is less data-intensive (Azzarri et al., 2006).

However, because of the stated characteristics, the wealth index is a unique indicator and cannot be compared to the traditional indicators of economic status. According to several studies, the asset index may be a decent proxy for long-term or permanent income but is often a poor proxy for current household income or expenditure (Filmer & Pritchett, 2001). Furthermore, Filmer and Pritchett (2001) stated that using asset-based indexes as alternative welfare measurements is constrained for various philosophical and practical reasons. The wealth index, which compares a household's wealth to those of other households in the sample, gives a relative measure of welfare but does not express the household's actual levels of welfare or poverty. Additionally, it has been discovered that the wealth index, in its most often used form, is biased toward urban areas and has little discriminating power at the bottom end of the wealth distribution (Filmer & Pritchett, 2001; Howe et al., 2008; Rutstein, 2008).

According to Howe et al. (2008) and Rutstein and Johnson (2004), the indicators included in the index may directly affect the outcome of interest depending on the objective of specific research. Due to the mentioned theoretical and practical limitations on wealth-related measurements, the wealth index and income cannot be used in this study as direct measures of household welfare. Instead, household consumption (*i.e.* food consumption, non-food items (including health, education, and other non-food expenditures), housing expenditures (including rent and utilities), and consumer durables) were used as a proxy for household welfare.

1.2.7.1. Consumption as the most preferred measure of welfare

Researchers have vigorously argued the advantages and disadvantages of various welfare indices, with a certain agreement that choosing consumption over income is preferable, particularly in the context of developing countries. For instance for Citro et al. (1995), consumption appears to better reflect the idea of "quality of living" since people draw their material well-being from the actual consumption of goods and services rather than from the receipt of income per se. Consistently for Deaton and Zaidi (2002), consumption more accurately depicts long-term income because it is less correlated with short-term income swings and is smoother and less volatile than income.

In addition, Deaton (1997) stated that because consumption in agricultural societies is smoothed over the seasons, it is more stable and more accurately reflects (or approximates) the genuine level of living. He also stated that even though gathering data on consumption typically takes much time, the concept of consumption is typically more apparent than the concept of income; as a result, it is very challenging to precisely measure household income, especially for households with self-employed individuals and those who work in the informal sectors. Therefore, household-level consumption was considered a proxy measure of welfare given that this study was done in a rural setting with households primarily engaged in farming and for whom income is likely to be a more sensitive issue than consumption. The above mentioned food and non-food aspects of consumption were considered as the contextual frames to examine welfare.

1.2.8. Crop technology nexus

Studies show that crop technologies (such as chemical fertilizers and improved varieties of seeds) are essential agricultural inputs that aid farmers in obtaining improved agricultural yields; farmers use these technologies to increase production and land productivity. It is also noted that seeds that meet the quality requirements favourably affect the productivity of land (Bishaw et al., 2012; Kamruzzaman & Takeya, 2008). In general, having access to crop technologies - improved seed in this case - allows farmers to enhance productivity, increases their income, and lessens their vulnerability to the seasonality of agricultural production and outside shocks (Hussain & Hanjra, 2004). In light of this, studies on how crops respond in terms of yield to seed rates demonstrate that using the proper seed rates leads to productivity, as seen by a considerable increase in crop production (Abraha et al., 2020; Abraham et al., 2018; Amare & Adane, 2015; Getahun et al., 2018; Wolde, 2021; Yechale et al., 2021). This

implied that controlling the seed rate could significantly impact agricultural output (or crop productivity).

According to studies on household market participation behaviour, a sensible farmer tends to supply a particular proportion of surplus output to the market after his or her demand is satisfied (Govereh et al., 1999; Jaleta et al., 2009). This strongly implied a causal relationship between commercialization and technical efficacy. To put it another way, being a productive and efficient farmer has a favourable impact on surplus production, the degree of commercialization, and revenue. Findings also pointed to trade-offs between commercialization and productivity, where commercialization is crucial for increasing technical efficiency in a setting where subsistence agriculture is characterized by credit constraints and input market failures (Gebre-Ab, 2006). Where possible, commercialization is intended to increase farmers' revenue so they can increase both the quality and quantity of food they consume (Achandi & Mujawamariya, 2016).

Smallholder commercialization as a process of agricultural transformation is expected to substantially impact farmers' welfare due to its comparative benefits over subsistence farming. For instance, Kirimi et al. (2013) noted that household commercialization is associated with a lower risk of being chronically food poor and better welfare. The studies by (Achandi & Mujawamariya, 2016; Diriba, 2018a; Gebre-Ab, 2006; Malumfashi & Kwara, 2013) also demonstrated a positive association between commercialization and the welfare conditions of smallholders.

The discussions above suggest that broad-based productivity growth in agriculture, in general, and in crops, is essential for improving rural residents' welfare and inclusive rural and structural transformations. Investments in agricultural technology innovation and utilization usually fuel this transformation. In other words, agricultural technology and commercialization encourage agricultural growth, enhance employment opportunities, and increase food availability, which all are crucial to enhancing the welfare and reducing poverty (Binswanger & Braun, 1991; Kirimi et al., 2013; Malumfashi & Kwara, 2013).

1.2.9. Common Interest Group and rural women and youths livelihood

AGP II aims to benefit 1.6 million households as the target number of direct beneficiaries to assist them in changing their rural livelihood from traditional farm-based cultivation to more market-oriented and diversified off-farm and non-farm activities. This will enable them to

realize the agricultural potential of rural farm households in various areas of the country. The program is also meant to assist a sizable number of indirect beneficiaries, including members of the direct recipient households (EIAR, 2018; Ministry of Agriculture (MoA)(b), 2015). Public Agricultural Support Services, Agricultural Research, Smallholder Irrigation Development, Agriculture Marketing and Value Chains, and Project Management, Capacity Development comprise the program's five intervention categories. The program aims to promote the commercialization of agricultural goods within the context of the fourth component (*i.e.* agriculture marketing and value chains) by improving smallholder farmers' access to input and output markets. The program supports farmers' registered (unions, primary cooperatives) and informal organizations and/or groupings within this component. One of the program's informal and economically driven farmer groups, the CIG initiative, primarily targeted women and young people (MoA(a), 2015; MoA(b), 2015).

The CIG project intends to diversify women's and youth's livelihoods and transfer them to various off-farm and non-farm activities because farmland size continually shrinks due to unprecedented population increase (MoA(b), 2015). One in six people in the globe today is young, and most young people in developing countries live in rural areas, making the need for such a strategy apparent (Ji-Yeun, 2018; Moore, 2018; Organization for Economic Cooperation and Development (OECD), 2018). The majority of young people in developing nations do, according to (OECD, 2018) survey, desire to alter their current employment position, but they do not want to work in agriculture. According to a study by (Bezu and Holden, 2014), only 9% of Ethiopian rural youngsters plan to pursue agriculture as their primary career. The survey also revealed that rural youth's limited access to agricultural land due to land scarcity and market limitations has continued to play a role in forcing youngsters to leave agriculture in pursuit of alternative sources of income. The study by (Schmidt and Woldeyes, 2019) also asserted that agriculture remains a significant source of livelihood for the vast majority of the country's rural youth (63%) and the general population, even though farm landlessness, negligible rural job creation, and limited non-farm labor opportunities are long-standing issues preventing them from having their fair share.

These facts indicate the significance of CIGs as a strategy for alternative livelihood for young people. Even though rural youth and women have similar levels of professional aspiration to their urban counterparts, the labor market offers few chances for jobs paying a living wage (OECD, 2018). Besides, despite their critical responsibilities in the rural economy,

women are reported to encounter barriers that prevent them from obtaining appropriate employment opportunities and increasing their productivity (International Labor Organization (ILO), 2019). Therefore, one way to bridge the gap is to involve them in livelihood-enhancing activities like CIG. This assertion is further supported by the fact that in developing countries, livelihood diversification is considered one of the first methods for rural households to survive (Worku & Woldetsadik, 2013). In studies on these groups' changing livelihoods, several ways of livelihood diversification were found among rural women and youth (Eneyew & Bekele, 2012; Mekonen, 2019; Schmidt & Woldeyes, 2019; Tedla, 2019; Worku & Woldetsadik, 2013). Low access and quality education, gender-based stereotypes, low access to information and the market, high dependency ratio, inadequate road infrastructures, low level of transport, and limited access to credit were also found as the variables that limit women and youth livelihood diversification and/or change (Adeyanju, 2019; Bekele & Worku, 2008; Demeke, 2016; Desalegn, 2016; Rim & Nsanganira, 2019; Seetanah et al., 2019; Singh & Belwal, 2008).

In addition to providing substantial income and employment opportunities for rural residents in general and landless rural youths and women in particular, rural-based agricultural enterprises have also been incorporated into the emerging spheres of diversified livelihood opportunities for agricultural households (Ellis & Biggs, 2001; OECD, 2007; Swedish International Development Cooperation Agency (SIDA), 2004). As a result, the contribution of the CIG scheme must be taken into account as part of the strategy for diversifying sources of income. This calls for understanding the CIG scheme's effect on rural women and youth livelihood changes. This study was therefore started with the proper acknowledgment of the significance of the CIG program for the diversification of youth and women's livelihoods in Ethiopia in general and the study area in particular. Overall, the scheme's emphasis on women and young people is noteworthy because guaranteeing their livelihoods would enable them to actively participate in the rural transformation necessary to bring about constructive change.

1.3. Statement of the problem

Ethiopia's rural development policies and packages have a relatively long history than many sub-Saharan African countries (Berhanu & Poulton, 2014). A review of the evolution of Ethiopian rural development policy revealed the implementation of various policies under different regimes throughout its history. The early development plans of the Imperial Era

prioritized industrial growth while ignoring agricultural development. They mainly focused on working with wealthier and commercial farmers in and around key project sites. However, the political climate during 1974 - 1991 favoured state and collective farms at the expense of independent farmers. Following 1991, economy-wide development programs like ADLI, Sustainable Development and Poverty Reduction Program (SDPRP), Participatory and Accelerated Sustainable Development to Eradicate Poverty (PASDEP), and successive GTPs (GTP I and II) were implemented. One of the objectives of the GTP(s) in the agriculture sector, among others, was to attain national food self-sufficiency. This goal was pursued by enhancing the productivity of smallholder farmers through the utilization of research-driven knowledge and technologies. Additionally, the focus was on expanding the production of industrial and export crops while also prioritizing the rehabilitation and conservation of natural resources, with particular emphasis on adopting a comprehensive package approach (Haile, 2015; Welteji, 2018).

The major proponents of market-led growth argued that improving agricultural technology will increase agricultural productivity, enabling smallholder farmers to produce marketable surplus and subsistence goods by improving their access to markets. This will improve their welfare (*i.e.* incomes and consumption), provide them with more opportunities for rural employment, and result in sustained agricultural growth (Dorward et al., 2004; Poulton et al., 2008; Stiglitz & Pike, 2004). The importance of focusing on small-scale agricultural systems through new and creative public-private partnerships, increased public investment in research and extension systems, development-oriented local governance and institutions, and the use of agricultural technologies are also widely acknowledged in the literature (Marzin et al., 2016; Tshuma, 2014; Watson, 2008; Wiggins et al., 2011; Yengoh, 2012). Similarly, Shete and Rutten (2015) demonstrated that putting land into large-scale farming lowers the food security status of nearby communities and causes income loss among locals.

The argument set up by advocates of large-scale agriculture that the focus should be switched from small-scale agriculture to large-scale farming is equally important. They criticize small-scale agricultural systems by outlining some of the broad potential benefits of large-scale agricultural investment for the rural poor, including the creation of a sizable number of farm and off-farm jobs, development of rural infrastructure, transfer of new technologies and practices, increased food and agriculture production for domestic consumption as well as

consumers abroad, global price stability and food security (Abesha et al., 2022; Keeley et al., 2014; Posluschny-Treuner, 2012; Rahmato, 2011).

Nonetheless, grounding on the fact that small-scale farms have a major contribution to the agriculture sector in Ethiopia with the land cultivated by them accounts for 95% of the total area under agricultural use, and they account for more than 90% of the total agricultural output (Diriba, 2018b), we chose to emphasize the argument favoring a small-scale agricultural system as the foundation for the main thesis of this study. To investigate the stated premise, we have chosen AGP II as one of the rural development programs that attempted to support smallholder farmers' agriculture. The program is founded on the major obstacles to the country's overall development and the agricultural sector, including low productivity, poverty, food insecurity, resource degradation, and vulnerability to natural disasters like drought. It primarily draws on land, labor, and water resource bases to address these issues while considering agro-ecological diversity in high-agricultural growth potential *woredas*. The central theme of the program is to focus on relatively better potential *woredas*, encourage stakeholders' involvement in yield-increasing activities, enhance the development of the agricultural value chain, encourage commercialization of Ethiopian agriculture, and promote value addition and nutritional diversity with a particular focus on women and young people. The program's agricultural development packages leverage the acceptance of technology as a foundation for increasing crop and livestock yield and commercialization (MoANR, 2016). In the agriculture potential *woreda* chosen for this study, the program has introduced a high-yielding *Korra tef* variety as the crop technology for smallholder farmers who own farmland and the CIG for rural women and youth who do not have farmland to cultivate.

Despite not being directly associated with the implementation of AGP II, numerous studies have been conducted in rural areas of Ethiopia and abroad on the impacts of adopting various crop technologies on smallholder farmers' productivity and income (Berhane et al., 2018; Buehren et al., 2017; Gebeyehu, 2016; Mebratu and Kenea, 2020; Natnael, 2019a; Negussie, 2020; Tesfaye et al., 2016; Vandercasteelen et al., 2016), on their commercialization status (Aman et al., 2014; Edosa, 2018; Endalew et al., 2020a; Gebreselassie and Sharp, 2007; Getahun et al., 2019; Jaleta et al., 2009) and on their welfare (Aman et al., 2014; Amsalu, 2014; Degefu, 2016; Edosa, 2018; Endalew et al., 2020b; Getahun et al., 2019; Mezgebo et al., 2014; Negussie, 2020b; Ruder, 2018; Tesfaye et al., 2016; Weldemeskel et al., 2020;

Wordofa et al., 2021), and the productivity effects of plot-level seed rate for different crops including *tef*, other than *Korra* variety (Abraha et al., 2020; Abraham et al., 2018; Amare & Adane, 2015; Arega & Yemgnushal, 2018; Bekalu & Arega, 2016; Getahun et al., 2018; Wolde, 2021; Yechale et al., 2021). Additionally, research has been done on the livelihood changes experienced by rural women and youth as a result of CIG-like interventions and/or activities (Adeyanju, 2019; Alebel et al., 2019; Bekele & Worku, 2008; Demeke, 2016; Desalegn, 2016; Eneyew & Bekele, 2012; Mekonen, 2019; Rim & Nsanganira, 2019; Schmidt & Woldeyes, 2019; Seetanah et al., 2019; Singh & Belwal, 2008; Tedla, 2019; Worku & Woldetsadik, 2013).

However, relatively little research has been done to empirically measure and quantify the impacts that technology-based programs like AGP II have on households in general or the effects of the *Korra tef* variety on smallholder farmers' productivity, income, commercialization, welfare, and plot-level productivity in particular. Studies on the CIGs have also emphasized formal or officially recognized businesses, including micro, Small and Medium-sized Enterprises (SMEs) and other comparable groupings. To the best of the researcher’s knowledge, no studies conducted in the study area have addressed the livelihood changes experienced by the beneficiaries of the CIGs. In other words, the student researcher is aware of the non-existence of empirical measures of the changes brought by the agricultural development packages introduced by AGP II in the study area. As a result, the measurements of the program's impacts on the above mentioned pillars of agriculture have mostly remained nonfigurative or abstract due to several factors.

First, programs like AGP II are required to do baseline surveys, midterm evaluations, and end-line surveys. Ongoing monitoring and evaluation are also necessary to meet these requirements. It is evident that AGP II has adhered to all of these requirements. However, according to the preliminary assessments conducted by the researchers prior to the initiation of this study, it was determined that the routine and crude evaluations mentioned have been conducted in an aggregated manner, given the integration of AGP-II implementation with the government's regular activities. Due to this, the researchers felt that these evaluations were conducted without due attention to the comparable interventions by governmental and Non-Governmental Organizations (NGOs). Thus, there is a gap in the stated conventional evaluations in measuring actual changes that are only attributable to the AGP II and the technology it has brought. That is, measurements of the changes the program brings are tough

due to the simultaneous presence of similar programs in the intervention area; which in turn made impossible to determine if the results were entirely attributable to the program. To alter this, the student researcher must firmly control the study's variables by selecting one of the technologies introduced by the program.

Second, there is a lack of information regarding the program's impact on beneficiaries' welfare statuses, which is outside the realm of the stated aggregate evaluations. The researcher did not find an in-depth analysis of the welfare impact by emphasizing the crop technologies introduced by the program, despite the general assessments and evaluations of the program basing their immediate objectives and the prevalent optimistic view that the program would positively contribute to the well-being of smallholders. This needs to be investigated since it is crucial for planning welfare in general and crop yield, income, and commercialization in particular, at all levels, from policymaking to farmer engagements. This study has therefore examined the welfare impact of crop technology use on users, as evidenced by their consumption.

The third gap arises from generic evaluations of the program that failed to link the key aspects of smallholder agriculture (*i.e.* agricultural technology use, productivity, income, productivity effects of plot-level seed rate, commercialization, and welfare). The typical generic assessments evaluate indicators of these pillars separately rather than revealing connections between them. Due to this, how these pillars are related and how improving one will affect the others is yet undetermined. For instance, the program's examination of technological use in agriculture is limited to summarizing the utilization rate, omitting to examine how the utilization of technology impacts the users' productivity, income, and level of commercialization. If it had been evaluated concurrently (in a way, it showed the contribution of one pillar for the other), it would have provided a complete picture of the actual impacts it had on the lives of the beneficiary smallholder farmers.

Regarding the methodological flaw, the mid-term assessment was carried out by selecting three *kebeles* from the study *woreda*, which consists of 25 *kebeles*. However, the study area's varied characteristics should be considered, together with the counterfactual knowledge, to ensure sample representativeness. Additionally, despite the program giving the CIG scheme a significant weight, the scheme's implementation trajectory (*i.e.* efficacy, strengths, weaknesses, opportunities, and threats) needed to be given more weight in the cursory mid-term evaluation. Furthermore, while the CIG scheme's investigation method calls for a

thorough analysis using a qualitative research approach, it merely describes and summarizes facts about the CIGs beneficiaries and their characteristics.

As a result, this study examines the impacts of adopting the AGP II-introduced *Korra tef* variety on smallholder farmers' *tef* productivity, income, commercialization and welfare, and the productivity effects of plot-level seed rate. It also examines how the CIG scheme impacts the livelihood of young people and women who benefit from it. These variables are all important determinants of the rural economy. They are closely linked to the ability of rural households to produce crop or food and generate income. Therefore, we generally label them as the "livelihood of rural households". This is in line with the broader definition of livelihood, which is a complex and multifaceted concept that encompasses the various activities and strategies that rural households use to secure their basic needs and achieve their desired standard of living (Chambers, 1995; Scoones 1998; Ellis, 2000). Overall, the gaps mentioned are the fundamental assumptions upon which this study's ideas are built. The study brings an empirical contribution that would enrich the program's development approach used in the study area and would also supplement similar development policies and strategies aimed at achieving secure rural livelihoods by indicating contributions of the program to the field of rural development as well as the emphasis given to small-scale agricultural systems.

1.4. Research questions

The following series of research questions clarify the gaps mentioned in the problem statement:

1. How does adopting the *Korra tef* variety affect the users' income and productivity?
2. Does the *Korra tef* production depend on the seed rate at the plot level?
3. How does using the *Korra tef* variety impact commercialization?
4. Are there welfare impacts of using the *Korra tef* variety, as shown by the users' food and non-food consumption?
5. How well does the CIG intervention improve the livelihood of the women and youth who benefit from the program?

This dissertation is organized into one broad theme in the form of the main objective and divided into five parts (each considered as the specific objective) to answer the above-stated questions.

1.5. Objectives of the study

The main objective of this study is to examine the impacts of AGP II *tef* interventions on the livelihood of rural households in *Wara-Jarso woreda* of Central Ethiopia.

The following specific objectives are crafted to achieve the main objective:

1. The impacts of AGP II introduced *Korra tef* use on farm households' productivity and income in Central Ethiopia - (Article I)

   This study is specifically meant to:

   a. Estimate the effects of the use of *the Korra tef* variety on the *tef* farm productivity of smallholder farmers in the study area (yields per hectare)
   b. Examine the effects of the use of *Korra tef* variety on the *tef* farm income of smallholder farmers in the study area (net income per hectare)

2. Productivity effects of plot-level *Korra tef* seed rate in Central Ethiopia - (Article II)

   This study is specifically meant to:

   a. Investigate the productivity effects of plot-level *Korra tef* seed rate
   b. Examine the relationship between plot-level seed rate and yield.

3. The impact of AGP II introduced *Korra tef* use on the commercialization status of farm households in Central Ethiopia - (Article III)

   This study is specifically meant to:

   a. Examine the level of commercialization of *Korra tef* variety producers in the study area.

4. Adoption of AGP II introduced *Korra tef* and its impact on farm households' welfare in Central Ethiopia - (Article IV)

   This study is specifically meant to answer the question:

   a. What is the impact of using *Korra tef* variety on the welfare of the user farm households (indicated by the major food and non-food consumptions)?

5. The AGP II introduced the CIG scheme and its effects on rural women and youth livelihood in Central Ethiopia - (Article V)

   This study is specifically meant to:

   a. Identify the activities performed by CIGs
   b. Examine how effective the implementation of activities of CIGs

c. Investigate the SWOT for the CIGs implementation
d. Identify intervention strategies that could be designed to enhance the operation of CIGs

1.6. Significance of the study

This study has significances to the academia and rural development policy and strategy formulations in several ways. First, most scholarly works on smallholder farmers' crop technology utilization did not disaggregate typologies of crops. However, the study under consideration has examined the impacts of crop technology use by selecting the dominant crop in the study area. By doing so, it reduces the spillover effects from other crops. The same applies to the research done on crop productivity, income, commercialization, and welfare statuses of users. The study presented the interrelated impacts of adopting the *Korra tef* variety. This way, the study has well acknowledged the program's contribution to the implementing organizations and other concerned bodies.

Second, provided that further insight into the outcome of the interventions introduced by the program (*Korra tef* variety and CIG scheme in this case) is required, this study took an important step by examining the nexus between the major pillars of agriculture and locating the consequences of these pillars on the welfare status of the user farm households. While doing so, the study informed the relevant stakeholders about the issues that should be improved for similar interventions. Finally, besides its contribution to growing literature on the identified research area and to the researchers' knowledge on the same, outcomes of this study are expected to be seen in the light of the popular assumption that the use of improved crop variety will promote the users' productivity and income, and commercialization which in turn determines their welfare; and youths and women engagements in the CIG will improve their livelihood. Aggregately, the outcomes of this study would assist policy and strategy formulation at the national, regional, and *woreda* levels on the processes of designing similar interventions in general and on the identified study subjects in particular.

1.7. Scope of the study

1.7.1. Subject coverage and focus

This study investigated AGP II's roles in helping program beneficiaries achieve stable livelihoods by examining five issues. The first issue investigated the impact of *Korra tef*'s use on farm households' yield and income. The second and third issues emphasized the

productivity implications of plot-level *Korra tef* seed rate and the impact of *Korra tef* use on farm households' commercialization status. The fourth issue is the impact of using *Korra* on the users' welfare status. The fifth and final issue focused on examining the effects of CIG on rural women and youth livelihood.

AGP II at the Federal Democratic Republic of Ethiopia (FDRE) level, the AGP II office in the Oromia regional state, and the AGP II coordination office at both the zonal and *woreda* levels were among the offices and bureaus that were visited for the study. In addition to the *Korra tef* users and the CIG beneficiaries in the chosen *woreda*, the Agriculture and Natural Resource Management Office in the study woreda were also included with their respective kebeles.

1.7.2. Geographical scope

Ethiopia, a country in East Africa, is the site of this study. Ethiopia is administratively structured into eleven regional states and two city administrations. The *Oromia* regional state was selected for the study because the interviews with the AGP II implementing offices at the federal and regional levels indicated that the AGP II activities in this region reasonably represent the program's overall activities. According to the federal level AGP II focal person, the regional states of *Oromia* and Amhara could be considered models for the program operations in both AGPs, *i.e.* AGPI and AGP II, provided that the program has been operating in agriculturally viable parts of the country (Mohammed, personal communication, October 2, 2020). The regional-level AGP II facilitator added:

> *When we compare the country's regional states where the program has been under implementation, activities in the Oromia region better embody the general aims of the program* (Edosa, personal communication, October 5, 2020).

As a result, *Oromia* has purposefully opted over other regional states considering information from preliminary assessments. Personal factors like accessibility, financial limitations, and time restraints of the researchers all contribute to the purposeful selection.

With a total area of 359,620 square kilometres, *Oromia* is the country's largest and most populated regional state. Its population is projected to be 37.3 million in 2018, with 83.9% residing in rural areas. It is divided into 20 administrative zones, 30 town administrations, 287 rural and 46 town *woredas* (CSA, 2018). Except with *Tigray*, *Oromia* shares boundaries

with most other regional states, as well as with Kenya and Sudan. Its geography is incredibly diverse (high mountains, valleys, rolling plains, and lowlands, including part of the Rift Valley). The amount of rainfall in the area varies greatly, ranging from 400 mm in the south to 2400 mm in the western highlands. Fifty percent of the region is at least 1,500 meters above sea level, and the difference in heights contributes to the region's wide range of temperatures (reflected in tropical, sub-tropical, and temperate zones). Agriculture has been the primary source of employment for the vast majority of people in the region. *Tef*, maize, wheat, barley, peas, beans, and oil seeds are the primary crops. The primary cash crop in the area is coffee. The region produces 51.2% of Ethiopia's crops, covers 45.1% of the country's farmland used for temporary crops, and has 44% of all the country's animals (BoFED, 2018).

1.7.3. The study area

A cross-sectional household-level study was conducted in the *Wara-Jarso woreda*. The "Setup of the study area" section below provides a detailed description of the study area.

1.7.4. Methodological scope

Both quantitative and qualitative research approaches were used. The survey method was used to obtain quantitative data and different methods and data collection tools were used for gathering qualitative data. The research frames used throughout the dissertation are described in the "Research methodology" section below. The specific research techniques, models, and data collection and analysis techniques are explained and discussed in the chapters where each study objective is located.

1.7.5. Time scope

The study was conducted for 2.5 years. The researchers used the study *woredas* and corresponding *kebeles* communication channels of the MoANR and channels within which AGP II has been under implementation to cover as much of the geographic area as possible. The researchers could access the required study participants within the prescribed timeframe.

1.8. Setup of the study area and research methodology

This section is divided into two subsections. The study area is described in the first sub-section, and the research methodology is covered in the second.

1.8.1. Description of the study area

1.8.1.1. Physical description of the study area

The study area, *Wara-Jarso woreda*, is located in the North Shewa zone of Oromia National Regional State in Central Ethiopia. It is 73 kilometres from the zonal headquarters, *Fitche*, and about 187 kilometres from Addis Ababa, the country's capital (Figure 1). Its elevation ranges between 38° 14' 60.00" East longitude and 9° 49' 59.99" North latitude (Latitude, 2020). East *Gojjam* Zone in the north (bounded by the *Abay* River Bridge), *Kuyu* and *Hidebu Aboute woredas* in the south and southeast, *Dera Woreda* in the east, and West *Shewa* Zone in the west are its shared borders. The *woreda* is divided into four town administrations: *Filiklik*, *Gohatsion*, *Tullu-Milky*, *Hosse*, and 25 rural *kebeles*. The *woreda*'s total land is about 119,835 km^2; of this total land area, 31% is used for farming, 20.5% is left fallow, 17.1% is used for grazing, 10.4% is used for forests, 9.8% is used for bushes and shrubs, and 6.2% is bare land unsuitable for cultivation. The remaining 5% is used for other land uses, such as settlements, roads, water bodies, *etc.* Some land uses occasionally overlap with one another (Wara Jarso woreda Agriculture and Natural Resource Office, 2019).

The location of the study area is shown on the following map:

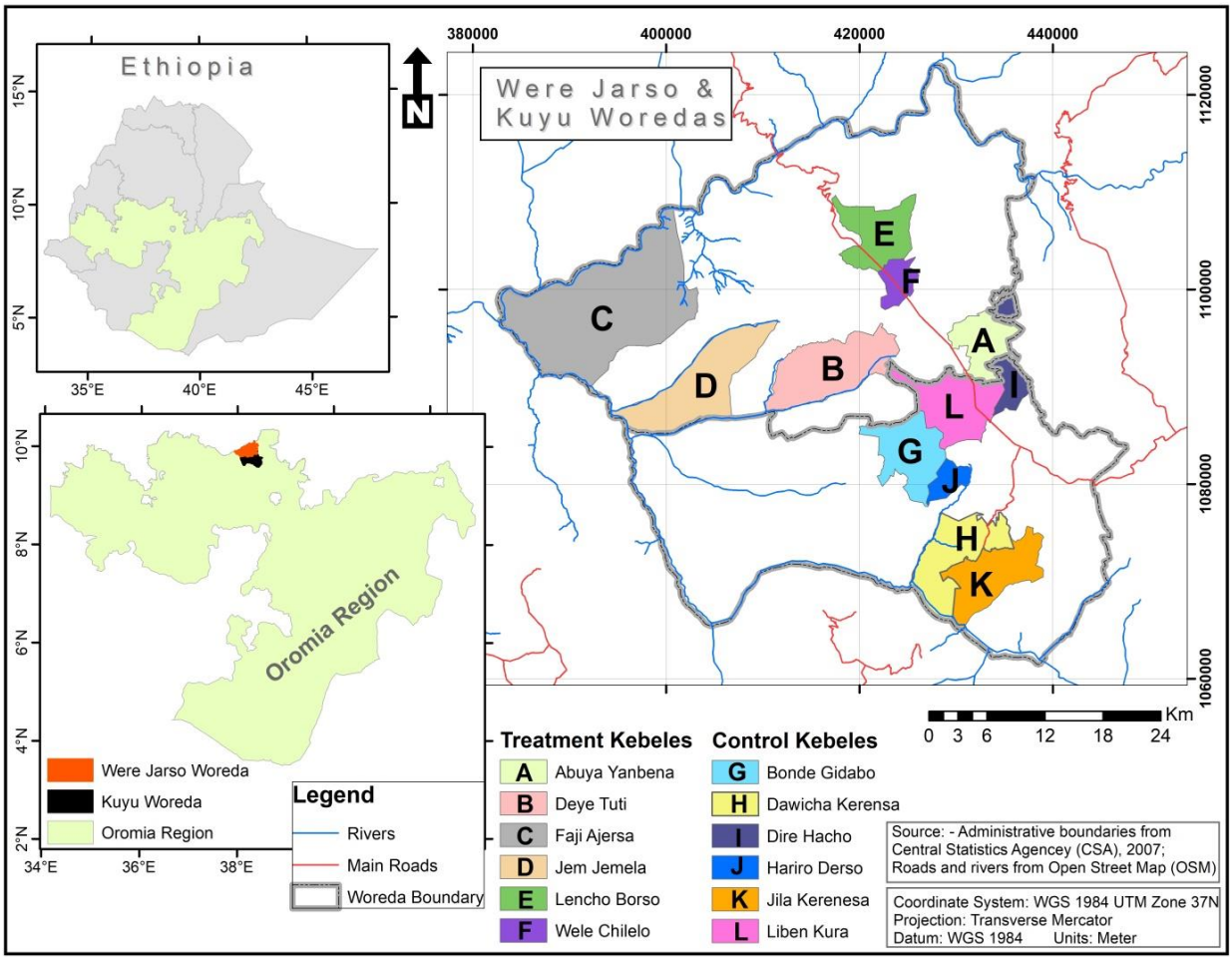


Figure 1: Map of the study areas (For the study objectives 1, 2, 3 and 4)

1.8.1.2. Population

Wara-Jarso woreda has a total population of 218,441, of whom 113, 589 (52%) are males and 104, 852 (48%) are females. There are 19,662 households, with 18,154 headed by men and 1508 by women. There are 26,890 housing units and 13,003 urban residents, or 8.7% of the population, fewer than the zonal average of 9.5%. The *woreda*'s estimated population density is 126.1 people per km^2, which is lower than the zonal average of 143 people per km^2, and the *woreda*'s average household size is five persons (Population projection, 2018).

1.8.1.3. Topography and climate

The *woreda* has an elevation that varies from 928 to 2786 meters above mean sea level. It consists of the three main agro-climatic zones: areas with sufficient rainfall (>2300m), moisture stress (1500 - 2300m), and lowland (below 1500). Its average monthly temperature ranges from 12°C in July to 28°C in May, at 19.8°C on average. With an average annual

rainfall of 1148.2 mm, the mean annual rainfall ranges from 849.7 to 1416 mm (National Meteorological Agency of Ethiopia [NMAE], 2020).

1.8.1.4. Agriculture: crop production in the study area

Wara-Jarso woreda is renowned for mixed farming: crop production, predominantly food crops like *tef*, wheat, barley, horse bean, field peas, potatoes, flax, and niger seed, as well as livestock raising. The highland is moderately productive; the main crops farmed here are *tef*, wheat, barley, and legumes. Crops, animals, fodder, and eucalyptus tree sales generate income. The principal crops farmed in the temperate agro-ecological zone are *tef*, wheat, pulses, and oil seeds (niger, sesame, and flax). Most households also raise cattle and goats. Mixed farming is also practiced in the lowland zone, with sorghum as the main crop. Thus, all three agro-climatic zones commonly grow *tef* and wheat. Agriculture, local labor, and firewood sales contribute significantly to poorer households' income, which they use to meet a part of their essential food requirements. The *woreda*'s soil fertility is preserved through the use of fertilizers, agricultural leftovers, compost, manure, crop rotation, and by fallow.

Farmers in the lowland agro-climatic zone use hoe culture and drought power, whereas most farmers in the *woreda* use drought power (oxen) to plow their fields. According to the *Woreda*'s Agriculture and Natural Resource Office, in addition to these traditional farming systems, the area's crop productivity potential is being hindered by farmers' limited access to contemporary farm inputs that increase productivity, application of fertilizer at rates below optimal levels, lack of contemporary threshing and harvesting facilities, lack of modern large-scale irrigation practices, and inefficient use of untapped perennial water resources. Besides, some farmers in the *woreda* need help to apply fertilizer to their farmland due to the rising cost of fertilizer (Wara Jarso woreda Agriculture and Natural Resource Office, 2019).

1.8.2. Research methodology

The study utilizes different techniques tailored to each objective's settings and goals. The research methodology encompasses the research design, population, sampling strategy, sample size, data sources, data collection tools, data analysis techniques, theoretical and analytical frameworks, objectives, data matrix, data presentation, data quality assurance, and ethical considerations. The specific objectives of the study are elaborated with corresponding details on their design and analysis procedures, which can be found in the respective sub-sections of research methods in chapters 2, 3, 4, 5, and 6.

1.8.2.1. Philosophical foundation

The notion that the issues of research methodologies are of secondary relevance to questions about which paradigm is suitable to one's research emphasizes the necessity for research philosophy in a given study (Guba & Lincoln, 1994). Put another way; it is a research philosophy that reflects significant presumptions about how a researcher sees the world. These presumptions will support the research strategy and the methodologies used in that plan (Saunders et al., 2003). Basing this, the pragmatic approach - a synthesis of the two main research philosophies (specifically positivist and interpretivist) - was adopted as a philosophical framework for directing both research methodologies and data analysis. For Creswell and Clark (2017), the mixed research method is associated with pragmatism as a worldview. For them, the emphasis is on the research outcomes, the significance of the question posed over the methodology, and the use of various data collection techniques to shed light on the issues under investigation. This indicates that pragmatism is pluralistic and focused on "what works" in real-world situations. According to Cherryholmes (1992), pragmatist researchers consider the "what" and "how" of research based on its intended outcomes. Pragmatism also allows mixed-methods studies to use various methods, viewpoints, assumptions, and multiple data-gathering and analyzing techniques.

The chosen research methods, which predominantly employed a positivist (quantitative) view for the first four objectives, aimed to capture the reality being studied. The utilization of qualitative data in conjunction with quantitative data allowed for a deeper understanding of the "how" and "why" aspects, going beyond a simplistic dichotomy between objectivity and subjectivity. On the other hand, the final objective relied entirely on the interpretations of individual participants, thus employing qualitative data.

It is important to note that the chosen research methods and their philosophical underpinnings can impact the validity of the research findings. The positivist approach used for the first four objectives, with its emphasis on quantifiable data and generalizability, may enhance the reliability and replicability of the findings. However, it is crucial to acknowledge that this approach may overlook certain nuances or contextual factors that could provide a richer understanding of the research topic. In contrast, the reliance on qualitative data for the final objective allows for a more nuanced exploration of individual perspectives and interpretations. While this approach may provide in-depth insights into the subjective experiences of the participants, it is important to recognize that findings derived from

qualitative data are context-bound and may not be easily generalizable to larger populations. By acknowledging these methodological choices and their implications, the study aims to provide a comprehensive and well-rounded understanding of the research topic, taking into account both objective and subjective aspects within its framework.

1.8.2.2. Research design

Using mixed approaches within a single study is viable and appropriate (Rossman & Wilson, 1985; Saunders, 2007; Vogel et al., 2013). Accordingly, a mixed-method approach with a cross-sectional time frame was used to address the study objectives. It addresses both explanatory and descriptive purposes. The premise that combining quantitative and qualitative approaches enables reaching the respondents' objective and interpretive viewpoints is the basis for picking the mixed method research approach for this study. Adopting the mixed method research approach also contributes to the strengths of the conclusions drawn from the study's findings. The concurrent embedded strategy of the mixed-methods approach was used for the study's first four objectives. Concurrent embedded is a research strategy in which quantitative data is used as the primary method, and qualitative data is embedded within the quantitative one to supplement its interpretation and for further explanation (Creswell & Creswell, 2017). The case study design was employed as a qualitative approach for the fifth and final objective. Details of the methods employed throughout the study are presented in the the following subsections.

1.8.2.3. Population, sampling procedure, and sample size

According to Kothari (2004), sampling is the procedure of selecting a sample from a population. The deliberate selection of the *woreda* was the first step. The *woreda* noted for crop production and commercialization (*i.e. Wara-Jarso woreda*) is purposefully chosen based on the data from AGP II coordinating offices at federal, regional, zonal, and *woreda* levels. The program introduces the seed variety of *Korra tef*. This variety had never been cultivated in the study area before the program has introduced in its second phase. This would make it possible to explicitly associate the successes and failures to the *Korra tef* variety chosen for the study. As per the information from *Wara-Jarso woreda*'s AGP II coordination office, the AGP II is under implementation in each of the *woreda*'s 25 rural *kebeles*.

The AGP II beneficiary households in the study *woreda* were the study's target population. The first four objectives used a multi-stage sampling procedure to get representative sample

households. In the first stage, *Wara-Jarso woreda* was purposefully chosen. The three major agro-ecological zones of the area were considered for the study since *tef* is commonly grown in all of them. Two *kebeles* were chosen from each of the main agro-ecological zone based on accessibility and considering their production level (high and medium producers). The quantitative component used stratified and systematic sampling; the qualitative part used a purposeful or judgmental sample technique. In stratified sampling, a sample is chosen within each stratum using a design that divides the population into non-overlapping groups known as strata (Creswell, 2009). Accordingly, two *kebeles* from each agro-ecology served as the actual study site. Ultimately, households were chosen from the sampling frames by employing systematic sampling. These households were considered the sample unit of analysis. The sampling frames were obtained from the corresponding *kebele*s AGP II coordination and administration offices. Such a rigorous step ensures the proper representation of the population under study.

One must observe the results of the program participants with counterfactuals. Unfortunately, we cannot access counterfactual information from the program beneficiaries. Since we do not know the counterfactual, the next best option is to estimate it from a sample of eligible non-participants. Based on this, we compared the results of households participating in the program (the treated group) with those of a comparison group that has not participated (the control group) (Pattyn et al., 2019). This categorization is based on the supposition that individuals who got treatment would have experienced results comparable to those of the comparison group in the absence of treatment (Abadie & Cattaneo, 2018). As a result, a sample of eligible non-participants (control group) from the nearby *Kuyu woreda*, which is quite comparable to the treatment group, was chosen to estimate the counterfactual. The *woreda* chosen for the control group shares similarities with the *woreda* considered as the treatment group aside from the AGP II interventions, including three primary agro-ecological zones, the predominant crops cultivated, and socio-cultural, economic, and other institutional characteristics. Six *kebeles* were chosen from the control *woreda* using the same procedures used in the treatment woreda.

Yamane (1967) suggested a more straightforward formula to determine sample size when the population is finite. He believed a sample size of 95% would be adequate for the finite population. As a result, Yamane's sample size determination formula was used by considering a 0.05% acceptable margin of error given the study population's finite character.

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

Where n = is the required sample size,

N = is the population size (7400 farming households – see Table 1 for the figure) and

e = is an acceptable margin of error (or the desired level of precision), which is 0.05.

According to this formula, the sample for this study is 375 farm households. Considering a 25% non-response rate, the study's actual sample size becomes 479 farm households. To increase the sample's representativeness and lessen concerns about a high non-response rate, a significantly higher percentage of non-response was considered. It is also believed that oversampling in the Propensity Score Matching (PSM) can address the problem of small sample size and improve the accuracy of the estimates (Bottigliengo et al., 2021). To balance the two groups, a sample size of 479 was divided into 221 and 258 *Korra tef* users and non-users, respectively. Finally, sample households from the treatment and control groups were chosen from each *kebele* using systematic sampling. Applying the Probability Proportional to Size (PPS), as shown in Table 1, allowed for a fair selection from the study *kebeles*.

Table 1: Distribution of the population and sample households across the study *kebeles*

Respondent type	***Kebeles***	**Population size (*Korra tef* producers)**	**Sampled households**
Users	Lencho Borsu	1100	70
	Wale Chilalo	540	35
	Abo Yayambana	510	33
	Dhaye Tuti	600	39
	Jemjem Mela	370	24
	Faji Ejersa	305	20
	Sub-total	**3425**	**221**
Non-users	***Kebeles***	**Population size (Non-*Korra tef* producers)**	**Sampled households**
	Liban Kura	865	56
	Bonde Gidabo	925	60
	Dire Hacho	835	54
	Hariro Derso	430	28
	Dawicha Kerensa	425	28
	Jila Kerensa	495	32
	Sub-total	**3975**	**258**
	Total	**7400**	**479**

Source: Field survey, 2020

1.8.2.4. Data sources and methods of collection

Both primary and secondary data were gathered. Most information came from primary data from farm households in the treatment and control *woredas*. The unit of analysis is a household because the study examines the impacts of agricultural technology use at the

household level. For the study's first four objectives, a semi-structured survey questionnaire was used to collect quantitative data between September 2020 and October 2020. The questionnaire was originally written in English and then translated into *Afan Oromo* for the interview. A pilot test was conducted to see if the interviewees fully comprehended the tool.

1.8.2.5. Tools of data collection

The study made use of the subsequent data collection techniques.

Questionnaire: A semi-structured survey questionnaire was used for the first four objectives to collect data on the study participants' farm households' demographic, socioeconomic, and institutional variables, such as the gender, marital status, farming experience of the household head, size of the household, total farmland, livestock and functional radio owned by the household, household's access to credit services, distance travelled by the household and the like. Other than these, the key themes covered by the questionnaire are households' resource ownership, technology characteristics, production costs and income, access to institutional services, and commercialization and welfare-related information. The questionnaire was designed using the study's objectives as a foundation and from measurements used in earlier related studies.

Key Informants Interview: In-depth interviews with key informants and experts who were relevant personnel in the field were conducted. These interviews followed a question guide, acting as an interview checklist, and continued until data saturation was achieved. For the first four objectives, a total of 15 respondents were selected as interviewees. The qualitative component of these interviews played a supportive role alongside the predominant quantitative data. In order to gather additional primary data, two farmers representing each of the three main agro-ecological zones were interviewed. The selection of farmers was based on their classification as high and medium users. Key informant interviews (KIIs) were also conducted with the regional AGP II monitoring and evaluation officer, the zonal AGP II facilitator, the *woreda*'s AGP II coordinator, and one Development Agent (DA) from each study *kebele* in the treatment group. All qualitative data interviews were conducted in appropriate and conducive settings, such as the interviewees' offices for office-based individuals and their homes for farmers. The interviews were carried out by the researcher personally, who took notes and recorded the interviews for reference.

Focus Group Discussion (FGD): FGDs were conducted with the chosen members of the CIGs using a FGD guide, also referred to as a discussion checklist. Through this approach, qualitative data was collected from the beneficiaries of the CIGs, as well as from the relevant interviewees associated with the final and fifth objective. A total of 11 KIIs and 4 CIGs were included in the study. Detailed profiles of both the KIIs and CIGs participants can be found in Tables 33 and 34, respectively, within the results and discussion section of Chapter 6.

Observation: Observation is the most crucial method for gathering unique data that maximizes research data validity (Babbie, 2010). It is advantageous to be intimately familiar with the research topic, and obtaining information directly from the sources is preferable. In this study, witnesses of program activities related to the study's objectives were recorded using an observation checklist. As a result, pictures and notes on the subjects or problems to be addressed were taken.

Document analysis: The secondary data were gathered from online sources (relevant journal articles and websites), hardcopy records, and relevant agricultural offices. They were then categorized into themes to meet the study objectives.

1.8.2.6. Techniques of data analysis

The first four study objectives were analyzed using descriptive and econometric methods, while the last objective was analyzed using thematic analysis.

1.8.2.7. Theoretical framework

The two distinct adoption-based theories and/or models serve as the foundation for this study. They were used to address issues like what adopter farmers must learn during the adoption process, how they must learn it, and from whom. The primary theoretical foundation for the study is the Target Input Model of adoption. Although the Target Input Model serves as the study's primary theoretical framework, ideas from the Dynamic Learning Model are also included. The Target Input Model was used because the study sought to show the impacts of adopting improved crop seed variety by farmers selected by the program to try the new crop variety. This model argues that the producer knows the production function with certainty, except for one parameter, which is typically conceptualized as the optimal input because it assumes that the best use of input is unknown and random (Ogada et al., 2014). The optimal input level is subject to idiosyncratic variation among the respective users. Additionally, the

model assumes that the best inputs come from a uniform distribution and that all farmers use the same production technology (De Janvry et al., 2017).

Likewise, the Dynamic Learning Model describes how people accept technology on the basis of being Bayesian and forward-looking. This model presupposes two benefits to adopting new technology: first, it may improve current earnings; second, it may encourage learning about the technology's value (knowledge), which is a public good and will benefit future decisions (Besley, 2002). Each adopter farmer has his/her plot to cultivate and must decide how many seeds to sow to the new variety. This model contributes to the theoretical framework of the study by explaining the facts that the adoption of new technology is driven by the perceived increase in profitability from the adoption of new technology and its grand premise that the early users of a given technology could not accurately predict its impact but could only adapt based on prior experience (Besley & Case, 1994; Chandrasekhar et al., 2020). The presumptions of these models are particularly suitable for the study under consideration since they are consistent with the facts of the population being studied and the nature of the newly-available technology introduced in the form of high-yielding *tef* variety. The ideas behind both models suggest that the adoption procedures made available to the chosen users increase their productivity. This, in turn, aids in demonstrating how the use of a particular agricultural technology and its productivity influence the users' income and level of commercialization. Eventually, this helps link adoption to user farm households' welfare.

The Asset Based Community Development (ABCD) model and the Belbin Theory of Teamwork were used as interpretive tools for the topics brought up in the CIG. The Belbin theory was used to study the functions of the teams, or in this case, the CIGs. According to this theory, creating an effective team involves individuals with varied personality traits that can discharge different duties or responsibilities. Assigning roles based on a member's strengths and weaknesses efficiently and effectively establishes a team (Belbin, 2010; BohatALA, 2019; Fisher et al., 2000; Indeed Editorial Team, 2021; Partington & Harris, 1999). Thus, we use the nine roles that the Belbin theory specified as viewpoints to examine the CIGs under study. The five guiding concepts of the ABCD model: citizen-led, relationship-oriented, asset-based, place-based, and inclusion-focused were also used to evaluate the CIGs' efficiency and effectiveness under the presumption that communities (*i.e.* members of the CIGs in this case) may initiate and direct the development process themselves. Concepts from the Process conflict, Social identity theory, and Minimum group

paradigm were also used as lenses to examine the performances of the CIGs. Last but not least, the SWOT analysis tool was used to investigate strengths, weaknesses, opportunities, and threats faced by the CIGs.

1.8.2.8. Analytical framework

Figure 2 illustrates the study's analytical framework from the earlier conceptual, empirical, and theoretical discussions. It is conceptualized that AGP II has introduced *Korra tef* variety for farm households and the CIG initiative for women and youths in the study area to improve the livelihood of both groups. The study aims to determine whether or not the program's goals have been achieved. For the study on farm households, the AGP II intervention area, *Wara-Jarso woreda*, was considered the treatment (user group); and the non-AGP II area, *Kuyu woreda*, is comparable to the intervention *woreda* and designated the control (non-user) group. The demographic, socioeconomic, and institutional characteristics that would capture the counterfactuals were shown as independent variables on the extreme right. The adoption of *Korra* is expected to increase productivity and income, demonstrated by high and low productivity and income. A higher yield (productivity) and surplus produce are anticipated to improve the users' commercialization, which in turn is expected to improve welfare, as seen by higher food and non-food consumption. The analytical framework further demonstrates the presumption that, other things being equal, the use of *Korra tef* seed at the recommended dosage will result in better crop yields. The Target Input Model's and the Dynamic Learning Model's adoption views are used as lenses to examine how the ideas mentioned above are connected. With regards to the CIG scheme introduced by the AGP II in the study area, the framework demonstrates that value chain, income, resource and business management, livelihood change, and/or empowerments of the program beneficiary women youths were analyzed from the scheme's activities, performances, and SWOTs by using the relevant theories and models as lenses.

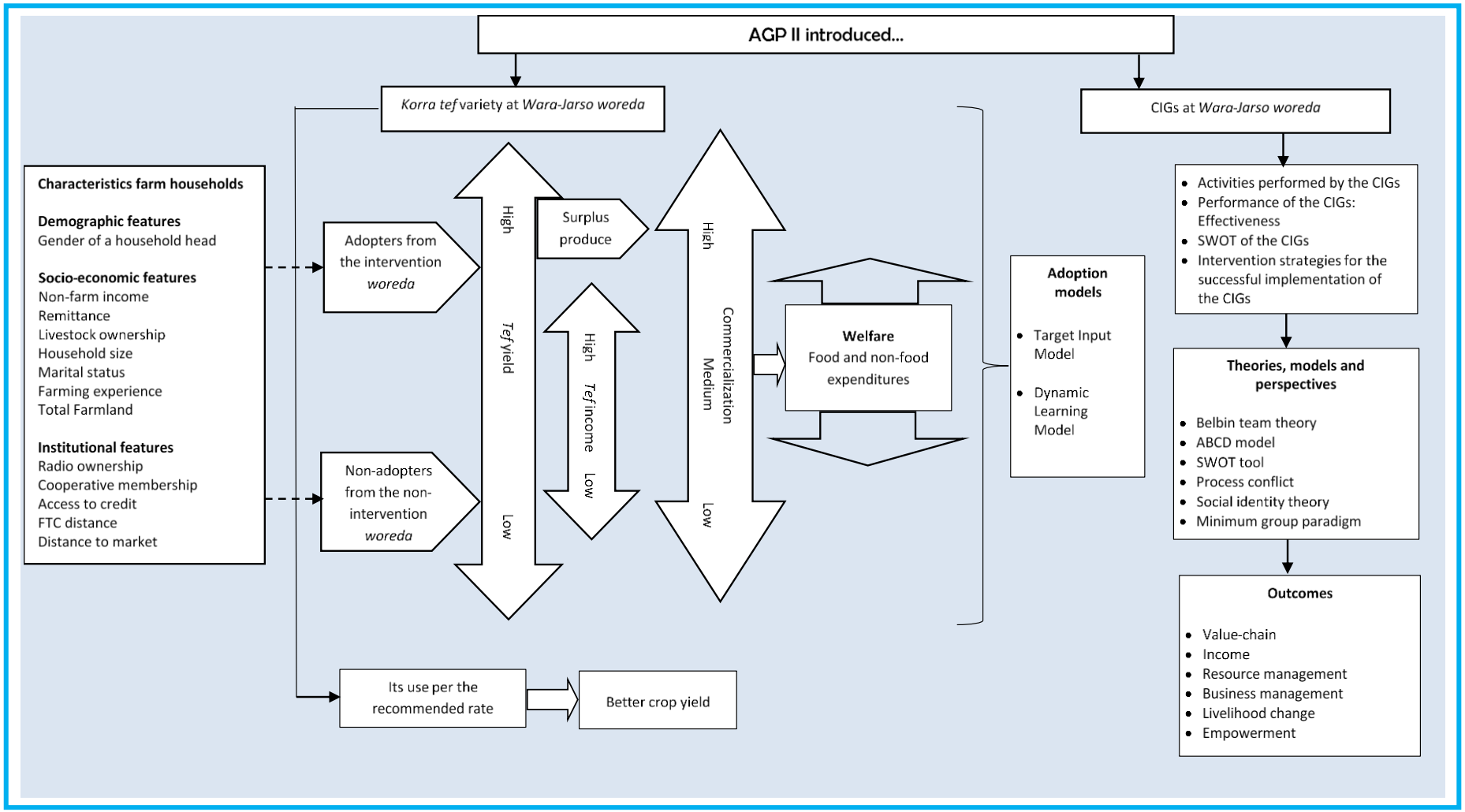


Figure 2: Analytical framework of the study
Sources: Author's construction

1.8.2.9. Objectives and data matrix

The objectives and data matrix are shown in Table 2 (*i.e.* a summary of information on study variables, data type, tools of data collection, and method of analysis in line with the specific objectives set).

Table 2: Objectives and data matrix

S. Nº	Objectives	Study variables		Data type	Observation units/Data sources/ Data from whom?	The need for qualitative data	Tools of data collection	Methods of data analysis
		Dependent variable(s)	The main independent/explanatory variables					
1	The Impacts of *Korra tef* (*Eragrostis tef*) Use on Farm Households Productivity and Income in Central Ethiopia: A Propensity Score Matching Analysis (Article I)	▪ User farm households' crop productivity ▪ User farm households' crop income	▪ Gender of household head ▪ Marital status of household head ▪ Farming experiences of household head ▪ Family size of household ▪ Total farmland ▪ Livestock owned by household ▪ Functional radio ▪ Access to credit services ▪ Distance household travels from home to FTC, where AGP II focal personnel resides ▪ The cooperative and/or association households primarily engaged in ▪ A distance from home to the main market (to input and output market) ▪ Income from non-farm activities ▪ Remittances, money transferred both from inside the country and abroad	Quantitative and Qualitative	▪ *Korra tef* users and non-users ▪ Experts (AGP II stakeholders DAs at the study *kebeles*)	▪ To investigate the farmers' and the relevant experts' perception of the use of *Korra tef* variety, particularly its impacts on their productivity and income. ▪ To assess the advantage of the *Korra tef* variety concerning *tef* crop productivity and income.	▪ Semi-structured questionnaire ▪ Interviews	▪ Chi-Square ▪ t-test ▪ Productivity=Crop output/Area planted ▪ PSM

2	Productivity Effects of Plot-Level *Korra tef* Seed Rate in Central Ethiopia: Applications of the Dose-Response Model (Article II)	▪ Plot-level seed rate	▪ Gender of household head ▪ Marital status of household head ▪ Farming experiences of household head ▪ Family size of household ▪ Total farmland ▪ Livestock owned by household ▪ Functional radio ▪ Access to credit services ▪ Distance household travels from home to FTC, where AGP II focal personnel resides ▪ The cooperative and/or association households primarily engaged in ▪ A distance from home to the main market (to input and output market) ▪ Income from non-farm activities ▪ Remittances, money transferred both from inside the country and abroad	Quantitative and Qualitative	▪ *Korra tef* users ▪ Experts (AGP II stakeholders DAs at the study *kebeles*)	▪ To examine farmers' and the relevant experts' perceptions on the productivity effects of plot-level *Korra tef* seed. ▪ To know whether they use *Korra tef* per the recommendation or not. ▪ To compare the plot-level seed rate of the *Korra tef* variety with other comparable varieties.	▪ Semi-structured questionnaire ▪ Interviews	▪ Chi-Square ▪ t-test ▪ One-way ANOVA ▪ Dose-Response model
3	The Impact of *Korra tef* (*Eragrostis tef*) Use on Commercialization Status of Farm Households in Central Ethiopia: A Propensity Score Matching Analysis (Article III)	▪ Commercialization level of user farm households	▪ Gender of household head ▪ Marital status of household head ▪ Farming experiences of household head ▪ Family size of household ▪ Total farmland ▪ Livestock owned by household ▪ Functional radio ▪ Access to credit services ▪ Distance household travels from home to FTC, where AGP II focal personnel resides ▪ The cooperative and/or association households primarily engaged in	Quantitative and Qualitative	▪ *Korra tef* users and non-users ▪ Experts (AGP II stakeholders DAs at the study *kebeles*)	▪ To examine the farmers' and the relevant experts' perception of how *Korra tef* variety has contributed to their level of *tef* commercialization. ▪ To assess marketing challenges and opportunities they have encountered in the processes of *Korra tef* commercialization.	▪ Semi-structured questionnaire ▪ Interviews	▪ Chi-Square ▪ t-test ▪ HCI ▪ PSM

			▪ A distance from home to the main market (to input and output market) ▪ Income from non-farm activities ▪ Remittances, money transferred both from inside the country and abroad					
4	Adoption of *Korra tef (Eragrostis tef*) and its Impact on Farm Households Welfare: a Propensity Score Matching Estimation in Central Ethiopia (Article IV)	▪ Welfare status of user farm households	▪ Gender of household head ▪ Marital status of household head ▪ Farming experiences of household head ▪ Family size of household ▪ Total farmland ▪ Livestock owned by household ▪ Functional radio ▪ Access to credit services ▪ Distance household travels from home to FTC, where AGP II focal personnel resides ▪ The cooperative and/or association households primarily engaged in ▪ A distance from home to the main market (to input and output market) ▪ Income from non-farm activities ▪ Remittances, money transferred both from inside the country and abroad	Quantitative and Qualitative	▪ *Korra tef* users and non-users ▪ Experts (AGP II stakeholders DAs at the study *kebeles*)	▪ To examine the farmers' and the relevant experts' perception of the impact of *Korra tef* on the user farmers' welfare in general and their food and non-food consumptions in particular.	▪ Semi-structured questionnaire ▪ Interviews	▪ Chi-Square ▪ t-test ▪ HCI ▪ One-way ANOVA ▪ PSM

5	Effects of Common Interest Groups on rural women and youth livelihood: A qualitative study from Central Ethiopia (Article IV)	NA	NA	Qualitative	▪ The CIG beneficiary women and youths ▪ Experts (AGP II stakeholders DAs at the study *kebeles*)	All are qualitative data and intended to: ▪ To identify the activities performed by CIGs ▪ To examine how effective the implementation of activities of CIGs are ▪ To investigate the SWOT for the CIGs implementation ▪ To identify intervention strategies that could be designed to enhance the operation of CIGs	▪ FGD ▪ Interviews ▪ Observation	▪ Case study ▪ MAXQDA 2020 software ▪ Content analysis ▪ Relational analysis ▪ Belbin's team theory ▪ ABCD model

1.8.2.10. Data presentation

The analysis and interpretation of a concurrent study integrate the two data types to seek convergence or commonalities in the findings (Bhattacherjee, 2012; Creswell, 2009). As a result, the two data types were combined at the findings and discussion stages for the study's first four objectives. This entails amalgamating the data and contrasting one set of data with another per the demands of the particular objectives. The last objective, which is entirely a qualitative study, also had findings and discussions that were presented together. With this, the major findings of the study were presented along with their discussion

1.8.2.11. Data quality assurance

According to Adams et al. (2007), three criteria - reliability, validity, and generalization - are typically employed for testing and evaluating measurements made by instruments as well as guaranteeing the accuracy of study results in terms of their overall design, data quality, and generalization. This study has attempted to ensure the reliability or consistency of the questionnaire in two ways. First, the supervisors and fellow graduate students reviewed the survey questions to ensure they were relevant, appropriate, well-stated, and accurately reflected the variables they were designed to evaluate. Second, the questionnaire was pre-tested in a comparable setting before the data collection to ensure the questions were understandable and consistent for respondents. The value for Cronbach's Alpha for the pre-test survey was $\alpha = 0.87$. It is also argued that at the pre-test stage, the main focus is not statistical accuracy, but feedback concerning the overall quality of the questionnaire (Rea and Parker, 2005). Basing this, the finalization of the questionnaire considered the comments and corrections suggested during pre-testing. Additionally, the instrument was translated from English (*i.e.* from the language it originally designated) into *Afan Oromo* and back to English to ensure that the instrument's original meaning is maintained. Finally, respondents were interviewed using the *Afan Oromo* version of the questionnaire.

The usage of the word validity in mixed research can be detrimental, according to Onwuegbuzie and Johnson (2006), because the idea of validity is frequently employed in quantitative research and despised by many qualitative researchers. Instead, they suggested using the concept of "inference quality" as the mixed research term for validity to describe the generalizability of the results. Building on this notion, the following qualities of this particular study at least influence the conclusions that can be drawn from it: (1) Quantitative and qualitative data were used from the program beneficiary respondents to create

descriptions and statistical generalizations. (2) The inference quality and generalization will likely worsen if the quantitative sample is not drawn randomly. As a result, probability sample selection was used for this study, strengthening the inference quality. (3) The researchers were not so involved with the group under investigation. This reduces the extent to which the researchers have bias and assesses how properly they present and use the respondents' perspectives. (4) The quality of the inferences is likewise improved since the strengths of the two approaches balance out the weaknesses of the first.

The quality of the qualitative data was ensured by using various techniques. The supervisors first remarked on each question in the interview guides. Trustworthiness was then ensured by avoiding a question with multiple purposes, lengthy statements and convoluted logic. False premises and leading questions were also avoided. Additionally, training was given to the quantitative data collectors on the study's objectives and methods of data collection and how they could create a good rapport with the study participants. The completeness and accuracy of data were also verified immediately after its collection was completed.

1.8.2.12. Ethical considerations

Rules of behaviour are ethics that often involve adhering to a code or set of principles (Robson, 2002). The rights of research participants are at the forefront of ethical concerns in research activities. According to Leedy and Ormrod (2005), no research should ever be carried out under conditions where full disclosure of the research's aims and purposes cannot be stated. Additionally, respondents should only be allowed to participate in a research project if they are fully aware of what that participation entails and what demands may be placed on them.

Following the stated ethical issue, an ethical clearance certificate was obtained from the College of Development Studies at Addis Ababa University. The purpose of the study, the freedom to choose whether or not to participate in the study without facing any penalties or negative effects, the length of the study, and the right to stop at any time were all carefully laid out for the study participants so that they could feel free to choose whether or not to take part. They were also told that any information they provided will be held in secrecy that data will be presented in an aggregate and that responses will not be linked to specific respondents. The study was typically undertaken following the briefing of the aforementioned explanations and after obtaining the verbal consent of the respondents,

interviewees and discussants. The researchers are also affected by ethical concerns, which refer to plagiarism and intellectual property. Because of this, plagiarism - the act of taking someone else's ideas, words, or other creative work and passing them off as one's own without giving proper credit - was viewed seriously as an academic crime.

1.9. Structure of the dissertation

This dissertation comprises seven chapters. A brief explanation of the study background, problem statement, research questions and objectives, significance, scope, and limitations of the study are covered in the first chapter, which serves as the dissertation's general introduction. This chapter reviewed the conceptual and empirical literature on the study under investigation. The literature establishes a connection between the five essays in this study and the philosophical assumption that directs the study in general. The general methodology for all the objectives included in the study (*i.e.* research design, population, sampling procedure, sample size, data sources and methods and tools of data collection, techniques of data analysis, theoretical and analytical frameworks of the study, objectives and data matrix, data presentation, data quality assurance, and ethical issues considered throughout the study) are described in this chapter. The literature and the theoretical foundations and model basis for the subjects this dissertation addresses were analyzed, summarized, and illustrated in the form of an analytical framework in a way that demonstrates the knowledge gaps that this study aims to fill (Figure 2). The analytical framework also demonstrates the conceptual connections between the articles in this dissertation and their foci. The methodology section of each study presents the specifics of the research design, data sources and methods of collection, sampling procedure, sample size determination, data collection tools, econometric specifications, and data analysis procedures. They are described alongside the methods, procedures and rationales for their use.

The dissertation's main body is covered in chapters two through six. The background, statement of the problem, objective, methods, findings and discussion, and conclusion, as well as any recommendations or policy implications, are all included in each chapter. Accordingly, the second chapter presents the first research objective of examining the impact of *Korra tef* variety use on user farmers' productivity and income. The third chapter presents the second research objective of investigating the productivity effects of plot-level *Korra tef* seed rate. The third research objective, which examines how commercialization has affected smallholder farmers who have used the *Korra tef* variety, is presented in the fourth chapter.

The fourth research objective, which examines the welfare consequences of using the *Korra tef* variety on user smallholder farmers, is presented in chapter five. The fifth and final research objective on examining the effects of CIGs on rural women and youth livelihood is covered in chapter six. The seventh and last chapter presents the synthesis of the study. By synthesis, conclusions from chapters, general recommendations and/or implications and limitation of the study and suggestions for further studies are presented. Objectives indicated in the study are also synthesized and discussed in view of the main theses of the study and with the basic tenets of the theories and/or models used.

The writing styles of the empirical chapters followed the journal's specific guidelines in which each article was published and/or submitted. Lastly, the articles were organized into the dissertation using the same formatting and citation styles. The first paper of the dissertation is presented in the upcoming chapter.

CHAPTER TWO: Article one

2. The Impacts of *Korra tef* (*Eragrostis tef*) Use on Farm Households Productivity and Income in Central Ethiopia: A Propensity Score Matching Analysis

2.1. Abstract

Ethiopia's government and development practitioners have encouraged agricultural innovations, including improved tef (Eragrostis tef) varieties to increase agricultural production. The improved seed varieties are expected to raise farm productivity and farmers' income. Based on this, the current study sought to determine how adopting improved tef variety affected farmers' productivity and income, focusing on the Korra tef variety introduced by the Agricultural Growth Program phase II. Cross-sectional data were collected from 479 randomly selected farm households in two woredas in Central Ethiopia, one as a user and the other as a non-user. The Propensity Score Matching (PSM) was used to investigate the impacts of using Korra tef variety on the users' tef production and income. The PSM model's robustness was tested using regression on variables and regression on propensity scores. According to the PSM analysis, adopting the Korra tef variety increased tef productivity by nearly six quintals per hectare. Additionally, it was found that switching to the Korra tef variety raised farmers' income by about 29500 Ethiopian Birr per hectare. Qualitative data supplemented the survey results. Based on these, it is reasonable to conclude that using the Korra tef variety increases the productivity and income of user farm households. Thus, farmers' awareness of the use of improved tef seed should be enhanced to increase their crop productivity and income. More personnel, money, and logistical resources should also be allocated to agricultural extension services.

Key Words: *Improved seed, Korra tef use, Agricultural Growth Program phase II, Propensity Score Matching*

2.2. Introduction

Tef (Eragrostis tef) is one of Ethiopia's most important cereal crops cultivated in a wide range of agro-ecologies. It is a staple food crop for millions in Ethiopia, the most salient crop by area planted and production value, and important crop in generating income. However, its productivity has remained low (Diriba, 2018a). Its lower productivity is attributed to the country's smallholder farmers' characteristics of low input/low output agriculture which mainly relies on conventional production techniques and a high reliance on rainfall in general (Diriba, 2018a; Kirchner, 2021; Sisay et al., 2017); and the low adoption of crop technologies including high-yielding varieties, fertilizer, and other agrochemicals (Gebeyehu, 2016) in particular.

Lack of access to and availability of high-quality seeds is emphasized as a significant challenge to increasing agricultural productivity in Ethiopia (Abebe & Alemu, 2017; Ojiewo et al., 2015). Such a challenge led to the need for intensification (*i.e.* increasing the productivity of farmland with new agricultural inputs) (Koko, 2012), which in turn increases the demand for improved seeds and fertilizers (Spielman et al., 2010); and put 'quality seed' in the center of the 'technology package' required to increase crop production (Alemu, 2011). As a result, the AGP-II is set as one of the initiatives designed to provide agricultural inputs and related technical assistance for raising agricultural production and productivity.

By enhancing access to crop technologies that increase yield, the program aims at increasing smallholders' crop production, food security, income, and nutrition security (MoA(a), 2015). In light of this, *Korra tef* variety was introduced in the study area to enhance farmers' production and income. However, the impacts of the *Korra tef* variety on farmers' productivity and income should have been studied. Numerous studies (Berhane et al., 2018; Buehren et al., 2017; Gebeyehu, 2016; Mebratu and Kenea, 2020; Natnael, 2019; Negussie, 2020; Tesfaye et al., 2016; Vandercasteelen et al., 2016) had instead focused on the impacts of agricultural extension services, improved crop varieties, the application of fertilizers, the practices of row planting and clustering, and the like on crops productivity and income. Other studies (Abebe and Alemu, 2017; Alemu, 2011; Bachewe et al., 2019; Kassa et al., 2019; Kebede et al., 2017; Tefera et al., 2016; Teferi et al., 2015) emphasized the challenges and opportunities of crop seed systems, productivity and efficiency, levels of crop technology adoption, and determinants and drivers of adoption of crop technologies and practices.

Aside from these, impact evaluations of technology-driven initiatives such as the AGP II on the productivity and income of farmers still need to exist more in Ethiopian agricultural literature. Besides, studies examining the impact of the *Korra tef* variety are rare in Ethiopia compared to the volume of literature available on the impacts of improved crop varieties. To the researchers' knowledge, research has yet to be done on the *Korra tef*'s impacts on productivity and income in the study area. This shows a knowledge gap on the impacts of using the *Korra tef* variety on the productivity and income of the *Korra tef* growers in general and the users in the study area in particular. Promoting crop technologies without considering their impacts on production and income is not a good investment and could lead to a loss of resources, including finance and time. As a result, this research examines how using the *Korra tef* impacts users' *tef* yield and income.

2.3. Conceptual framework

Figure 3 presents the conceptual framework illustrating the impacts of using *Korra tef* variety on farm households' productivity and income. It is imperative to encourage the use of agricultural (crop) technology to increase production and income (Abate et al., 2018; Awotide et al., 2016; Bachewe et al., 2019; Gebeyehu, 2016; González et al., 2009; Haile, 2015; Natnael, 2019; Tesfaye et al., 2016). For farm households in the study area, AGP II has introduced *Korra tef* to increase crop yield and income as part of the program on the growth of agriculture. Therefore, the study aims to determine whether the program's goals have been met. The intervention area of the program was designated as the treatment group (user group). In contrast, the adjacent area where the program was not present was deemed the control group (non-user group). On the extreme left, despite their difference in adopting *Korra*, the demographic, socio-economic, and institutional factors that would enable us to compare the two groups were listed as independent variables. The outcome variables were the intended *tef* productivity and income impacts of adopting *Korra*, displayed at the far right. This conceptual framework generally posed the question of whether adopting the *Korra tef* variety increases the farm households' production and income.

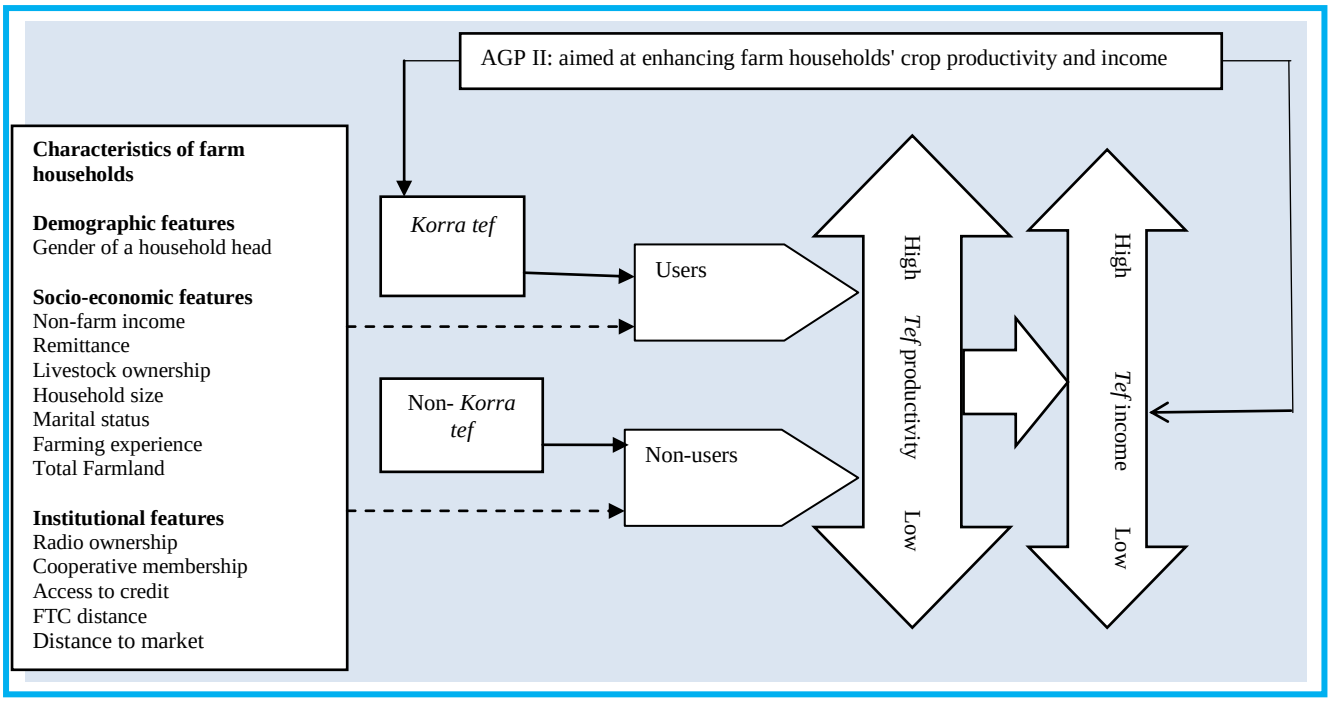


Figure 3: *Korra tef* use and farm households' productivity and income
Source: Author's construction

2.4. Research methodology

2.4.1. Research design

With cross-sectional data, one of the mixed-methods approaches, the Concurrent Embedded Strategy, was employed. In this approach, quantitative data is the predominant method, while qualitative data is embedded within it to supplement its interpretation and for further explanation (Creswell & Creswell, 2017).

2.4.2. Sampling procedures and data sources

The target population of the objective under consideration is AGP II beneficiary households in the study *woreda*. A multi-stage sampling procedure was used to get representative sample households. For the first stage, *Wara-Jarso woreda* was purposefully chosen. The three agro-ecological zones in the *woreda* were considered for the study because *tef* is a common crop across these agro-ecological zones. Two *kebeles* were chosen from each agro-ecological zone based on accessibility and considering their production level (high and medium producers). The nearby *Kuyu woreda*, highly comparable to the treatment group, was chosen to estimate the counterfactual from a sample of eligible non-participants (control group). The *woreda* considered for the control group shares similarities with the treatment *woreda* aside from the interventions made by the AGP II, including having three primary agro-ecological zones, the

predominant crops cultivated, and socio-cultural, economic, and other institutional aspects. Six *kebeles* were chosen from the control *woreda* using the same procedures in the treatment woreda.

Due to the finite nature of the study population, a 5% acceptable margin of error was considered while applying Yamane (1967)'s sample size calculation formula (Equation 1). In the end, a total of 479 farm households were accounted for in the study. To achieve a balance between the two groups, 221 and 258 were divided into treatment and control groups, respectively. Applying the PPS, as shown in Table 1, allowed for a fair selection of samples from the *kebeles*.

A semi-structured survey questionnaire was used to obtain the quantitative data, which is the main primary data of the study, in September and October, 2020. The questionnaire was initially written in English, then translated into *Afan Oromo* and reviewed by the native speakers of the latter. The pilot test was conducted to ensure the interviewee fully comprehended the tool. Two farmers from each of the three main agro-ecological zones were interviewed for the qualitative data of the supplementary primary data, which was based on the classification of high and medium *Korra tef users*.. The regional AGP II monitoring and evaluation officer, the zonal AGP II facilitator, the *woreda* AGP II coordinator, and one DA from each agro-ecology zone were also considered as KIIs from the treatment group. On the other hand, secondary data were collected from the agriculture office in the treatment *woreda* and relevant journal publications and websites.

2.4.3. Tools and techniques of data analysis

The STATA version 16 Software Package was used to manage and analyze the quantitative data, along with descriptive and econometric analyses. The demographic, socio-economic, and institutional characteristics of the respondents were described and compared using descriptive statistical analysis techniques such as mean, standard deviation, proportions, frequency, and percentages. Chi-square and t-test analysis were used to determine whether categorical or dummy variables are related or independent from one another and the mean variation of continuous variables, respectively. The yield and income impacts of *Korra tef* use were estimated using the PSM. The PSM's procedures were adopted from (Rosenbaum & Rubin, 1983). Qualitative data from the KIIs were embedded into the quantitative data at the end of the discussion.

For the PSM, since the purpose is to estimate the treatment effect of using the *Korra tef* variety (d), Y represented the outcomes (productivity and income) dependent on a set of characteristics of farm households denoted as "j" and "i" respectively.

$$Y = \alpha + \tau d_j + \beta X_{ij} + \varepsilon \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots . . \dots . \dots . [2]$$

The average productivity difference between the treatment (*Korra tef* users) and control (non-users) groups is seen in Equation 3 (τATE). Since unobservable factors may correlate with the use of *Korra tef* and omitted factors that affect its productivity and income, it is not easy to accurately estimate the impacts of *Korra tef* utilization on productivity and income. As we only compare the productivity and income of households with and without *Korra*, these are the fundamental difficulties associated with the counterfactual situation. As a result, the Average Effect on the Treated (ATT) is recommended over the Average Treatment Effect (ATE). The yield and net income impacts of the *Korra tef* on its producers at the expense of non-producers are referred to by ATT in this study and are outlined as follows:

$$\tau ATE = E[Y|X, d = 1] - E[Y|X, d = 0] \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots . \dots . . \dots . \dots \dots \dots [3]$$

Y_1 and Y_0 in equation 4 represent the productivity and income of *Korra tef* users against non-users. E [Y0|d = 1] would represent the counterfactual result for the treated groups if they did not use *Korra*.

$$ATT = E[Y_1|d = 1] - E[Y_0|d = 1 \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots . \dots \dots \dots \dots \dots . . [4]$$

Due to the process of self-selection into the usage of Korra, comparing the expected outcome Y0 for treated households (E[Y_0|d=1]) to that of non-treated households (E[Y_0|d=0]) may not accurately estimate the true outcome for the treated group, as there can be systematic differences between the two groups. This self-selection bias, resulting from the placement of the AGP II program, can introduce a bias in the estimation. In the context of this study, the households included in the treated group were categorized as users due to their participation in the AGP II program. As a result, they are less likely to be statistically comparable to the comparison group. To address this issue, PSM was employed to account for selection bias, mitigate the limitations of matching on numerous observed variables, and estimate

counterfactual effects. Therefore, a subsequent matching process was conducted to compare farm households that have utilized *Korra* with those that have not, but possess similar characteristics. The propensity score, denoted as p(x) and based on a set of characteristics x (as outlined by Rosenbaum & Rubin, 1983), was utilized in this analysis:

$$p(x) = P_r[d = 1|x] = E[d|x] \ldots \ldots [5]$$

In light of these, it is imperative to consider the Conditional Independence Assumption (CIA), also referred to as the Unconfoundedness Assumption. This assumption necessitates that the outcome variables (Y_0) exhibit independence from the treatment (in this case, the use of *Korra*) conditional upon a set of observable variables (x). It is equally important to account for the concept of common support, which ensures an appropriate basis for comparison. The Unconfoundedness Assumption plays a crucial role in accurately identifying and assessing the impact, as it accounts for the disparity between the treated and control groups, thereby mitigating selection bias. By utilizing the control group units to construct a counterfactual for the treatment group, this assumption allows for a more precise evaluation of the impact. Conversely, the assumption of common support enables a suitable comparison by ensuring a sufficient overlap in the characteristics of the treated and untreated units, facilitating adequate matches. To enhance the robustness of the impact estimates derived from propensity scores, it is further advisable to limit matches to users and non-users who share common support within the distribution of propensity scores (Smith & Todd, 2005). Hence, to determine the optimal estimation model for assessing the commercialization impact of using the *Korra tef*, four commonly employed matching algorithms, namely nearest neighbor, radius, caliper, and kernel matchings, were utilized. The estimation results of these matching algorithms are presented in Table 13.

2.4.4. Definition of variables and working hypothesis

The study considered two dependent variables: The first is *Korra tef* productivity measured in terms of *Korra tef* yield per hectare (Diskin, 1997):

$$Productivity = \frac{Crop\ Output\ (Kilogram)}{Area\ planted\ (Hectare)} \ldots \ldots [6]$$

The second outcome variable is the annual household income measured as net income from the *Korra tef* farm calculated by Ethiopian Birr (ETB[7]). The study's treatment variable is the use of *Korra tef*. The theoretical and empirical research suggested that the demographic, socio-economic, and institutional variables listed and defined in Table 3 are critical in enhancing or impairing smallholder farmers' farm productivity and income. These variables were chosen based on their applicability to the target population's characteristics and regarded as independent variables.

Table 3: Definition and measurements of the independent variables used in the study

Notation	Name of the variables	Type	Unit/Measurement
SEXHH	Gender of household head	Dummy	1 for male, 0 for female
MARSTATUSHH	Marital status of household head	Categorical	Scores from 1-6
FARMEXPHH	Farming experiences of household head	Continuous	Farm experience of household head (in years)
HHSIZE	Family size of household	Continuous	Total number of household members
TOTLAND	Total farmland	Continuous	Household's total farmland (ha)
TLU	Livestock owned by household	Continuous	Tropical Livestock Unit
RADIOOWN	Functional radio	Dummy	1 for yes, 0 for none
CREDUSE	Access to credit services	Dummy	1 for yes, 0 for none
FTCDIST	Distance household travels from home to FTC[8], where AGP II focal personnel resides	Continuous	Km
MAINPARTCCOOP	The cooperative and/or association households largely engaged in	Categorical	Scores from 1-10
MRKTDIST	A distance from home to the main market (to input and output market)	Continuous	Km
INONFARMACT	Income from non-farm activities	Continuous	ETB
REMIT	Remittances, money transferred both from inside the country and abroad	Continuous	ETB

[7] ETB is *the national currency of the Federal Democratic Republic of Ethiopia*

[8] *FTCs (Farmers' Training Centers) are structures established in rural Ethiopia to support smallholder farmers. They were established throughout the country to train farmers on the use of technological packages and facilitate agricultural extension services.*

2.5. Results and discussion

2.5.1. Descriptive results

The descriptive results indicated that male-headed households accounted for 90.81% of the respondents. According to the gender proportion, male-headed households comprise 89.14% and 92.25% of users and non-users, respectively (Table 4). Comparable statistics from the Ethiopian Rural Household Survey (ERHS) show that women head around one-quarter of households (World Bank, 2016). The chi-square test result also showed no significant differences between users and non-users regarding gender or credit availability. However, they differed significantly in terms of marital status, radios ownership, and participation in various cooperatives and/or organizations.

Table 4: Statistical summary of X^2-test distribution for dummy and categorical variables

Explanatory variables	Categories	Total sample (%)	Non-users (%)	Users (%)	$\chi 2$ (p-value)
SEXHH	Male	435 (90.81%)	238 (92.25%)	197 (89.14%)	1.3782 (0.240)
	Female	44 (9.19%)	20 (7.75%)	24 (10.86%)	
MARSTATUSHH	Married, Single Spouse	442 (92.28%)	241 (54.52 %)	201 (45.48%)	11.3183 (0.045**)
	Married, more than one spouse	5 (1.04%)	2 (40.00%)	3 (60.00%)	
	Single	4 (0.84%)	3 (75.00%)	1 (25.00%)	
	Divorced	9 (1.88%)	4 (44.44%)	5 (55.56%)	
	Widowed	10 (2.09%)	1 (10.00%)	9 (90.00%)	
	Not together for any reason	9 (1.88%)	7 (77.78%)	2 (22.22%)	
RADIOOWN	Yes	215 (44.89%)	104 (40.31%)	111 (50.23%)	4.7314
	No	264 (55.11%)	154 (59.69%)	110 (49.77%)	(0.030**)
CREDUSE	Yes	271 (56.58%)	113 (43.80%)	95 (42.99%)	0.0319
	No	208 (43.42%)	145 (56.20%)	126 (57.01%)	(0.858)
MAINPARTCCOOP	Agricultural cooperative	275 (57.41%)	128 (49.61%)	147 (66.52%)	24.6069 (0.003***)
	Village saving and loan association	35 (7.31%)	26 (10.08%)	9 (4.07%)	
	RUSSACO	47 (9.81%)	23 (8.91%)	24 (10.86%)	
	Iddir	12 (2.51%)	8 (3.10%)	4 (1.81%)	
	Equub	9 (1.88%)	6 (2.33%)	3 (1.36%)	
	Kebele council	20 (4.18%)	9 (3.49%)	11 (4.98%)	
	Youths' association	27 (5.64%)	19 (7.36%)	8 (3.62 %)	
	Women's association	8 (1.67%)	6 (2.33%)	2 (0.90%)	
	Local representative	22 (4.59%)	16 (6.20%)	6 (2.71%)	
	Religious organization	24 (5.01%)	17 (6.59%)	7 (3.17%)	

***p<0.01; **p<0.05; Standard errors in parenthesis

Source: Field survey, 2020

The t-test results indicated that users' farming experience, household size, total farmland, livestock ownership, market and FTC distances, and remittances received significantly differed from non-users (see Table 5). The typical household size was relatively large, with an average of seven people per family. The Demographic and Health Survey found that Ethiopia has an average of 4.6 children; nevertheless, this result is close to the average of 6.4 children found among the poorest households (DHS, 2016). The productivity and income of a household may be impacted by the size of the household in both good and negative ways. If the large household size is harnessed as a source of family labor, it could have a positive impact by lowering labor and production costs. On the other hand, having many dependents in a household may undercut their income and productivity. The groups' earnings from non-farm activities did, however, differ insignificantly.

Table 5: Statistical summary of t-test for continuous variables

Explanatory variables	Mean values			t (p-value)
	Non-users	Users	Combined	
FARMEXPHH	17.00388	18.70136	17.78706	-2.0607 (0.0399**)
HHSIZE	6.589147	7.235294	6.887265	-2.9413 (0.0034***)
TOTLAND	1.805075	1.871136	1.871136	-2.0189 (0.0441**)
TLU	4.546046	3.000905	3.833152	4.8607 (0.0000***)
FTCDIST	2.907558	2.316742	2.634969	4.9171 (0.0000***)
MRKTDIST	10.46047	11.50362	10.94175	-4.1677 (0.0000***)
INONFARMACT	3050.194	3581.9	3295.511	-0.8295 (0.4072)
REMIT	1937.597	1172.851	1584.76	2.0512 (0.0408**)

***p<0.01; **p<0.05; Standard errors in parenthesis
Source: Field survey, 2020

During the 2020 production season, farmers in the study area used a variety of inputs for *tef* farms. Inputs such as seeds, fertilizers, different soil fertility reclamation methods, compost, herbicides, and insecticides were among the indispensable costs considered for the analysis. The price of labor use - family and hired labor - was also considered. All input costs were converted into the then-market price in ETB. In light of this, as shown in Table 6, the t-test result revealed the presence of a statistically significant difference in the average amount of *tef* seed used by the *Korra tef* users and non-users at p<0.01, in which its average use for the non-users exceeds the users. The KIIs evidenced that the *Korra tef* variety reduces the seed sowed per hectare.

Additionally, there was a statistically significant difference between the groups' average costs for the *tef* seed they used (Table 7). Costs for the *tef* seed might be the result of the significant price difference between the *Korra tef* variety and others, as shown by the qualitative

research, which found that the price of 1 kg of the *Korra tef* back then ranged from 48 to 52 ETB while the price for the same amount of *tef* varieties other than *Korra* was between 37 and 48 ETB. Similar significant disparities have been observed in the groups' use of other agricultural inputs, such as DAP, urea, herbicides, and pesticides, where users exceed non-users. This result is consistent with the KII's argument that using *Korra tef* necessitates using more fertilizers, herbicides, and pesticides than alternative *tef* varieties. Because of the AGP II intervention, frequent agricultural-related awareness-raising activities also continue playing a role in the user's increased compliance with using agricultural inputs per the advised dosages. In addition to these, the variations may result from the fertilizer recommendations' (*i.e.* blanket fertilizer amount (100 kg ha^{-1})) disregard for the location and crop-specificity, as fertilizer requirements depend on the soil moisture content and fertility status, past cropping patterns, and cropping systems (Assefa et al., 2013).

Table 6: Average input use for *tef* production by respondent types (kg/ha)

Input item	Mean values			t (p-value)
	Non-users	Users	Combined	
Seed (*Korra Tef* variety for users and other than *Korra* for non-users)	27.17338	16.90991	22.43804	73.0644 (0.0000***)
DAP	90.40628	93.71516	91.93292	-3.9723 (0.0001***)
Urea	108.0736	110.737	109.3024	-2.5934 (0.0098***)
Herbicide	0.958217	1.04669	0.999039	-2.1322 (0.0335**)
Insecticide	1.050039	1.093484	1.070084	-2.3060 (0.0215**)

***p<0.01; **p<0.05; Standard errors in parenthesis

Source: Field survey, 2020

With p<0.01 and <0.05, users and non-users have shown no substantial differences in costs for soil fertility reclamation and compost (Table 7). Since both groups reported comparable prices, these variations might be related to the quantity of fertilizer used. The idea that a higher-yielding variety takes more labor but yields more output per unit of labor may also explain the difference in average labor costs (Abate et al., 2015; Coelli et al., 2005). The qualitative finding in which the KIIs stated that the *Korra tef* farm required more labor than other types of *tef* corroborates labor-related findings. On the other hand, the negligible differences in the uses of compost and soil erosion protection show that many farmers from both groups have used compost to improve the maximum yield potential of their land and conduct soil erosion protection activities, regardless of the seed varieties they use. Besides, it was found that only one household (0.4%) from users and 14 households (5.43%) from non-users had rented-in farmland for *tef* farms in the production season of 2020. Thus, land

renting was not included in the analysis of the cost of production due to the small number of sample households that rented land for the *tef* farm. In addition, no household has mentioned using irrigation for the *tef* farm. This aligns with key informant reports that they have only recently begun educating farmers on using irrigation water for *tef* farms.

Overall, the combined mean of the total variable costs incurred for *tef* production was 19968.54 ETB; but the average for users and non-users was 23223.27 ETB and 17180.57 ETB, respectively. At $p<0.01$, the cost differs statistically significantly (Table 7). This difference is verified by the qualitative evidence that shows improved *tef* varieties in general, and *Korra tef,* in particular, needs a larger financial commitment than local *tef* varieties. The result is also in consonance with a case study conducted in Northeastern Ethiopia, where farmers who adopted the *Boset tef* seed variety reported greater input costs (fertilizer and seed) and increased production costs (Natnael, 2019b). The same is true of another study, in which labor (58%) and fertilizer (22%) were the two major production costs for the production of *Korra* and *Boset tef* varieties compared to local *tef* varieties (Bekele et al., 2019).

Table 7: Average input costs of *tef* production by respondent types (ETB/ha)

Inputs	Mean values			t (p-value)
	Non-users	Users	Combined	
Seed (*Korra tef* variety for users and other than *Korra* for non-users)	1079.70	825.15	962.26	40.9736 (0.0000***)
DAP	1356.09	1405.73	1378.99	-3.9731 (0.0001***)
Urea	1458.99	1494.95	1475.58	-2.5933 (0.0098***)
Soil erosion protection	35.78	39.60	37.54	-0.2819 (0.7781)
Compost	1342.66	1332.91	1338.16	0.1827 (0.8551)
Herbicide	172.50	188.39	179.83	-2.1270 (0.0339**)
Insecticide	262.50	273.32	267.49	-2.2999 (0.0219**)
Labor	11206.33	17047.50	13901.32	-37.1498 (0.0000***)
Total production cost	17180.57	23223.27	19968.54	-29.8676 (0.0000***)

***p<0.01; **p<0.05; Standard errors in parenthesis
Source: Field survey, 2020

2.5.1.1. Measuring *tef* productivity and income

As previously noted, the productivity of smallholders' *tef* is determined by the volume of *tef* produced per hectare. Net income is the amount of money collected from a *tef* farm after variable costs associated with *tef* production have been computed. The survey findings presented in Table 8 reveal that the average *tef* productivity (yield) for the sampled households was recorded as 1712 kg/ha. However, the average yield was notably higher for users of *Korra tef,* reaching 2037 kg/ha, while non-users achieved an average yield of 1434

kg/ha. In terms of *tef* income, the results indicate that users of *Korra tef* earned an average annual income of 64310.19 ETB, in contrast to 34686.96 ETB for non-users. The observed mean difference between users and non-users is statistically significant, highlighting a considerable disparity. These findings suggest that *Korra tef* users exhibit higher productivity levels and tend to generate greater annual income compared to non-users.

Table 8: Level of productivity and income of *tef* producers in 2020

Outcome variables	Obs	Mean	Std. Dev.	Min	Max	t (p-value)
Productivity (ha^{1})	479	1712.64	336.51	1058.82	2575.76	-43.7648 (0.0000***)
	258	1434.25	132.44			
	221	2037.63	169.01			
Income (ETB/ha^{1})	479	48354.46	16091.03	21142.3	82272.50	-28477.43 (0.0000***)
	258	34686.96	5177.22			
	221	64310.19	7513.00			

***p<0.01; Standard errors in parenthesis
Source: Field survey, 2020

Figure 4 shows a comparison of the average variations in *tef* productivity and Net Income between users and non-users.

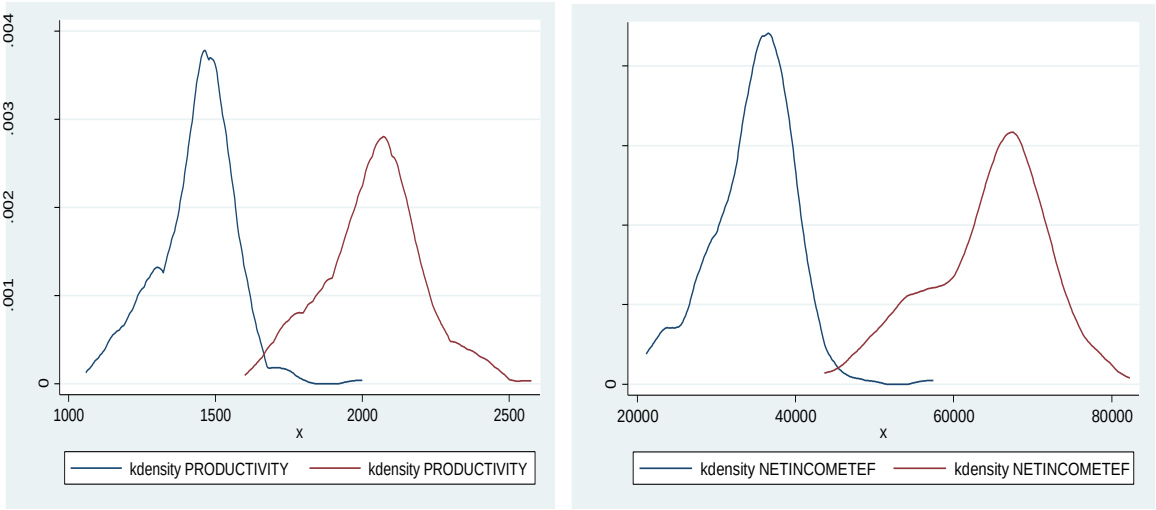


Figure 4: Comparisons of productivity and income differences
Source: STATA output

The differences that were discovered are then thoroughly examined using a model.

2.5.2. Impact of *Korra tef* on Productivity and Income

Hypothesis: Adopting the *Korra tef* variety increases farm households' *tef* productivity, raising farm income.

To put the hypothesis to the test and calculate the impacts of *Korra tef* use, productivity and income were used as outcome variables. *Korra tef* users were categorized as the treatment group and non-users as the control group. Variables that have an equal impact on the control and treatment groups were chosen to calculate the outcome variables with the assumption that the inclusion of bulky variables and the exclusion of important variables greatly bias the results (Caliendo & Kopeinig, 2008; Heckman et al., 1997) (see Table 3).

Testing the Variance Inflation Factor (VIF) and Contingency Coefficient (C) for the continuous and dummy/categorical variables was done to reduce the impact of multicollinearity. The results showed that all continuous variables had VIFs of less than 1.21 with mean values of 1.09 (Table 9) and that the dummy/categorical variables had C close to zero (Table 10). Thus, it is determined that the model is free from multicollinearity, giving us the confidence to move forward with our regression.

Table 9: Result of VIF

Variables	VIF	1/VIF
HHSIZE	1.06	0.943059
FARMEXPHH	1.21	0.824110
TOTFARMLAND	1.20	0.830737
TLU	1.07	0.931316
FTCDIST	1.05	0.953237
MRKTDIST	1.02	0.979941
INONFARMACT	1.07	0.934798
REMIT	1.05	0.952393
	1.09	

Source: Field survey, 2020

Table 10: C test for discrete variables

Variables	(1)	(2)	(3)	(4)	(5)
(1) SEXHH	1.000				
(2) MARSTATUSHH	-0.397	1.000			
(3) MAINPARTCCOOP	-0.114	0.086	1.000		
(4) CREDUSE	0.086	-0.068	0.026	1.000	
(5) RADIOOWN	0.025	0.012	-0.071	-0.031	1.000

Source: Field survey, 2020

2.5.2.1. Estimation of propensity score

Estimating the selected variables' propensity score was done using probit regression. The differences between the two groups were statistically significant, according to the STATA results of the p-values in Table 11 for the variables of household size, farming experience, total farmland, livestock ownership, membership in agricultural cooperatives and/or associations, radio ownership, FTC and market distances, and remittances. A high degree of

covariate balance between the treatment and control samples should be generated to make the matching process more manageable by having a homogeneous group.

Table 11: Probit regression of *Korra tef* use

Variables	Coef.	Std.Err.	P>z
SEX	-0.3809371	0.2389731	0.111
HHSIZE	0.1157336	0.0282889	0.000
MARSTATUSHH	0.0106221	0.0695231	0.879
FARMEXPHH	0.0161557	0.007943	0.042
TOTFARMLAND	0.4486467	0.2001243	0.025
TLU	-0.1182213	0.0233214	0.000
MAINPARTCCOOP	-0.0745842	0.0203583	0.000
RADIOOWN	0.4734555	0.1324159	0.000
CREDUSE	0.0021285	0.1321177	0.987
FTCDIST	-0.2699168	0.0512259	0.000
MRKTDIST	0.1143858	0.0239768	0.000
INONFARMACT[9]	7.41e-06	9.33e-06	0.427
REMIT	-0.0000329	0.0000164	0.045
_cons	-1.775279	0.5628004	0.002
Log-likelihood	-265.18831		
Number of obs	479		
LR $chi^2(13)$	130.80		
Prob > X^2	0.0000		
Pseudo R^2	0.1978		

Source: Field survey, 2020

2.5.2.2. Testing the balance of propensity score and covariates

Ps-test was used to create a balance between the covariates of the two groups. Because of this, the bias percentage that ranged between 1.6 and 45.6 before matching has decreased to 0.2 to 6.8 after matching (Table 12). This shows that the bias percentage has kept well below the 20% critical threshold cutoff point, indicating a minimized imbalance between the treatment and control samples (Rosenbaum & Rubin, 1983). As a result, the covariate balance between the treatment and control samples is greatly enhanced, which can be employed in subsequent estimation processes.

Table 12: Propensity score and covariate matching

Variables	Unmatched Matched	Mean		% bias	% reduction |bias|	P>|t|
		Treated	Control			
SEX	U	0.8914	0.92248	-10.7		0.241
	M	0.89302	0.89233	0.2	97.8	0.981
HHSIZE	U	7.2353	6.5891	27.0		0.003
	M	7.1488	7.1951	-1.9	92.8	0.832
MARSTATUSHH	U	1.2986	1.2287	7.2		0.434
	M	1.2884	1.3218	-3.4	52.2	0.744
FARMEXPHH	U	18.701	17.004	19.0		0.040
	M	18.428	18.295	1.5	92.2	0.875
TOTFARMLAND	U	1.8711	1.8051	18.5		0.044
	M	1.8696	1.8773	-2.2	88.3	0.818

[9] *The variable 'Income from non-farm activities (INONFARMACT)' remains untransformed due to its normal distribution.*

TLU	U	3.0009	4.546	-45.5		0.000
	M	3.0254	3.0633	-1.1	97.5	0.870
MAINPARTCCOOP	U	2.5158	3.5891	-32.8		0.000
	M	2.5349	2.6681	-4.1	87.6	0.634
RADIOOWN	U	0.50226	0.4031	20.0		0.030
	M	0.49302	0.50055	-1.5	92.4	0.876
CREDUSE	U	0.57014	0.56202	1.6		0.859
	M	0.57209	0.58049	-1.7	-3.4	0.861
FTCDIST	U	2.3167	2.9076	-45.6		0.000
	M	2.3498	2.438	-6.8	85.1	0.446
MRKTDIST	U	11.504	10.46	38.6		0.000
	M	11.476	11.582	-3.9	89.8	0.686
INONFARMACT	U	3581.9	3050.2	7.6		0.407
	M	3542.3	3496.9	0.6	91.5	0.948
REMIT	U	1172.9	1937.6	-19.0		0.041
	M	1178.6	1235.9	-1.4	92.5	0.859

Source: Field survey, 2020

2.5.2.3. Choice of the Matching Algorithm

The four main matching estimators were tested to determine the best estimation model. The STATA outputs of these estimators are shown in Table 13. The Nearest Neighbor Matching (with 2, 3, 4, and 5-Nearest Neighbors), as well as all Radius and Kernel matching estimates, have all met the Rubin (2006) criterion that states that for the overall balance to be sufficient, a value of B should lie below 25, and a value of R should lie between 0.5 and 2. However, we chose the Kernel estimator with a Bandwidth of 0.1, showing the lowest mean bias (2.3) and B value (11.0). The values of Ps R^2 and LR X^2 were also used as indicators for completing the balancing criteria. The assumption that both groups have a similar distribution in covariates after matching is confirmed by the relatively low Ps R^2 (0.002 in the estimate we selected) and the insignificant LR X^2 (1.30) after matching.

Table 13: Comparison of the matching estimators for both productivity and income

Performance criteria	Unmatched	Matching estimates												
		Nearest Neighbor					Caliper			Radius Caliper			Kernel	
		NN (1)	NN (2)	NN (3)	NN (4)	NN (5)	0.01	0.05	0.1	0.01	0.05	0.1	Bandwidth 0.01	Bandwidth 0.05	Bandwidth 0.1
Ps R^2	0.198	0.009	0.009	0.007	0.005	0.004	0.009	0.009	0.009	0.006	0.003	0.003	0.008	0.003	0.002
LR chi^2	130.80	5.57	5.08	4.10	2.86	2.61	5.57	5.57	5.57	3.75	1.97	1.57	4.77	1.74	1.30
$p>chi^2$	0.000	0.96	0.973	0.990	0.998	0.999	0.960	0.960	0.960	0.994	1.000	1.000	0.980	1.000	1.000
MeanBias	22.5	5.7	4.9	4.2	3.1	3.2	5.7	5.7	5.7	3.5	3.0	2.5	4.3	2.7	2.3
MedianBias	19.0	5.5	4.9	4.3	2.8	3.6	5.5	5.5	5.5	2.4	2.2	1.9	5.1	2.6	1.7
B	112.4*	22.8	21.8	19.5	16.3	15.5	22.8	22.8	22.8	18.7	13.5	12.1	21.1	12.7	11.0
R	0.50*	0.86	0.97	0.98	0.92	0.90	0.86	0.86	0.86	0.88	0.61	0.71	0.95	0.65	0.68
%Var	60	40	40	40	40	40	40	40	40	40	50	40	40	30	40

Source: Field survey, 2020

According to the Minima and Maxima criterion, observations with a propensity score smaller than and larger than the opposing group were eliminated while determining the common support region (Caliendo & Kopeinig, 2008). As a result, the range of common support is between 0.065 and 0.893 (Table 14), and any households outside of this range were excluded from the matching process. Fortunately, in all matching estimators, only six observations were shown outside the common support zone.

Table 14: Distribution of estimated propensity scores

Variable	Groups	Obs.	Mean	Std. dev.	Min	Max
Pscore	Total HH	479	0.4580324	0.2474228	0.0007765	0.9636034
	Treated	221	0.5884689	0.1892896	0.0653953	0.9636034
	Control	258	0.346302	0.2366982	0.0007765	0.8932305

Source: Field survey, 2020

Figure 5 depicts the propensity score of the distribution density of the treatment and control groups graphically. This indicates that the balance has been successfully attained because the p-score is fairly distributed between the treatment and control groups.

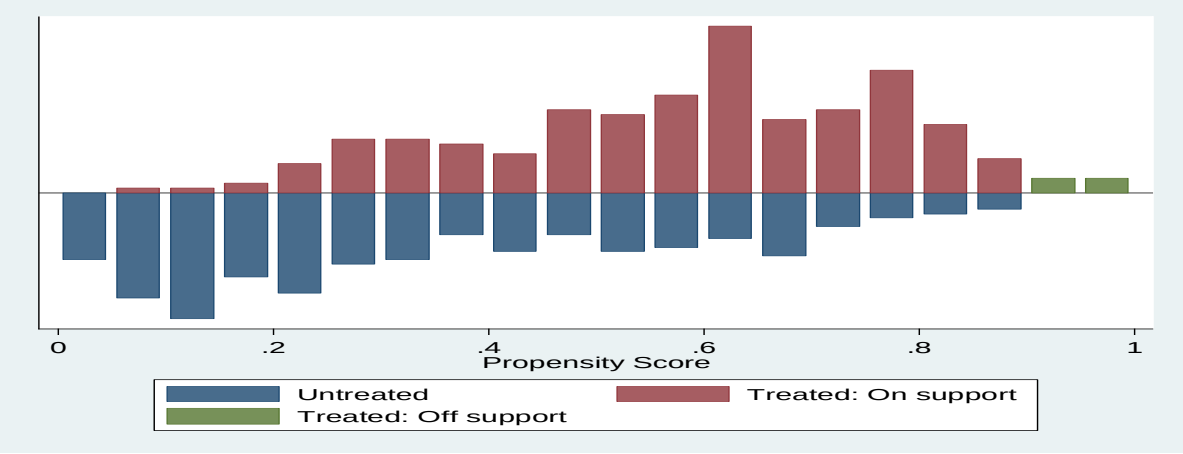


Figure 5: Distribution of propensity score generated from Kernel Matching
Source: STATA output (2020)

2.5.2.4. Estimation of treatment effect on the treated

Tables 15 and 16 show the results of the impacts of the use of *Korra tef* on the outcome variables of productivity and income.

Farm household productivity: According to the Kernel estimate (Bandwidth 0.1), farm with *Korra tef* significantly impacts *tef* productivity and is equal to 598.77. The ATT was positive, and users were significantly (P<0.01) better than non-users by 598.77 kg per ha^{-1}

(Table 15). The result shows that adopting the *Korra tef* variety increased the users' *tef* productivity by about six quintals per ha^{-1}. Thus, households that use the *Korra tef* variety are more productive than non-users. This result is in agreement with the studies conducted by (Abate et al., 2018; Awotide et al., 2016; Danso-Abbeam et al., 2018; Gebeyehu, 2016; Jabbar et al., 2011; Natnael, 2019a; Ogunniyi et al., 2018; Tesfaye et al., 2016), in which the use of various agricultural technologies had demonstrated a positive and significant impact on crop yield.

Table 15: Productivity result of average treatment effect on the treated (ATT)

Variable	Sample	Treated	Controlled	Difference	S.E	T-stat
Productivity	Unmatched	2037.63235	1434.25385	603.378504	13.7868468	43.76
	ATT	2037.22512	1438.44577	598.779347	16.3709648	36.58

Source: Field survey, 2020

Farm household income: According to the Kernel matching method (Bandwidth 0.1), farming with the *Korra tef* variety positively and significantly impacted the users' Net Income gains from *tef* produce in 2020. As shown in Table 16, the difference was equal to 29566.69 ETB, indicating that the users in the *tef* farm made about 29500 ETB more per ha^{-1} than the non-users. This result is congruent with the studies by (Danso-Abbeam et al., 2018; Hailu et al., 2014; Natnael, 2019b; Ogunniyi et al., 2018; Tesfaye et al., 2016) which found that adopting crop technologies significantly affected farmers' farm income.

Table 16: Income result of average treatment effect on the treated (ATT)

Variable	Sample	Treated	Controlled	Difference	S.E	T-stat
Net Income	Unmatched	64310.1887	34686.9639	29623.2248	583.114717	50.80
	ATT	64281.6786	34714.9915	29566.6871	683.336593	43.27

Source: Field survey, 2020

2.5.2.5. Sensitivity analysis

Sensitivity analysis is conducted to evaluate how reliable or consistent the PSM results are (Caliendo & Kopeinig, 2008; Liu et al., 2013). Based on this, the robustness of hidden bias among the two outcome variables of the study is shown in Table 17. The lowest critical value (Γ) that includes zero for the productivity outcome variable is 8.8 (95% confidence interval). This result suggested that the two groups should have differed by up to 780% ($e\gamma$ =8.8) in terms of unobserved variables if it was to be sensitive to unobserved factors, which is

unlikely under normal circumstances. Even though the Gamma value was estimated up to 40 for the outcome variable of income, a 95% confidence interval showed no ranges that include zero. This result has also indicated that for the productivity and income estimated at various levels of critical values $e\gamma$, the p-critical values are significant, informing that important covariates that affected the outcomes have been taken into account. Overall, the hidden bias magnitude confirms the hypothesis that the findings of significant differences in *tef* productivity and income between users and non-users are insensitive to hidden biases; as a result, the positive impacts found are attributed to the use of the *Korra tef* variety.

Table 17: Rosenbaum bounds sensitivity analysis (Kernel matching algorithm, bandwidth = 0.1)

Outcome variables	***Gamma (hidden bias magnitude)**	**Significance level**		**Hodges-Lehmann point estimate**		**Confidence interval (95%)**	
		upper bound (sig+)	lower bound sig-	upper bound (t-hat+)	lower bound (t-hat-)	upper bound (CI+)	lower bound (CI-)
Productivity (ha^1)	1	0	0	342.144	342.144	281.616	413.399
	2	3.5e-14	0	219.765	515.157	171.998	630.104
	7	0.003874	0	72.7345	1167.88	22.8706	1638.75
	8	0.012532	0	60.538	1269.81	9.52496	1750.47
	8.8	**0.025882**	**0**	**52.633**	**1335.05**	**-0.546653**	**1837.19**
	8.9	0.028042	0	51.6227	1342.37	-1.72343	1847.37
	9	0.030319	0	50.7499	1351.6	-2.9806	1858.46
Income (ETB/ha^1)	1	0	0	30127.8	30127.8	28933.3	31216.7
	10	0.000029	0	22001.3	36225.8	19761.7	37739.2
	20	0.002236	0	19841.6	37693.6	16590.8	39871.9
	30	0.010141	0	18729.3	38534	14361.7	41572.7
	40	0.022209	0	17978.7	39057.6	11372.3	44492.6

* - gamma (Γ) - log odds of differential assignment due to unobserved factors

Note: The lowest critical value of gamma for 95% CI that includes zero is bolded.
Source: Field survey, 2020

2.6. Conclusion and policy implications

This study investigates the impacts of adopting *Korra tef* on the user smallholder farmers' productivity and income. The result from the PSM showed that use the *Korra tef* variety increased *tef* productivity by about six quintals per ha^{-1} on average compared to non-users. The average Net Income of users was also around 29500 ETB per ha^{-1}, more than the non-users. This indicated that use the *Korra tef* variety has significantly impacted *tef* productivity and income of farm households. Therefore, the government should increase the supply of *Korra tef* variety through more effective extension, credit, and input supply systems. The agricultural extension services in the study area should also get adequate human, financial,

and logistical resources from the federal, regional, and development partners for these endeavours. Future research could build on this study's findings to determine whether adopting the *Korra tef* variety has varied consequences based on the users' agro-ecological zones, the size of farmland set aside for *tef* production, and/or the degree of their use. These might lessen the likelihood of incorrect impact estimations, conclusions, and recommendations.

CHAPTER THREE: Article two

3. Productivity Effects of Plot-Level *Korra Tef* Seed Rate in Central Ethiopia: Application of the Dose-Response Model

3.1. Abstract

Ethiopia's government and development practitioners have encouraged the use of improved tef (Eragrostis tef) varieties to increase crop production. However, apart from introducing improved tef varieties, more needs to be known about the plot-level productivity effects of adopting these varieties. Based on this, the current study sought to investigate the productivity effects of plot-level tef seed rate in Central Ethiopia, focusing on the Korra tef variety. Two hundred twenty two farmers who farm with the Korra tef were selected using a multi-stage stratified sampling technique. Survey data were gathered from these respondents using a questionnaire, and the interview guides were used to gather qualitative data from the key informants. The productivity outcomes of seed rate users categorized as users below, within, and above the recommendations were examined using one-way ANOVA. The F-test results indicated disparities in productivity across the three types of seed rate users. The impacts of seed rate on productivity were examined using the Dose-Response Model, which was applied to five seeding rates (12, 14, 16, 18, and 20kgha^{-1}). According to a Dose-Response analysis, the highest average tef yield was attributed to a seed rate of 20kgha^{-1}, slightly higher than the recommended. The findings showed that most farmers' crop productivity increases using recommended seed rates. These findings implicate that encouraging farmers to use improved seed varieties is inadequate. Instead, farmers should be encouraged to use the recommended seed rates. Rethinking the ideal Korra tef seed rate for the study area is also required.

Keywords: *Korra tef; Users; Plot-level seed rate; Productivity; Dose- Response Function; Central Ethiopia*

3.2. Introduction

Tef, *Eragrostis tef*, is a staple food crop for 70% of Ethiopians and is currently used in several countries to produce grain and fodder (Numan et al., 2021). It is suited to various habitats, including those with wet soil and drought stress (Assefa et al., 2013). It is growing in popularity in developed countries' healthy food markets because of its appealing nutritional composition and gluten-free accreditation (Aemiro et al., 2021). In addition to being a good source of iron and fibre, it also contains more calcium and other essential minerals (Koubová et al., 2018). Despite the preferences, and occupying the largest area of all grain crops (24%, or 3.02 million hectares) and the higher grain production in Ethiopia (17.29% or 5.02 million tons), its national average yield is relatively poor compared to other cereals. In 2015-16, it had a national average yield of 15.6 quintals per hectare, significantly lower than the same year's average national output for maize (33.87 quintals per hectare) (CSA, 2016).

The types of seed and soil, waterlogging, insect pests, and weeds are some factors that significantly impact grain output. Agronomic factors like seeding rate and methods, seedbed preparation, fertilizer rate, and application timing continue to significantly impact the productivity of *tef* (Amare & Adane, 2015; Dargicho et al., 2020; Tulema et al., 2005). Seeding rates and sowing techniques significantly impact the *tef* produced and its productivity (Yechale et al., 2021). The lack of reliable data on the responses of several high-yielding varieties is also one of the main challenges to sustainable *tef* production (Mebratu et al., 2016). Thus, knowing the effects of a seed rate enables one to make an informed choice regarding its use.

Most farmers in developing countries use either lower or higher seed rates than the recommended ones, which widens the gap between potential and actual yield (Yirgalem et al., 2021). *Tef* seeding rates in Ethiopia vary depending on the seed used and the farmers' practices. Under various circumstances, 15–55 kg of *tef* seed is typically sown per hectare (Koubová et al., 2018; Aemiro et al., 2021). For instance, Seyfu (1997) indicated that due to the small seed size (1000 seeds weigh 0.265 grams), it was challenging to spread 15kgha^{-1} of seeds evenly via the broadcasting sowing method, and thus many farmers had a custom of dispersing *tef* at a rate of 40–50kgha^{-1}. Other than these, nowadays, introducing agencies, programs, or institutions have developed their standards of seed rate upon introducing new varieties of *tef*. As a case, the AGP II has recommended a seed rate of 15 to 18kgha^{-1} (Key informant interviews, October 11, 22 and 28, 2020).

Low seed rates result in fewer plants per unit area, reducing production; high seed rates promote competition among crops for scarce resources like water, nutrients, and sunlight, leading to poor crop quality and low yield (Hameed et al., 2002). Plants compete fiercely for light above ground and nutrients below ground when their density surpasses an ideal threshold (Baloch et al., 2002). The consequence is a slowdown in plant growth and a reduction in grain output. These assertions implies for the necessity of calculating the optimum plant population density per unit area to achieve the highest yields.

Numerous studies, for instance, (Abraha et al., 2020; Abraham et al., 2018; Amare & Adane, 2015; Arega and Yemgnushal, 2018; Bekalu and Arega, 2016; Getahun et al., 2018; Wolde, 2021; Yechale et al., 2021) have been carried out in various settings on the yield response of *tef* to its seed rates. These studies indicated how using the appropriate seed rates increased *tef* yields significantly and hinted that regulating the seed rate could greatly impact *tef* yields. However, a detailed study has yet to be conducted into how different *tef* varieties respond to seed rates. There also needs to be more information on Ethiopia's recommended *tef* seed rates in general and the *Korra tef* variety in particular. Location-specific seed rate trials and validations is also strongly advised to maximize production (Yirgalem et al., 2021). However, the yield impact of farm-level *Korra tef* seed rates in the study area has yet to be discovered. As a result, this study aims to investigate the productivity effects of *Korra tef* seed rates and examine the correlation between plot-level seed rates and yield in Central Ethiopia. Given the significant gap in agronomic recommendations for the *tef,* the results of this study will assist in determining the optimum seed rate for the production of *Korra tef* via the use of the broadcasting method.

This study is expected to make two contributions to the literature. First, the common metric to measure crop yield per hectare in response to a certain seed rate is the General Linear Model (GLM) (Abraham et al., 2018; Arega and Yemgnushal, 2018; Bekalu and Arega, 2016), while others use average treatment effect models (Abraha et al., 2020; Amare and Adane, 2015; Getahun et al., 2018). However, this study has come with an unusual analytical approach, the dose-response model, a popular analytical model in medical science disciplines (Ritz et al., 2015; Van der Vliet & Ritz, 2013a). Hence, as to the researchers, this study is the first to use a generalized linear dose-response model to examine the impact of plot-level *tef* seed rates on its yield. Second, it will contribute to empirical research on the issues of plot-

level seed rates vis-à-vis their yield and assist farmers in determining whether to alter the suggested seed rates.

3.3. Conceptual framework

The conceptual framework for the study is shown in Figure 1 using previous conceptual, empirical, and theoretical discussions. It is conceptualized that AGP II has introduced *the Korra tef* variety for farm households in the study area to improve their productivity. The program has also recommended the desired seed rate to help increase the introduced seed's productivity. Therefore, the study aims to evaluate how the plot-level *Korra tef* seed rate affects farmers who have adopted the crop in the study area. The demographic, socio-economic, and institutional factors listed on the extreme left are the typical characteristics of user farm households. These variables were chosen with the supposition that they would not be impacted by interventions other than adopting the *Korra tef* variety. In the middle is the study's treatment variable, the seeding rate (*i.e.* 12, 14, 16, 18, and 20kgha^{-1}). At the far right is the study's dependent variable (*i.e.* the average yield of *Korra tef* produced by farm households). This conceptual framework generally demonstrates that, other things being equal, using *Korra tef* seed at the recommended dosage will result in better crop yields.

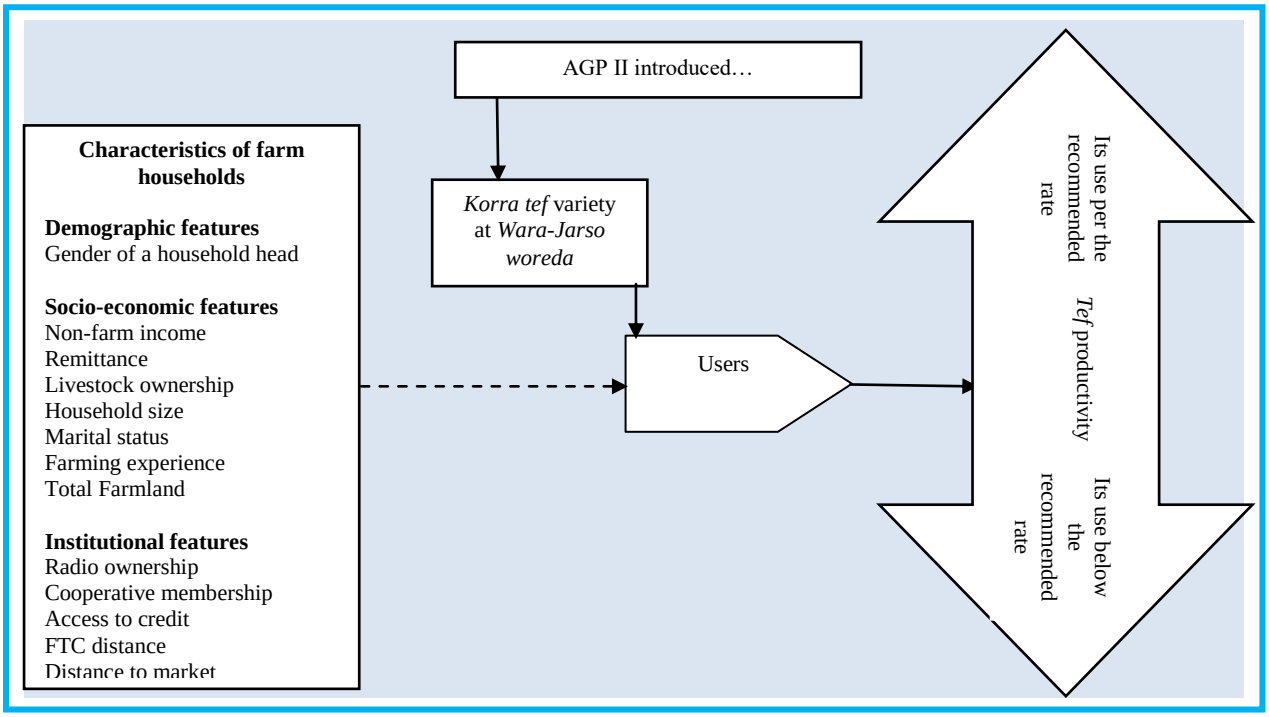


Figure 6: Productivity effects of plot-level *Korra tef* seed rate
Source: Author's construction

3.4. Research methodology

3.4.1. Context of the study: Experimental material used for the study

Tef is the most widely grown crop in the study area and is produced in all of the area's agro-climatic zones. As part of its effort to increase crop yield, AGP II introduced the *Korra* variety of *tef* into the study area. The program specifically considered the area because of its significant potential for *tef* production. The *tef* cultivar mentioned has a higher production potential. As a result, farm households were selected for *Korra tef* use based on several factors, including their willingness to grow it on a minimum of one hectare, their willingness to consult with local development agencies, and their readiness for the practice.

3.4.2. Research design

The Concurrent Embedded Strategy of the mixed method was used as the study's research design. Based on this strategy, the survey data were used as the method's guiding primary data, and the qualitative data were blended within the survey data (Creswell & Creswell, 2017).

3.4.3. Sampling technique and sample size determination

A multi-stage sampling technique was employed to select sample households from the *Korra tef* producer smallholders, the study's target population. *Wara-Jarso woreda* was deliberately selected as the study area in the initial stage due to its higher *tef* production. In the second stage, two *Kebeles* from each agro-ecological zone were selected based on the purported categories of high and medium *Korra tef* growers to ensure the representativeness of the samples. These categories were established with the assistance of the DAs and the AGP II coordinating office of the study *woreda*. Lastly, a total of six rural *kebeles* were considered for the study. The program's beneficiary farm households were believed to share similarities since the same selection criteria were used throughout the intervention *woreda*'s agro-ecological zones. The sufficiency and representativeness of the selected samples were guaranteed by such homogeneity. The users' lists were obtained from the study *kebeles*' official documents. Provided that the issue of seed rate was solely emphasized in this particular study, 221 *Korra tef* user farm households who considered as a treatment group in the first objective were considered as the sample size of the study. Here, we couldn’t do the comparison among the user and non-user groups because the farm households in the category of control group have used different varieties of *tef* with various seed rates, making the

comparison irrelevant. Like the preceding objective, the sample sizes in each treatment *kebele* were determined using PPS of the farm households considered for the study (see Table 1).

3.4.4. Data collection methods

The leading primary data (*i.e.* quantitative data) were collected in September and October 2020 from the *Korra tef* user farm households using hard copies of semi-structured questionnaires and trained enumerators. The interviews were conducted in *Afan Oromo* after the questionnaire was initially written in English. A pilot test was conducted to evaluate the tool's validity and reliability. AGP II coordinator, zonal AGP II facilitator, regional AGP II monitoring and evaluation officer, one DA from each agro-ecology zone, and six *Korra tef* producer farmers (two farmers from each agro-ecology labelled as high and medium producers) served as the study's key informants and provided the supportive qualitative data. The study's lead researcher used the interview guides to gather it. The official reports of the study *woreda*'s AGP II coordination office, pertinent journal articles, thesis, dissertations, books, proceedings, websites, and other sources were also reviewed to generate secondary data, which was then used to complement the primary data obtained from the primary sources.

3.4.5. Data analysis methods

The STATA version 16 Software Package was used for the quantitative data analysis, which involved applying descriptive statistics and econometric analysis. On the other hand, transcripts of the qualitative data were used to support the interpretation of the quantitative data.

3.4.5.1. Tools and techniques of descriptive data analysis

The respondents' demographic, socio-economic, and institutional traits were described using means, standard deviations, proportions, frequencies, and percentages. ANOVA was used in light of (Abraham et al., 2018; Amare and Adane, 2015; Dargicho et al., 2020; Getahun et al., 2018; Yechale et al., 2021) to examine the nature and degree of the correlation between yield and seed rates. Thanks to one-way ANOVA, we could divide the seed users into three groups, including those who used as per, below and beyond the recommendations. Such categorization enables us to demonstrate productivity disparities between the various seed rate user groups.

3.4.5.2. Specification of the Dose-Response model

The Dose-Response Model explains a cause-and-effect relationship (Guardabascio & Ventura, 2014; Robinson et al., 2020). This regression model's independent and dependent variables are the dose or concentration and the response or effects, respectively. Any quantity of biological, chemical, or radiation stress that has been predetermined and that causes a specific, known response is referred to here as the dose (Ritz et al., 2015). It is a non-negative quantity, and although this assumption is frequently made in intended experiments, it is not always true (Rudemo et al., 1989). On the other hand, a particular dose defines the response. It is prone to random variation because it quantifies a pertinent effect. The response can be continuous (like biomass, enzyme activity, or optical density), binary (like dead/alive, immobile/mobile, or present/absent), or discrete (like the number of juveniles, offspring, or roots observed in a specific time interval), but the continuous response is by far the most prevalent (Van der Vliet & Ritz, 2013b). These definitions implied that dose response and dose effect are the two most important terms to describe what happens after exposure (Guardabascio & Ventura, 2014). The amount of *tef* yield is considered the response or effect in this study, while the rate at which the *Korra tef* seed was applied by the adopting farm households is termed the dose or the concentration. Therefore, the Dose-Response Model is used to quantify the effect of seed rate on crop productivity. The degree to which the desired reaction changes as the dose is varied is likewise described by the dose-response curve (Calabrese, 2014). As a result, it is assumed that there will be a linear dose-response relationship between the seed rate of *Korra tef* (dose/concentration) and yield of the same (response/effect).

This section demonstrates the full specification of a dose-response (regression) model, how a parametric function of dose, and the assumptions about the distribution of the response characterizes the mean. Because these functions share the property of reflecting a fundamental understanding of the causal relationship between the dose and the response - for example, that when a dose increases, the response monotonically decreases or increases one way or another towards minimum or maximum response limits, respectively - the emphasis is primarily put on ways to model the mean trends using mostly S-shaped or related biphasic functions. Due to the versatility and adaptability of these functions, they can be used to describe a variety of model parameter-based procedures that enable the interpretation of observed effects within numerous plausible frameworks. Such procedures include statistical

models like parametric survival analysis, generalized (non) linear, and nonlinear regression (Ritz et al., 2015).

Specifically, the model function f shown below that depends on the dose x characterizes the mean of y (denoted E(y)).

$$E\,(Y) = f\,(x,\beta) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [7]$$

y represents an observed response value corresponding to a dose of $x \geq 0$. Although y values are often positive, they can also be arbitrarily positive or negative. The relevant observed response values for a given dose x are scattered around $f(x, \beta)$. Except for the values of the model parameters $\beta = (\beta_1, \ldots, \beta_p)$, which need to be estimated from the data to generate the function that best fits the data, the function f is thoroughly known as it reflects the assumed relationship between x and y. On the other hand, the assumptions about the distribution of y will change depending on the type of response.

Whenever doses are not randomly assigned but are given under experimental conditions, like in the case of the study under consideration, estimation of a dose-response function is possible using the Generalized Propensity Score (GPS) (Guardabascio & Ventura, 2014). The GPS has a balancing property comparable to the binary propensity score. Conditional on observable characteristics, the level of the treatment can be considered random for units belonging to the same GPS strata. This allows removing biases associated with differences in the covariates (Hirano & Imbens, 2004). The balancing property of the dose-response function also helps eliminate any hidden biases resulting from using the observable characteristics presumed to be common to all user farm households to estimate the propensity score.

3.4.6. Definition of variables and working hypothesis

The study's treatment variable is the seeding rate (*i.e.* 12, 14, 16, 18 and 20kgha^{-1}), while the dependent variable is the average yield of *Korra tef* produced by farm households. Gender of household head (SEXHH), marital status of household head (MARSTATUSHH), farming experiences of household head (FARMEXPHH), family size of household (HHSIZE), total farmland (TOTLAND), livestock owned by household (TLU), functional radio (RADIOOWN), access to credit services (CREDUSE), distance from home to FTC (FTCDIST), cooperative or association that households primarily participate in

(MAINPARTCCOOP), and distance from home to the main market (to input and output market) (MRKTDIST), income from non-farm activities (INONFARMACT), and remittances, money transferred both from inside the country and abroad (REMIT) are the demographic, socio-economic, and institutional factors considered as the common characteristics of the adoptive farm households. These variables were selected under the presumption that they are not affected by other interventions except the use of the *Korra tef* variety.

Hypothesis: Ceteris paribus, utilization of the *Korra tef* seed per the recommendation increases its yield.

3.5. Results and discussion

Farmers traditionally broadcast the *tef* seed of 25-50kgha^{-1} (ATA, 2013). However, ATA favours row planting over broadcasting and recommends reducing the seed rate for row planting to between 3 and 5kgha^{-1} to allow for less seedling competition and ideal tilling of the *tef* plant (ATA, 2015). Following the introduction of the *Korra tef* variety by the AGP II, the beneficiary farmers at the study area were instructed to plant it at a seed rate of 15-18kgha^{-1}. Building on this, the users were divided into three groups to evaluate the impact of the plot level seed rates on *tef* production. Farmers in the first group used less seed than the recommended, those in the second group used the recommended seed rate, and farmers in the third group used more seed than the recommended.

The distribution of average production across different seed rates is shown in Table 18, along with the one-way ANOVA results for the farmers' use of seed rates that were below, at, and above the recommendations during the 2020 cropping season. Accordingly, the analysis of variance showed that 4.52%, 12.22%, and 83.26% of the respondents use seed rates below, above, and within the recommended rates, respectively. This indicates that more than 95% of the farmers in the study area use seed rates that are above or within the recommended range. Farmers in the study area have typically used a seed rate of 16.95kgha^{-1}, which is within the recommended range. The analysis of variance showed a significant yield difference between farmers who use below, at, and above the recommended seed rates and a very significant ($P< 0.001$) effect of seed rate on grain production. Farmers that use seed rates that are lower than recommended have the lowest average *tef* productivity. This finding is consistent with previous studies (Arega & Yemgnushal, 2018; Shifera et al., 2020), that reported that seed

rates significantly impacted grain yield. It is also corroborated by the qualitative data where the key informants reported that the AGP II had been widely engaged to change the study area's trend of using seed rates below the recommended rates. In other words, the fact that most farmers follow the recommended seed rate indicates that most program beneficiaries have followed what the relevant agricultural development experts of the study area have instructed. The result also aligns with the key informants' assertion that only some farmers deviate from the advised seed rates.

The study's participants were asked about their use of seed rate. Since they used to link greater seed rates with larger yield gains, they prefer to apply higher seed rates than the recommended ones to achieve better yield growth. However, improvements were shown once they adhered to the recommended doses by the agricultural development experts via the AGP II activities. These purported improvements have been supported by the relevant data gathered and analyzed.

Table 18: Distribution of average productivity across varying seed rates

Seed rate	**Observation**		**Seed Rate (kgha^{-1})**		**Productivity (Qtha^{-1})**		**F (Prob > F)**
	Frequency	**Percent**	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**	
Below-recommendation (<15kgha^{-1})	10	4.52	13.85	0.812958	1606.643	417.6449	2.46 (0.0003)
Within-recommendation (>=15kgha^{-1} & <=18kgha^{-1})	184	83.26	16.82	1.032292	1923.846	339.6114	
Above-recommendation (>18kgha^{-1})	27	12.22	18.94	0.3489912	2179.525	355.8053	
Total	221	100	16.95	1.366235	1940.73	361.0342	

*******p<0.01; Standard error in parenthesis

Source: own survey data (2020)

Figure 7 shows how the average yield is distributed among different seed rate user categories (below, within and above the recommendation). The levels of seed rates and the yield of *tef* were positively correlated, suggesting that the use of the recommended seed rates are linked to higher *tef* yields across all seed use categories. The users' yield increases when they use the seed up to and somewhat over the recommended doses. This could be because all of the respondents were AGP II beneficiaries and used seed rates per the guidance from local agricultural development experts.

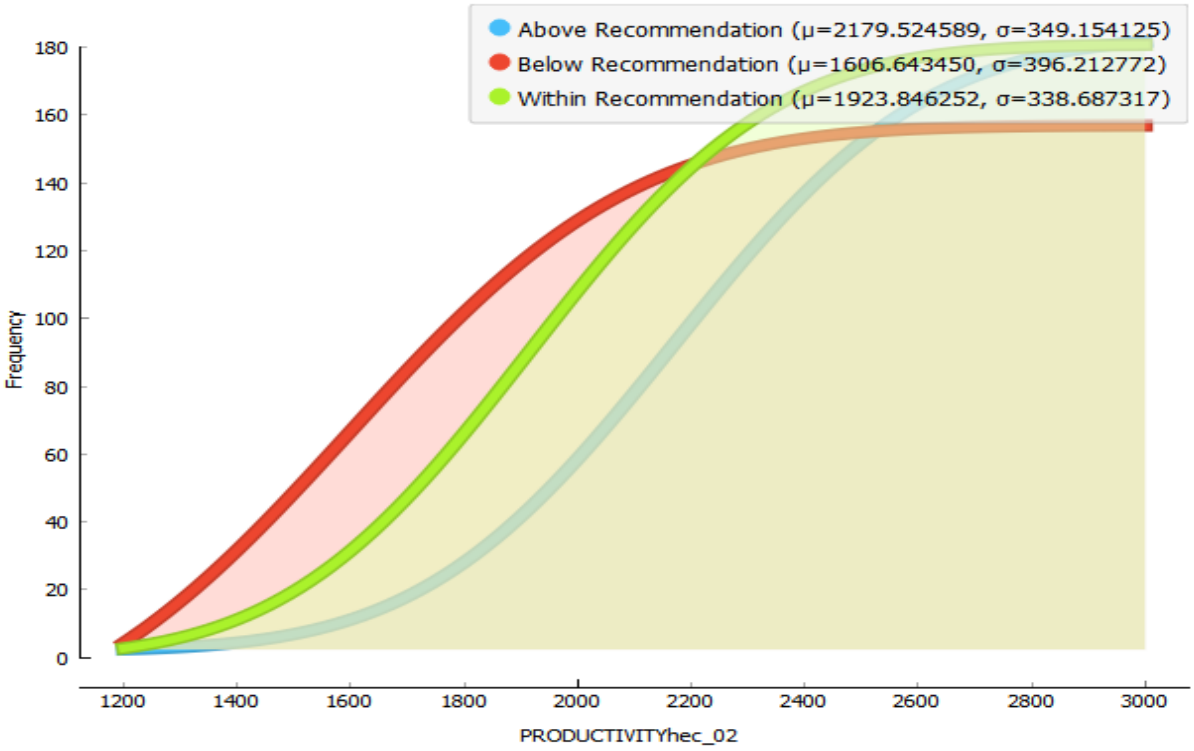


Figure 7: The distribution of average yield across varying seed rates
Source: Field survey (2020), Extracted by Orange Data Mining Software

However, the comparison drawn from the one-way ANOVA results needs to fully account for the seed rate's effects on yield. The analytical model of the dose-response function was used to examine the impact of a dose or concentration (*Korra* seed rate in this study) on the response (*Korra tef* yield) based on the generalized linear regression model. The GPS was used to balance the considered variables, provided that the study's doses were administered under controlled (rather than randomly assigned) conditions. Accordingly, as shown in Table 19, the estimate of the GPS reveals that, except for the respondents' farm experiences (p = 0.040), the difference between the respondents was statistically not significant for all the variables selected as relevant (with the p values of >1%). This guaranteed that there was a relative balance of variables among the respondents. The presence of a relative balance suggests that the characteristics of the respondents are homogenous, which would enable us to quantify the effects of seed rate on yield objectively. The possibility that the AGP II has targeted farmers with comparable characteristics could be linked to the absence of notable variances among various seed dosage users. Since the key informants reported that farm experience was not set as a criterion for being beneficiaries in the program's component of 'crop productivity', the slight variations seen in the respondents' farm experiences could be

attributed to the absence of such criterion in this regard during the recruitment of the beneficiaries.

Table 19: Estimation of the Generalized Propensity Score

Variables	Coef.	Std.Err.	z	P>z
SEX	-0.0071204	.0566026	-0.13	0.900
HHSIZE	0.0057116	.0073237	0.78	0.435
MARSTATUSHH	-0.0113463	.0174163	-0.65	0.515
FARMEXPHH	-0.0044818	.0021871	-2.05	0.040
TOTFARMLAND	0.0044647	.0508481	0.09	0.930
TLU	-0.0000972	.0077392	-0.01	0.990
MAINPARTCCOOP	-0.0000669	.0056192	-0.01	0.991
RADIOOWN	-0.0306982	.034691	-0.88	0.376
CREDUSE	-0.0399188	.0325014	-1.23	0.219
FTCDIST	-0.014042	.0154509	-0.91	0.363
MRKTDIST	-0.0024691	.0074901	-0.33	0.742
INONFARMACT	9.73e-08	2.27e-06	0.04	0.966
REMIT	-1.80e-06	4.58e-06	-0.39	0.694
_cons	1.010578	.2493589	4.05	0.000
Log-likelihood	21.09022662			
Number of obs	221			

Source: Field survey, 2020

The GPS was determined before the dose-response function was used to investigate the impacts of seed rate on productivity. Since the sample respondents have used different seed rates, different predictive margins were used to examine the degree of change in *tef* productivity. In light of this, five seeding rates (12, 14, 16, 18 and 20kgha^{-1}) were arranged. The model's analysis demonstrated that minimizing the seed rate lessened the grain yield, and the more the respondents used seed rates close to the recommended doses, the greater their yield. The lowest seed rate of 12kgha^{-1} is correlated with the lowest average *tef* yield (1222.24kgha^{-1}).

On the other hand, by sowing the *tef* plants at the highest seed rate (20kgha-1), the greatest grain yield (1980.13kgha^{-1}) was obtained. A direct correlation between the seed rate used and the amounts of yield obtained was observed between the two extreme margins of the seed rates (*i.e.* when 12kgha^{-1} and 20kgha^{-1} were applied), in which they both increase together and decrease together (see Table 20). Thus, it is indicated that the *tef* yield obtained from plants grown at the seed rate of 20kgha^{-1} exceeded the *tef* yields obtained from plants grown at the seed rates of 18, 16, 14, and 12kgsha-1 by 9.57%, 19.14%, 28.71%, and 38.27%, respectively. This result is consistent with the study by Abraham et al. (2018), who found that in Ethiopia's *Ada*-District, East *Shewa*, a higher *tef* yield was obtained at the seed rate of 20kgha^{-1} than at 15, 10, 5, and 2.5kgha^{-1} seed rates. Similarly, Sewnet (2005) found a higher

rice grain production at the seed rate of 120kgha-1 than at 60, 80, and 100kgha-1 seed rates in the *Fogera* area of Central Ethiopia. The current study's result generally suggests that it is possible to increase *tef* yield if farm households in the study area use the *Korra tef* variety as recommended.

In contrast to the current finding, Amare and Adane (2015)'s study in Ethiopia's Eastern *Amhara* Region found that the maximum grain yields, 2527kgha^{-1} and 3067kgha^{-1}, were obtained with the lowest seed rate, 5kgha^{-1}, on black soil in the years 2012 and 2013, respectively. A study conducted at *Konso* and *Arbaminc*h in Southern Ethiopia also found that *tef* sown with a seed rate of 5kgha^{-1} significantly increased grain yield by 12.3%, 29%, 29.5%, and 31.7% when compared to *tef* sown at a rate of 10, 15, 20, and 25kgha^{-1}, respectively (Arega & Yemgnushal, 2018). Another study found that *tef* sown at the seed rates of 5 and 10kgha^{-1} enhanced grain production by 45.15% compared to the *tef* sown at the rates of 15, 20, and 25kgha^{-1} (Bekalu & Arega, 2016). The fact that the grain yield per unit area varies basing the performance of individual plants, panicle density, as well as the total number of plants grown in the area could be the cause of these discrepancies (Abraham et al., 2018; Angassa, 2007; Baloch et al., 2002; Delessa, 2017; Yirgalem et al., 2021). Therefore, additional studies on various soil types, *tef* varieties, seasons, and locations are needed to make a firm proposal.

Table 20: Marginal effects of different seed rates on *tef* yield

Seed rate (kg)	Delta-method		t	$p > \|t\|$	[95% Conf. Interval]	
	Margin	Std. Err.				
12	12.22239	0.0655019	186.60	0.000	12.09401	12.35077
14	14.11711	0.0409203	344.99	0.000	14.03691	14.19732
16	16.01184	0.0195883	817.42	0.000	15.97345	16.05023
18	17.90657	0.0204495	875.65	0.000	17.86649	17.94665
20	19.8013	0.0421653	469.61	0.000	19.71865	19.88394

Source: Field survey, 2020

To sum up, the Dose-Response relationship, the correlation between plot level seed rate and yield, is shown in Figure 8. The dose is displayed on the horizontal axis, while the response is displayed on the vertical axis. The slope of the Dose-Response curve determines the degree to which the desired response changes as the dose is altered. A steeply rising, protracted curve shows that, throughout a broad dose range, a slight change in dose results in a substantial change in the drug's effect (Calabrese, 2014). The figure indicates the path of an increase in *Korra tef* productivity following the use of the respective seed.

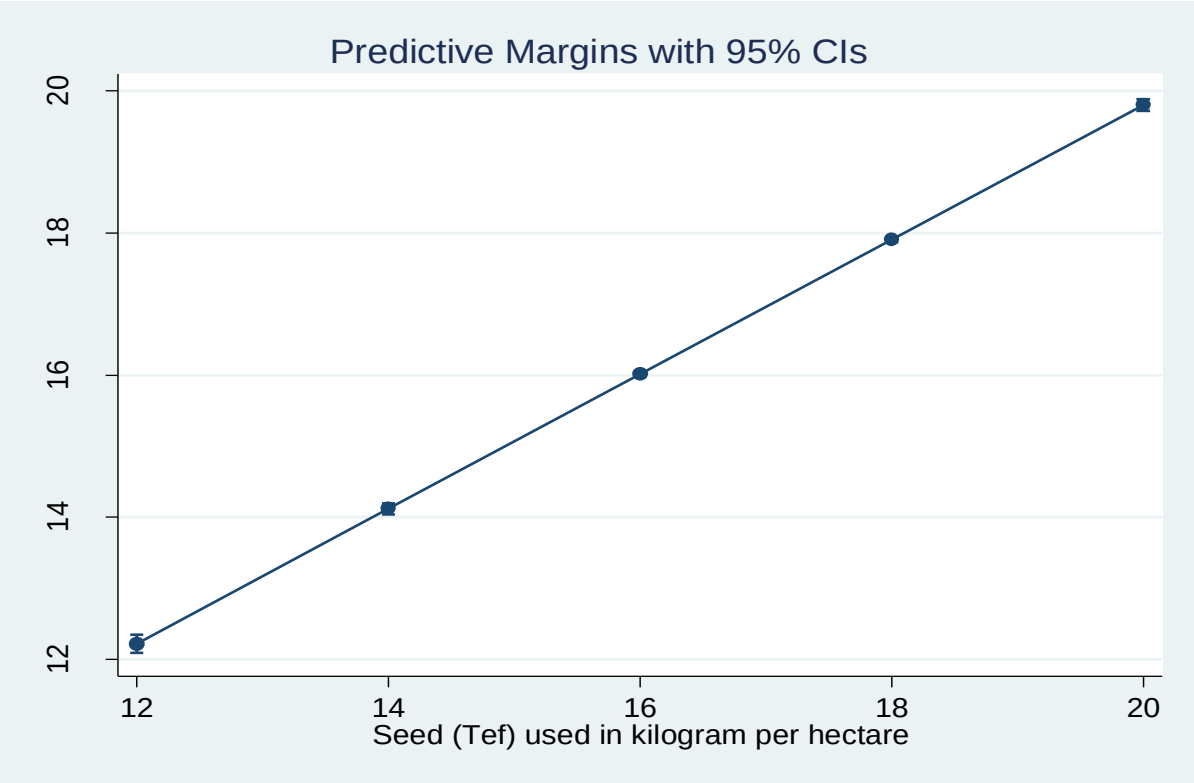


Figure 8: Seed rate-yield response curve
Source: STATA output (2020)

3.6. Conclusion and recommendations

This study was conducted to examine the productivity effects of plot-level *Korra tef* seed in Central Ethiopia (*Wara-Jarso woreda*) at the level of farm households that adopted one of the high-yielding *tef* varieties, *Korra*, during the 2020 cropping season. A one-way ANOVA used for the different seed rate user categories as users below, above, and with recommendations showed that *Korra tef* yield was significantly (P=0.0003) affected by the seeding rate. Thus, substantial production differences were seen among the farmers that used seed rates below, within, and above the recommendations. The Dose-Response Model also showed that the treatments conducted at five levels of seed rates (12, 14, 16, 18, and 20kgsha^{-1}) produced the highest *tef* yield at the highest seed rate (20kgha^{-1}) and the lowest *tef* yield at the lowest seed rate (12kgha^{-1}). The grain yields obtained from plants produced at the seed rate of 20kgha^{-1} were higher by 9.57%, 19.14%, 28.71%, and 38.27%, respectively than the *tef* yields obtained from plants grown at the seed rates of 18, 16, 14, and 12kgsha^{-1}. Hence, the *Korra tef* seed rate is significant in estimating crop output.

Even though drawing any firm conclusions from a study of one season and one location is difficult, from the findings of this study, we commend using the *Korra tef* seed rate per the recommendation with a slight variation on the seed rate set as optimum for the study area (*i.e.* 15-18kgha^{-1}). With all other factors staying constant, the *Korra tef* variety in the study area can obtain a reasonably optimal yield by applying a seeding rate of roughly 20kgha^{-1}. Nevertheless, the yield effects of *Korra tef* seed rates for various soil types, tillage frequency, socio-economic settings, weather conditions, spatial arrangements, and other agricultural inputs (like fertilizers) should be investigated. This will have implications for future research on plot-level seed rate yield effects by enriching the existing discussions and knowledge on the same. Furthermore, the current study needs to be repeated over the years with similar settings at multiple sites to confirm the results and develop solid and more conclusive recommendations that can be used by the farmers that grow *Korra tef*.

CHAPTER FOUR: Article three

4. The Impact of *Korra tef* (*Eragrostis tef*) Use on Commercialization Status of Farm Households in Central Ethiopia: A Propensity Score Matching Analysis

4.1. Abstract

The government and other development practitioners in Ethiopia have promoted crop technologies like improved tef varieties to improve farmers' crop productivity and, in turn, their commercialization status. However, the commercialization impacts of these crops needed to be thoroughly examined. This study examined the commercialization impact of adopting improved tef variety (Korra) in Central Ethiopia using cross-sectional data of 479 tef producer farm households drawn from two districts, one from the users and the other from non-users. A multi-stage sampling procedure was followed to select the respondents. A semi-structured questionnaire was used as a leading primary data collection method for household survey data. Interviews were conducted with the relevant key informants of the study. The extent of smallholder commercialization was examined using the Household Commercialization Index (HCI), and the impact of Korra tef use on users' commercialization was estimated using Propensity Score Matching (PSM). The HCI result revealed that 46.95% of sampled farmers sold tef during 2020, while the selling rates were 58.92% and 36.7% for the users and non-users, respectively. This indicated that the non-users and users were semi- and commercialized, respectively. The PSM result also indicated a positive and significant impact on households' tef commercialization, with the users' commercialization rate exceeding the non-users by 23.43%. Hence, efforts should focus on ensuring farmers access to sufficient quantities of high-quality Korra tef seed and encouraging improved access to their institutional services.

Keywords: *Korra tef; Agricultural Growth Program II; Users; Non-users; Household Commercialization Index; Impact assessment*

4.2. Introduction

Agriculture is a mainstay of the Ethiopian economy. It has continued to play a significant role in the economy by contributing to employment, foreign exchange profits, industrial inputs, and food production. Around 79% of the population is employed therein, and it accounts for 79% of foreign earnings, contributes 27.5 billion dollars or about 33.88% of the Gross Domestic Product (GDP), and is the main source of raw materials and capital for investment and the market (Diriba, 2020; O'Neill, 2021; Wendimu, 2021). As a result, it greatly impacts many people's livelihoods, food security, poverty reduction, employment, income, socio-economic development, and environmental sustainability (Diriba, 2020; Shikur, 2020; Welteji, 2018). However, the country's smallholder farmers, who constitute the bulk of the rural poor, of whom only 14% possess more than 2 hectares of farmland, still need to fully benefit from the multiple functions of agriculture (Diriba, 2020; Wendimu, 2021). Only households that farm more than two hectares of land can achieve basic subsistence under normal circumstances (Diriba, 2020). Studies showed that most of the country's smallholder farmers had been excluded from the formal market system and corresponding income-mediated privileges (Beyene, 2018; Demeke & Haji, 2014). As a result, the level of agricultural commercialization for smallholders in the country remained low (Alemu & Berhanu, 2018; Tesfahun, 2021).

Since smallholder commercialization is the major pathway from a semi-subsistence agrarian society to a more diversified and food-secure economy, most development practitioners view it as a critical component of the structural transformation (Orr et al., 2021). It is argued that smallholder commercialization can significantly increase income and welfare, support overall economic expansion, and lessen poverty (Shadreck et al., 2013). It is also crucial for developing and expanding countries' economies heavily dependent on agriculture (Cheber, 2018). In Ethiopia, one of the agrarian countries, the government's agricultural development policies and plans have long been focused on transforming smallholder farmers' subsistence-oriented production system into a market-oriented production system (Aman et al., 2014; Gebre-Ab, 2006). For example, the GTP I and II implemented from 2010/11 to 2019/2020 have encouraged the production and marketing of high-value agricultural products. Besides, these programs aimed to increase competitiveness in domestic, regional, and global markets. As a result, significant resources have been channelled toward agricultural commercialization through regular agricultural extension activities and with the assistance of development partners (Gebremedhin & Jaleta, 2010; Getahun, 2020; Tesfahun, 2021).

One of the government's partners in agricultural development is the AGP II. The program has promoted and supplied improved agricultural inputs to help smallholder commercialization and shift their production from subsistence to a market-oriented economy. According to the 2015 Program Design Document, the distribution and marketing of agricultural inputs would help farmers access the market by affecting the quantity and quality of their produce (MoA(a), 2015). With this justification, the program has focused on agriculturally promising areas while considering typical farm activities in the selected areas. In light of this, *Wara-Jarso woreda*, the area where this study was conducted, is one of the program's intervention areas basing the fact that *tef* is a common crop that is cultivated in all agro-ecological zones and altitudes of the area, and as the area is considered a potential for greater *tef* production.

Ethiopia is the largest *tef* producer in the world (Lee, 2018). *Tef* is the most popularly grown and consumed cereal in Ethiopia. The crop has the largest area under cultivation, making up 29.5% of all cultivated land and producing 19.7% of all cereals (Diriba, 2020). Likewise, it is the main staple food crop in the study area. It ranked first in its contribution to overall grain output and market share, with wheat coming in second (Wara Jarso woreda Agriculture and Natural Resource Office, 2019). Besides home consumption, it is used as a cash crop, animal feed, and construction material. Its high resilience capacity withstanding periods of drought and flood as it attracts few insect pests and diseases, and its minimal post-harvest loss all increase its importance (Fufa et al., 2011; Minten et al., 2018). A team of scholars has computed the trend of *tef* cultivation and production in Ethiopia from statistical reports of the CSA of Ethiopia for 2000/01-2017/18 (Solomon et al., 2019). Based on this, its area, yield, and production increments are demonstrated in Figure 9.

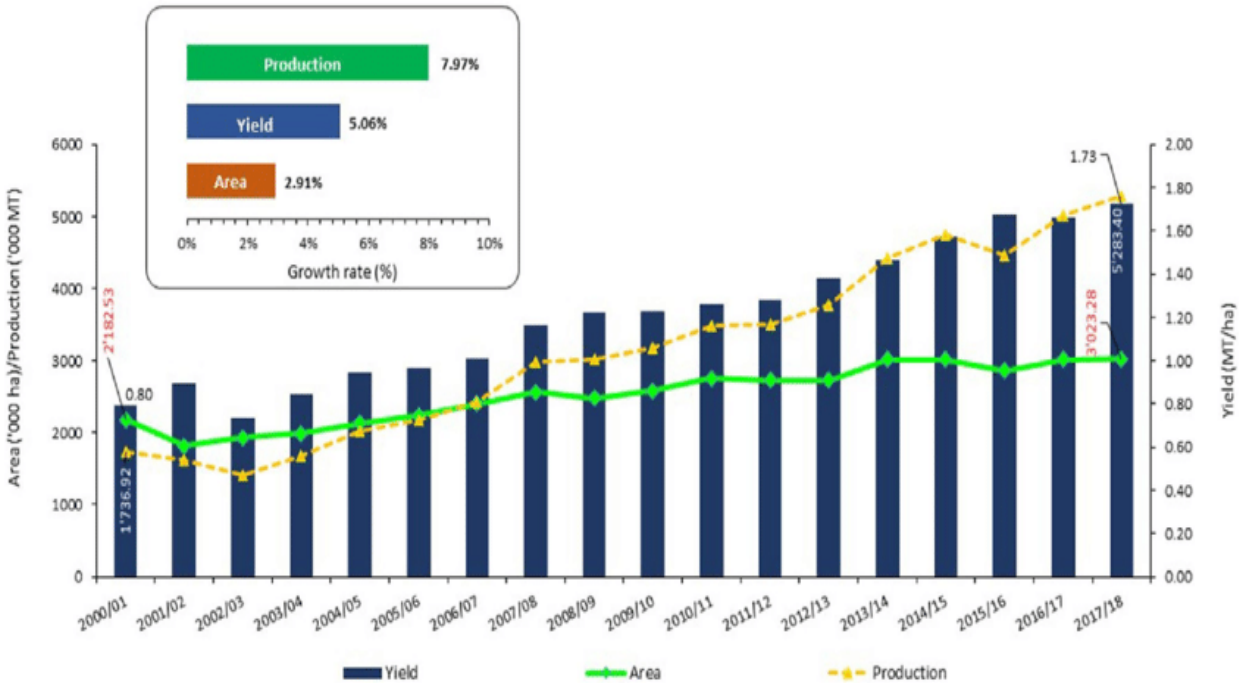


Figure 9: Trend of *tef* cultivation and production in Ethiopia from 2000 to 2018
Note: Growth rates are calculated using the semi-log function (lnX t = a + bt).

However, Ethiopia has yet to tap its *tef* production and market potential and develop an efficient *tef* value chain and marketing scheme (Lee, 2018). Grounded on this, AGP II has distributed the new high-yielding *tef* variety known as "*Korra*" in the study area to enhance the crop productivity and commercialization of *tef* producer farmers. Despite the advocacy and promotion for adopting improved *tef* varieties by development practitioners like AGP II, studies examining the commercialization impacts of adopting improved *tef* varieties in general and *Korra tef* variety in particular on users are uncommon. Additionally, most previous studies on smallholder commercialization have largely focused on their market orientation and engagement, neglecting the commercialization impacts of adopting improved seed varieties. Some studies have indeed examined smallholder commercialization (Afework and Endrias, 2016; Gebre-Ab, 2006), the challenges they encounter (Boka, 2017), and the potential for sustainable intensification (Mutyasira, 2020). Others highlighted the smallholder commercialization processes, determinants, and impacts by emphasizing *tef*, wheat, maize, and other horticulture crops (Aman et al., 2014; Edosa, 2018; Endalew et al., 2020b; Gebreselassie & Sharp, 2007; Getahun et al., 2019; Jaleta et al., 2009). Generally, little evidence exists on the commercialization impacts of producing *tef* in general and *Korra tef* variety in particular. Therefore, this study is intended to investigate the commercialization impact of adopting the *Korra tef* variety on smallholder farmers in *Wara-Jarso woreda*,

Central Ethiopia. Information on the commercialization impact of *tef* is needed to assist the government's effort to encourage the use of improved *tef* varieties in general and its commercialization in particular.

4.3. Conceptual framework

We developed the conceptual framework shown in Figure 10 based on studies that examined the impact of crop technology use on farm households' status of crop commercialization (Afework & Endrias, 2016; Assefa, 2022; Gebremedhin & Jaleta, 2010; Gerezgiher, 2016; Mazengia, 2016; Poulton, 2017; Shadreck et al., 2013; Tadele et al., 2017; Taffesse et al., 2012). To compare the characteristics of users and non-users of the *Korra tef*, we first identified the demographic, socio-economic, and institutional characteristics that both groups' farm households had in common on the left side of the Figure. The idea that using *Korra tef* leads to the production of surplus products, which enhances its commercialization status, is indicated on the right side. Generally, the overall message of the conceptual framework indicated below is that based on the assumption that the user and non-user farm households are, in most cases, comparable by the mentioned characteristics, the use of *Korra tef* has a positive impact on *tef* commercialization of the users through an increase in its yield.

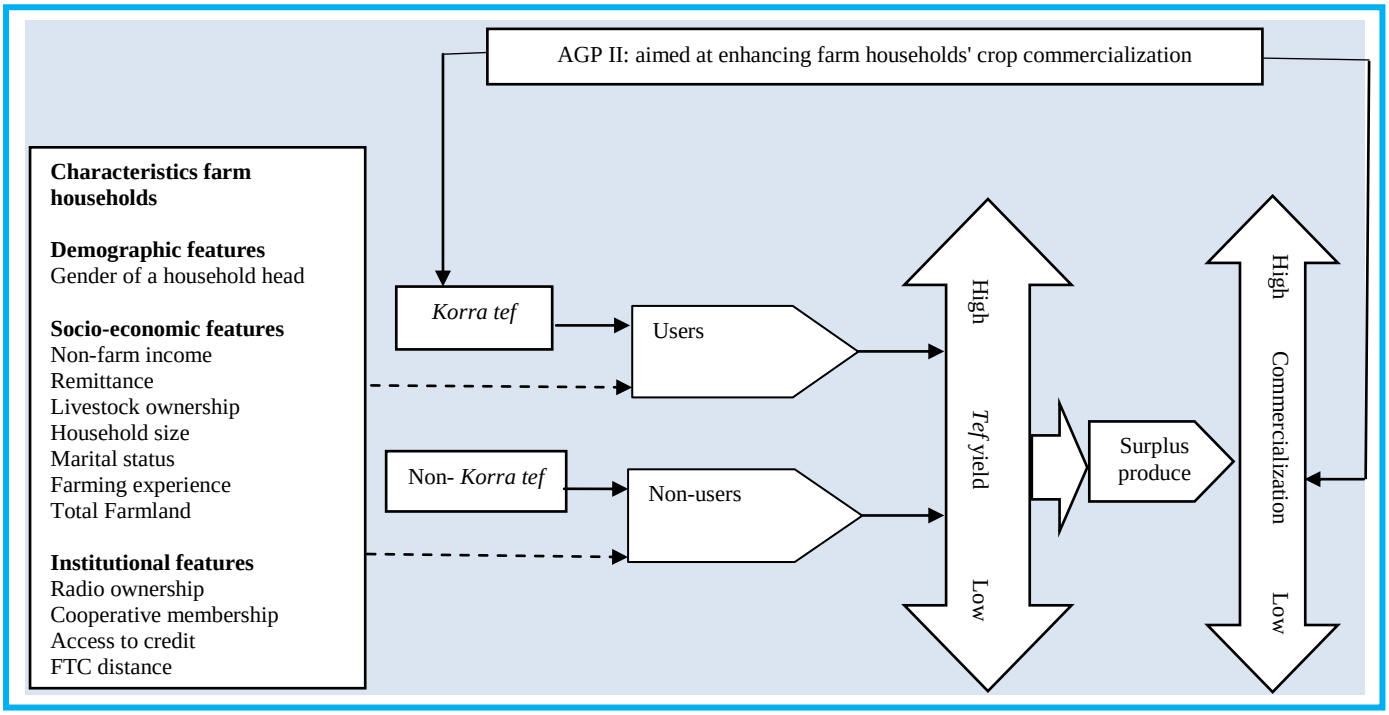


Figure 10: *Korra tef* use and farm households' commercialization
Source: Author's construction

4.4. Research methodology

4.4.1. Research design

The study used a mixed-methods research approach with a cross-sectional time frame. As per the Concurrent Embedded Strategy of the mixed method, the survey data were used as a guide, and the qualitative data were embedded within the survey data to support the descriptive and explanatory functions (Creswell & Creswell, 2017).

4.4.2. Sampling procedures and data sources

The study's target population was *the Korra tef* producer households at *Wara-Jarso woreda*. The sample households were selected by using a multi-stage sampling method. First, the study *woreda* was chosen purposefully. Second, *Korra tef* users were identified with the assistance of the study *woreda*'s AGP II coordination office and the DAs. Two *kebele*s were chosen from the three major agro-ecological zones of the *woreda* based on their *Korra tef* production classification as allegedly high and medium growers to ensure sample representativeness. As a result, six *kebeles* were considered as the actual study areas. To estimate the counterfactual data, the same procedures were followed to select the control *woreda*, the nearby *Kuyu woreda*, study *kebeles* and the respective households in them. However, the criterion of *Korra tef* producers was substituted by *tef* producers. Likewise, *Kuyu woreda* comprises three main agro-ecological zones. It is comparable to *Wara-Jarso woreda* in terms of the crops grown there and other institutional, cultural, and socio-economic characteristics. The lists of farm households for both groups were compiled using the official records of the study *kebeles*. The sample size was computed by (Yamane, 1967)'s sample size determination formula on account of the finite character of the population under study (Equation 1). Finally, 479 farm households were obtained with the 95% desired level of precision. Two hundred twenty-one users from the treatment group and 248 non-users from the control group were selected to keep a balance between the two groups for using an impact assessment model. As shown in Table 1, the sample size in each *kebele* was calculated using the PPS of the identified number of farm households.

As it is indicated in the introduction section, *tef* is the most widely grown crop in the study area and is produced in all of its agro-climatic zones. Due to this, AGP II has introduced the *Korra tef* variety into the study area to increase its yield and commercialization. Non-mechanized farming and subsistence agriculture characterize the area, and farmers in the area

are comparable in terms of the size of their farmland, credit use, livestock ownership, market distance, and family size, among others. The program particularly considered the area because of its significant potential for *tef* production. Farm households in the area were chosen for adopting *Korra tef* based on several factors, including their willingness to grow it on a minimum of one hectare and to consult with local development agencies, and their level of readiness for the practice.

The probability of possessing a selection bias is narrow, provided that the program has apparent criteria for selecting beneficiaries, and the study accordingly considers these criteria. In other words, even though the study area is purposively selected, the selection of samples from both user and non-user groups was randomly conducted. This, in turn, marks the non-occurrence of selection bias.

The study used both primary and secondary data. The main primary data (*i.e.* quantitative data) were collected from the *Korra tef* producers in the treatment *woreda* and non-*Korra tef* producers in the control *woreda*. The data were collected in September and October of 2020 using paper versions of semi-structured questions and trained enumerators. The questionnaire was initially developed in English, translated into *Afan* Oromo, and interviewed by the latter. A pilot test was conducted to determine whether the actual responders could comprehend the survey tool. The supporting primary data (*i.e.* qualitative data) were obtained from various relevant KIIs (*i.e.* DAs from each agro-ecology zone, the regional AGP II monitoring and evaluation officer, the zonal AGP II facilitator, the study *woreda*'s AGP II coordinator, and six *Korra tef* producer farmers (two farmers from each agro-ecology labelled as high and medium producers)). The study's principal investigator collected the qualitative data using interview guides. Relevant journal articles, websites, and the official records of the study *woreda*'s AGP II coordinating office were reviewed for the secondary data.

4.4.3. Tools and techniques of data analysis

Both econometric and descriptive analyses were used to examine the quantitative data. The STATA version 16 Software Package was used for the analysis. The qualitative data were used to substantiate the interpretation of quantitative data. Farm households' demographic, socio-economic, and institutional characteristics were examined and described using descriptive statistical analysis techniques like mean, standard deviation, proportions, frequency, and percentages.

Researchers like (Gebremedhin and Jaleta, 2010; Gerezgiher, 2016; Govereh et al., 1999; Osmani et al., 2014) examined the level of household commercialization using the Household Commercialization Index (HCI). HCI measures the ratio of the gross value of crop sales by household i in year j to the gross value of all crops produced by the same household i in the same year j, expressed in percentage.

$$\text{HCI} = \frac{\text{Gross Value of } \textit{Korra} \text{ variety } \textit{tef} \text{ sale of farmer i at year j}}{\text{Gross value of all } \textit{Korra tef} \text{ production of farmer i at year j}} \text{x100} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots [8]$$

According to these authors, the benefit of such a measure is that commercialization is regarded as a continuum, avoiding the crude distinction between households that are "commercialized" and those that are "non-commercialized." It gives the degree of commercialization for each household individually. The value of HCI lies between 0 and 100%. An entirely subsistence-oriented household would have a value of zero, and the closer the index is to 100, the more commercialized the household is. Based on the stated logic behind the use of HCI, this study has employed it to determine how much more market-oriented the households of *Korra tef* users are than non-users.

The PSM technique was applied to estimate the commercialization impact of adopting the *Korra tef*. The model was chosen because of the absence of baseline data and as the matching technique in the model has room to correct for observable selectivity. The model has also opted to estimate the effect of receiving treatment (*i.e. Korra tef* variety in this case) since the random assignment of treatments to subjects is not feasible in this study. The conclusion in this regard was drawn from the *Korra tef* users by comparing them with the non-users. Hence, we turn in to determine the ATT since it is hard to know the outcomes for users when they have not used and non-users when they have used. According to Rubin (2001), the ATE is calculated as follows:

$$\tau ATE = E[Y|X, d = 1] - E[Y|X, d = 0] \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots [9]$$

The above equation (τATE) assumes that the commercialization level of the users before their use E (Y0 |D=1) can be approximated by the commercialization level of non-users at times of data collection E (Y0 |D=0). However, it is hard to precisely estimate ATE using the above-stated equation as we do not observe E (Y0 |D=1) yet we do observe E (Y1 |D=1) and (E (Y0

|D=0). Additionally, the self-selection bias emanating from adopting *Korra* through the placement of AGP II may result in a biased estimation. In other words, in the context of this study, the households considered in the treated group came into the category of users through the program placement of the AGP II. As a result, they are less likely to be statistically equivalent to the comparison group. In such a case, PSM adjusts for selection bias, minimizes the limitation from matching on many observed variables, and estimates counterfactual effects. The propensity score, p(x) conditional on a set of characteristics x according to (Rosenbaum & Rubin, 1983) is given as:

$$p(x) = P_r[d = 1|x] = E[d|x] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [10]$$

Where, d = {0, 1} is the indicator of exposure to treatment and
x is the multidimensional vector of pre-treatment characteristics.

Econometric literature suggests that the soundness of the outputs of the PSM technique depends on the employability of two basic assumptions: the CIA and the Common Support Condition (CSC). CIA (also known as Unconfoundedness Assumption) notes that the potential outcome variable (YO) is independent of the treatment status (use of *Korra*) conditional on a set of observable variables x. Thus, it is important to precisely detect the impact as it considers the difference between the treated and control groups to reduce the selection bias. This allows the units from the control group to be used to construct a counterfactual for the treatment group. The assumption of common support, on the other hand, enables appropriate comparison by facilitating a sufficient overlap in the features of the treated and untreated units to find adequate matches. Since the impact estimates calculated using propensity scores are highly sensitive to the matching method, robustness can be further improved by bounding matches only to users and non-users with common support in the distribution of propensity scores (Smith & Todd, 2005). Hence, the four commonly used matching algorithms, namely nearest neighbour, radius, caliper, and kernel matchings, were employed to find the optimal estimation model for the commercialization impact of adopting the *Korra tef*.

4.5. Definition of variables and working hypothesis

Commercialization of the study area's smallholder farmers is a dependent variable, indicated by HCI, which is measured as the ratio of the gross value of *Korra tef* sales to the gross value of the *Korra tef* produced by the AGP II beneficiary smallholder farmers in the cropping

season of 2020, expressed in percentage. The use of *Korra tef* variety is the treatment variable of the study. A review of the theoretical and empirical literature on household commercialization indicated that the characteristics shown in Table 3 influence the commercialization of smallholder farmers and are considered the study's independent variables.

4.6. Results and discussion

4.6.1. Descriptive results

Tables 4 and 5 give the summary statistics of the chi-square (x^2) and t-test of the selected variables believed to be relevant in demonstrating the commercialization characteristics of the surveyed households. The x^2 was used to test relationships between dummy and/or categorical variables (Table 4). The means of continuous variables are reported based on the utilization status of the study households (Table 5). The explanatory variables used for estimation in the model were selected from these variables.

The analysis covers 479 households, of whom 221 (46.14%) adopted the *Korra tef* variety in 2020, and 258 (53.86%) did not. As shown in Table 4, a statistically insignificant difference was observed in the gender of the household heads of the two groups. However, 90.81% of the sample households are male-headed. This plays a positive role for both groups *tef* commercialization since male-headed households are believed to have a higher chance to participate in the market than women-headed due to higher social networks (Gebreselassie & Ludi, 2008). The x^2 results also revealed a statistically insignificant difference in their access to credit services and whether they have attended formal education. The two groups vary regarding their marital status and the cooperative and/or association they predominantly engaged in.

Access to market information could be an important factor in commercialization since it presents farmers with a range of options. With this, ownership of functional radio is imperative in the dissemination of information hence affecting smallholders' commercialization. Most farm households, 264 (55.11%), lacked a functional radio. Only 111 (50.23%) users and 104 (40.31%) non-users have functional radios. The key informants of the study evidenced that most households in the area listened to agricultural and non-agricultural programs. This may imply that households with access to information (whether

agricultural or non-agricultural) are aware of numerous methods for improving the commercialization of their *tef*.

A significant difference was found between the groups regarding their experiences in *tef* farming and the average size of their families. The same is true for the total sizes of farmland, livestock owned, average distance household travel from home to FTC and from home to input-output market, and remittances received. However, the income from non-farm activities shows a statistically insignificant difference between the two groups, suggesting that both groups' non-farm income might be equally correlated with households' level of commercialization or decision to sell their *tef*. The simple comparison of the two groups of households indicated that users and non-users differ significantly by the majority of the factors chosen as relevant to explain them (*i.e.* statistically quite different in 10 variables and showed no significant difference in 3 variables) (see Tables 4 and 5).

4.6.1.1. Farm inputs used in *tef* production

In the literature on smallholder commercialization, commercialization of the output side is often realized with the precondition of commercialization on the input side (Gebremedhin & Jaleta, 2010). It is also assumed that improved farming inputs increase output-side commercialization (Getahun et al., 2019). In light of such allegations, describing farm inputs used to produce *tef* is imperative. Farmers of the study area used different inputs for *tef* production in 2020. The typical farm inputs in the area include improved seed, fertilizers, herbicides, insecticides, soil fertility reclamation, compost, and labor. The analysis considered the costs of these inputs (by ETB) at the time.

Table 21 shows an average of 22.43 kg of improved seed and 91.93 kg of DAP, and 109.3 kg of Urea were used per hectare. On average, herbicide and pesticide used per hectare were 0.99 and 1.07 litres, respectively. Overall, the t-test result revealed a significant mean difference between the groups in the uses of the selected inputs at the p values of less than 0.01 and 0.05, in which the inputs usages of the user significantly surpassed their non-user counterparts except in the case of seed usage. The key informants also confirmed the survey result that the *Korra tef* variety reduces the amount of seed sowed per hectare. In congruent with the survey result indicated in Table 21, a higher fertilizer usage of the *Korra tef* variety in general and more usage of Urea than DAP, in particular, were also reported by all the key informants. As to them, the relatively higher usage of Urea has emanated from the fact that

they added Urea twice and DAP only once. Thus, the users' increased fertilizer use could have been influenced by the *Korra tef* variety's higher fertilizer consumption. The same is true for herbicide and pesticide use; the key informants added that using the *Korra tef* variety has urged them to use more than they would otherwise have to use.

Table 21: Average input use for *tef* production by respondent types (kg or litre/ha)

Inputs	Mean values			t (p-value)
	Non-users	Users	Combined	
Seed (*Korra tef* variety for users and other than *Korra* for non-users) (kg/ha)	27.17338	16.90991	22.43804	73.0644 (0.0000***)
DAP (kg/ha)	90.40628	93.71516	91.93292	-3.9723 (0.0001***)
Urea (kg/ha)	108.0736	110.737	109.3024	-2.5934 (0.0098***)
Herbicide (litre/ha)	0.958217	1.04669	0.999039	-2.1322 (0.0335**)
Insecticide (litre/ha)	1.050039	1.093484	1.070084	-2.3060 (0.0215**)

***p<0.01; **p<0.05; Standard errors in parenthesis

Source: Field survey, 2020

Except for soil fertility reclamation and compost applications, significant mean differences between the two groups were observed in the costs of other major inputs used to produce *tef* (Table 22). To begin with the cost of seed, the reason, for instance, could be though the then prices of 1 kg *Korra tef* was greater than other varieties of *tef* in which the former was from 48 to 52 ETB while the latter was from 37 to 48 ETB per kg, the difference was observed among them in terms of seed usage. The tiny differences in the costs of the fertilizers for the two groups could also emanate from the amount of their utilization since comparable prices of fertilizers were reported.

The key informants also confirmed that using more insecticide and herbicide on the *Korra tef* farm has increased the cost of production compared to growing other *tef* varieties. The mean difference in labor costs is consistent with the qualitative finding that the production of the *Korra tef* variety needs more labor than other *tef* varieties. This is in line with studies by (Abate et al., 2015; Coelli et al., 2005), which reported that higher-yielding varieties needed more labor but produced more output per unit of labor. As both groups engage in various soil erosion prevention techniques and supplement agricultural land with organic matter to increase its productivity, their comparable costs in terms of soil fertility restoration and compost could be signs of the presence of similar soil types in both study areas.

Overall, a significant difference was observed between users and non-users in terms of the overall cost of *tef* production in the cropping season of 2020. This is consistent with the

assertion of key informants that the *Korra tef* farm incurs higher costs than the indigenous *tef* varieties. Similar findings came from a study on the *Boset tef* variety, where greater production expenses, particularly for fertilizer and seed, were noted (Natnael, 2019b). Another study on *Korra* and *Boset tef* has also shown that they have a higher variable cost of production than local *tef* variants (Bekele et al., 2019).

Table 22: Average input costs of *tef* production by respondent types (ETB/ha)

Inputs	Mean values			t (p-value)
	Non-users	Users	Combined	
Seed (*Korra tef* variety for users and other than *Korra* for non-users)	1079.703	825.1463	962.2559	40.9736 (0.0000***)
DAP	1356.088	1405.731	1378.992	-3.9731 (0.0001***)
Urea	1458.994	1494.947	1475.582	-2.5933 (0.0098***)
Soil fertility reclamations	35.77257	39.59797	37.53753	-0.2819 (0.7781)
Compost	1342.651	1332.908	1338.156	0.1827 (0.8551)
Herbicide	172.4985	188.3859	179.8286	-2.1270 (0.0339**)
Insecticide	262.4873	273.3218	267.4861	-2.2999 (0.0219**)
Labor	11206.33	17047.5	13901.32	-37.1498 (0.0000***)
Total production cost	17180.57	23223.27	19968.54	-29.8676 (0.0000***)

*******p<0.01; ******p<0.05; Standard errors in parenthesis

Source: Field survey, 2020

4.6.1.2. *Tef* production and income

The mean *tef* production for users and non-users was 2037.63 and 1434.26 quintals with standard deviations of 169.01 and 132.44, respectively (Table 8). The result indicated the significant mean difference between *tef* produced by the groups at a 1% significance level. Even though one cannot exclusively generate a causal relationship from a mere descriptive finding, respondents who adopted *Korra tef* earn more income. The total sample households reported an average net income of 48354.46 ETB from the *tef* farm. With the average net incomes of 64310.19 ETB and 34686.96 ETB for the users and non-users, respectively, a significant mean difference is found between the two groups at a 1% probability level.

4.6.1.3. Categories and levels of commercialization of *tef* producers

Based on the taxonomy of commercialization by (Samuel and Kay, 2008; Tadele et al., 2017), the commercialization of smallholders are grouped into three categories: less commercialized farmers (those who sell up to 25% of their output), semi-commercialized farmers (those who sell between 25% and 50% of their output) and commercialized farmers (those who sell more than 50% of their output). The results showed that 80 (16.70%) of sample households fall in the category of 1-25% commercialization index, indicating that

they are less-commercialized in terms of *tef* output, 173 (36.12%) fall in semi-commercialized and most of the sample households 226 (47.12%) are commercialized farmers. Among 226 farm households in the category of 'commercialized farmers', the majority of them, 190 (84.07%), belong to the user category selling up to 75.75% of their *tef* yield, while the remaining 36 (15.93%) are from the non-user category selling up to 66.67% of their *tef* produce (Tables 23 and 24).

Table 23: Categories of commercialization of *tef* producers in 2020

Categories	**Non-users**		**Users**		**Combined**	
	Frequency	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
Less-commercialized farmers (1 - 25%)	78	97.5	2	2.5	80	16.70
Semi-commercialized farmers (26 – 50%)	144	83.24	29	16.76	173	36.12
Commercialized farmers (≥51%)	36	15.93	190	84.07	226	47.18
Total	258	53.86	221	46.14	479	100

Source: Field survey, 2020

Table 24 presents the results that show the aggregate levels of household *tef* commercialization in the study areas. Considering the gross value of *tef* sold, the overall average level of commercialization of the *Korra tef* growers in the study area was 46.95%. This result is consistent with the national average, which is about 46.53% of *tef* produced are sold in Ethiopia as reported by (CSA, 2020). It is also comparable with the findings of (Assefa, 2022; Degefa et al., 2022; Eshetu, 2018; Getahun et al., 2019), but it outdistances some and lags behind others. This situation could be attributed to the reason that *tef* is the most commonly grown crop used for consumption in the area. The qualitative data also evidenced that *tef* is extensively consumed and valued as a cash crop by local farmers.

On the other hand, the HCIs for the users and non-users were 58.92% and 36.7%, respectively. This implies that user and non-user farmers in the study areas sold 58.92% and 36.7% of their yield, respectively, indicating the extent of commercialization of the user and non-user households, in general, was in the categories of commercialized and semi-commercial farmers, respectively. The finding that the commercialization of the user households exceeds the non-users could be attributed to the use of the *Korra tef* variety. The HCI results also suggest that using *Korra tef* variety is vital in enhancing its marketing. The subsequent econometric analysis addresses the detail of the impact of *Korra* on its growers' commercialization status.

Table 24: HCI of *tef* producers in 2020

Variable	Category	Obs	Mean	Std. Dev.	Min	Max
HCI	All sample households	479	46.95	15.49931	13.43	75.75
	Users	221	58.92	8.455635	20	75.75
	Non-users	258	36.70	12.52093	13.42857	66.67

Source: Field survey, 2020

Figure 11 shows the kernel density estimates of the commercialization index of the users, denoted by the red colour, and non-users by the blue colour.

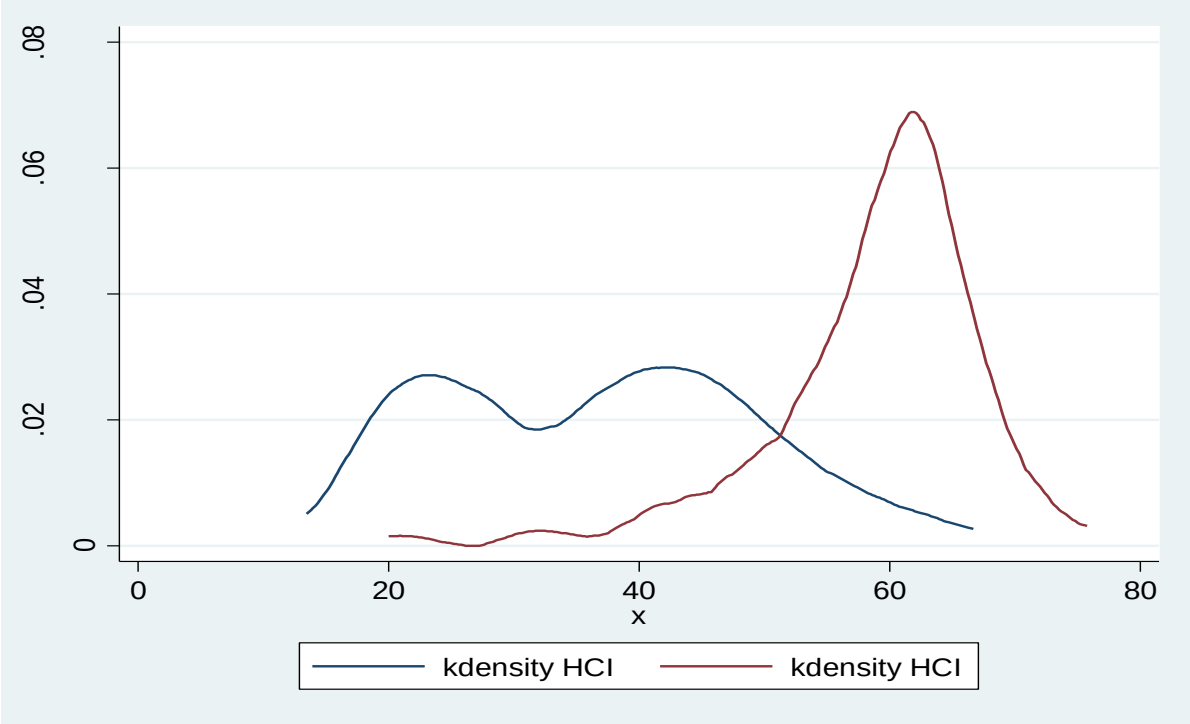


Figure 11: Kernel density estimate of HCI
Source: STATA output (2020)

4.6.2. Impact of *Korra tef*'s variety on smallholder farmers' commercialization

Hypothesis: Adopting the *Korra tef* variety increases the user farm households' status of *tef* commercialization.

As indicated in the hypothesis above, the commercialization status of *tef* producer households is the outcome variable used to calculate the commercialization impact of using the *Korra tef* variety. *Korra tef* user and non-user households were considered as the treatment and control groups, respectively. The PSM was used to compare the observed outcomes of adopting *Korra tef* variety with counterfactual outcomes from the non-users. With this, the ATT is

estimated, emphasizing the impact of the use of *Korra tef* variety on the users. Since the intention of using the PSM is to develop an index that can be used to match the users and non-users, the choice of variables to be included in the propensity score estimation is vital. Thus, basing the Heckman et al. (1997)'s notion that omitting important variables can increase the estimation bias, demographic, socio-economic, and institutional factors that are not affected by being user or not were selected for calculating the impact of using the *Korra tef* variety on the users' *tef* commercialization status (see Tables 3 and 4). However, significant differences were found between the two groups in 10 of the selected variables. Fortunately, the PSM allows extracting a set of matching households from non-users that resemble those who used.

Before estimating the propensity score for the user and non-user households, the hypothesized explanatory variables were examined for the likelihood of multicollinearity. Tests of the VIF for continuous variables and C for discrete variables were thus employed. The results showed that the value of VIF for each of the continuous variables was found to be less than 1.21 with a mean value of 1.09 (Table 9), and the value of C for the discrete variables did not exceed 0.75 (Table 10), indicating the independence of the study variables from one another (Tattao, 2007). Hence, there is no multicollinearity problem among all the conjectured explanatory variables incorporated in the model. This assures us that the model is devoid of multicollinearity issues, enabling us to move forward with the regression.

4.6.2.1. Estimation of propensity score

A probit regression model was used to estimate the p-score of the selected variables for the user and non-user households. The p-score result shows that the two groups are statistically different in all explanatory variables except gender, marital status, access to credit, and income from non-farm activities (Table 11). However, a high covariate balance between the treatment and control samples is required before estimating the impact. Hence, it is implied that the variables must be corrected before calculating ATT.

4.6.2.2. Testing the balance of propensity score and covariates

As shown in Table 12, except for sex, marital status, access to credit, and income from non-farm activities, the two groups significantly differed in other variables selected for estimating their commercialization status. However, the imbalance between them was minimized after matching since the percentage of bias reduced from the ranges of 1.6 and 45.6 before

matching to the ranges of 0.2 and 6.8 after matching. With this, the percentage of bias has minimized to the level it gets below the cutoff point of 20% (Rosenbaum and Rubin, 1983), indicating the absence of a statistically significant correlation between the controlled and treated groups. The p-values in Table 12 show the variations in the selected variables before and after matching, where the covariates of the variables exhibited significant differences were balanced. A balance of covariates between the two groups, in turn, allows for further impact estimation procedures.

4.6.2.3. Choice of Matching Algorithm

For a relatively better estimation algorithm, the four major matching estimators were tried with different bandwidths and trim levels by considering the PSM assumptions that the percentage of mean bias and βvalue should be <5 % and β < 25%, respectively (Caliendo & Kopeinig, 2008). As shown in Table 13, many of the matching estimates have fitted the Rubin (2001)'s suggestion of the required balance in which the value of β is expected to lie below 25, of R between 0.5 and 2, and the mean bias below 5. All estimation algorithms have shown insignificant LR chi^2, which is considered an additional indicator for a high degree of covariate balance between users and non-users ready for use in the estimation process. The values of Ps R^2 are also lower in all of the estimators. Nevertheless, we opted for the Kernel estimation algorithm with Bandwidth (0.1) as it has shown the lowest Ps R^2, mean bias, and B and R values. A relatively lower Ps R^2 (0.002 in the estimator we choose) confirms that user households do not exhibit many divergent characteristics.

Furthermore, as per the Minima and Maxima criterion, observations with a propensity score smaller than and larger than that of the opposing group were eliminated while determining the common support region (Caliendo & Kopeinig, 2008). Fortunately, only six observations were shown outside the common support region in all matching estimators calculated. As a result, observations whose propensity score is lower than the minimum of 0.065 and higher than the maximum of 0.893 in the opposite group were not included for matching (Table 14).

The propensity score of the distribution density in users and non-users, as graphically depicted in Figure 5, indicates the presence of a wide common support region and the reasonable distribution of the pscore across both groups. This suggests that the fair balance required to estimate the impact of the use of the *Korra tef* variety on the users' *tef* commercialization status is attained.

4.6.2.4. Estimating treatment effect on the treated (impact of its use on the users)

The PSM result shows that the use of *Korra tef* variety positively and significantly impacts users' status of *tef* commercialization. As indicated in Table 25, the ATT is positive, and users were significantly (P<0.01) more commercialized than non-users by 23.43%. The result implied that the use of the *Korra tef* variety increased users' commercialization of *tef* by 23.43% more than the non-users. That is, users' commercialization rate is 23.43% higher than households in the matching control group. This result is consistent with the findings of (Degefa et al., 2022; Gebreselassie and Sharp, 2007; Mazengia, 2016), in which a positive and significant effect have observed from the use of improved *tef* varieties.

Table 25: Commercialization result of average treatment effect on the treated (ATT)

Variable	Sample	Treated	Controlled	Difference	S.E	T-stat
Commercialization	Unmatched	58.9251264	36.6980133	22.2271131	0.993288918	22.38
	ATT	58.9990815	35.5669668	23.4321147	1.240988	18.88

Source: Field survey, 2020

4.6.2.5. Sensitivity analysis

Sensitivity analysis is recommended for estimating unobservable biases from the result of the PSM (Liu et al., 2013). The results of the Rosenbaum bounds sensitivity analysis are shown in Table 26. A critical value known as e (Gamma) estimates the hidden bias's magnitude. For the outcome variable of household commercialization, the lowest critical value ($e\gamma$) that includes zero is 34.5 (95% confidence interval). This showed that to label the obtained result as sensitive to unobserved factors than inferring the impact of the use of the *Korra tef*, the user and non-user households should have been different up to 3350% ($e\gamma$ =34.5) in terms of unobserved covariates, which would appear improbable under normal circumstances. The result also implies that for the household commercialization status estimated at various levels of critical value $e\gamma$, the p-critical values are significant. This further indicates that important covariates that affected the outcome have been considered. Hence, the hidden bias magnitude confirms that significant differences between users and non-users in the commercialization of *tef* are insensitive to unobserved selection bias, in which the positive impact found could only be attributed to the use of the *Korra tef.*

Table 26: Rosenbaum bounds sensitivity analysis (Kernel matching algorithm, bandwidth = 0.1)

Outcome variable	*Gamma (hidden bias magnitude)	Significance level		Hodges-Lehmann point estimate		Confidence interval (95%)	
		upper bound (sig+)	lower bound sig-	upper bound (t-hat+)	lower bound (t-hat-)	upper bound (CI+)	lower bound (CI-)
Commercialization	1	0	0	24.4312	24.4312	23.3467	25.4169
	10	0.000048	0	14.9933	30.3394	11.5257	31.6954
	20	0.003644	0	11.6792	31.6587	5.89751	33.6658
	30	0.016628	0	9.55868	32.3805	2.15523	35.1593
	34	0.024047	0	8.89761	32.5849	0.284837	35.9246
	34.1	0.024245	0	8.8966	32.5949	0.124757	35.9605
	34.2	0.024443	0	8.88137	32.6042	0.007188	35.9716
	34.3	0.024642	0	8.86757	32.6115	0.005375	35.9821
	34.4	0.024841	0	8.84788	32.6194	0.000637	36.0288
	34.5	**0.025041**	**0**	**8.83937**	**32.6195**	**-0.043041**	**36.0364**
	34.6	0.025241		8.82634	32.6232	-0.075189	36.0475

* - gamma (Γ) - log odds of differential assignment due to unobserved factors

Note: The lowest critical value of gamma for 95% CI including zero is bolded.
Source: Field survey, 2020

4.7. Limitations of the study and areas for further studies

The lack of previous research on the study topic is the major limitation of this study. There are very few studies on the impact of adopting different *tef* varieties on the commercialization status of *tef* producer households in general and no similar research on our study topic in particular. This might impede the scope of the study under consideration. Thus, for a mature understanding of the commercialization impacts of *Korra tef* and to gain additional insight into its commercialization implications, future studies could address determinants of its use in the study area and/or other comparable areas. This would also help identify farmers' essential traits or actions linked to more dynamic paths of commercialization of *Korra tef*.

4.8. Conclusion and policy implications

Many studies have been conducted on the linkage of the use of an improved variety of *tef* seed and *tef* productivity and its contribution to households' income gain. However, a study on whether using an improved *tef* has contributed to users' commercialization status has received little attention. The empirical literature on the possible direction of a relationship between the use of *Korra tef* and smallholder commercialization is not found. Micro-level

information regarding the impact of using improved *tef* variety on the household commercialization status would be helpful for the design of pro-poor development policies and/or strategies. Hence, comprehending the impact of using improved crop varieties on smallholder commercialization is imperative in implying development policies and strategies that revolve around farm households' commercialization.

In this study, we consider households who used the AGP II introduced *Korra tef* variety as the treatment group from the AGP II intervention *woreda* and households who did not use *Korra* as the control group from the adjacent non-AGP II *woreda*. The average commercialization impact on the treated was estimated using the HCI for the descriptive analysis and PSM for econometrics analysis. Considering the volume of *tef* sold, the average level of commercialization of the sample households is 46.95%. The level of *tef* commercialization varies between user and non-user farm households, with the former accounting for 58.92% and the latter for 36.7%, respectively. The majority of the users, 190 (84.07%), lie in the category of commercialized farmers, while 144 (83.24%) of the non-users lie in the category of semi-commercialized farmers. The PSM estimate has also indicated that the use of the *Korra tef* variety has a positive and significant impact on user households' by which the rate of their *tef* commercialization was found to be 23.43% higher than non-users *tef* commercialization. This is indeed consistent with the qualitative finding in which it was alleged that using the *Korra tef* promotes the users' commercialization by enhancing their productivity and raising marketable surpluses of their *tef*.

The policy implication of our finding is that intensifying the use of improved varieties of *tef* (*i.e. Korra* in this case) is paramount to augment smallholders' productivity. This could support the commercialization of *tef* producers by creating a surplus of produce. Hence, policies, strategies, and programs to strengthen *tef* producer smallholders' linkage to the output markets should consider the supply of improved *tef* varieties with all required packages. The concerned government structures at all levels, in general, and the agricultural offices, in particular, need to encourage the use of improved varieties of *tef* by strengthening extension services, availing supportive agricultural technologies, and enhancing market access.

CHAPTER FIVE: Article four

5. Adoption of *Korra tef* (*Eragrostis tef*) and its Impact on Farm Households Welfare: a Propensity Score Matching Estimation in Central Ethiopia

5.1. Abstract

This study examined the impact of using Korra tef (Eragrostis tef) on farm households' welfare in Ethiopia. It was conducted with 479 farmers during the 2020 cropping season. Two hundred twenty-one were Korra users, and the remaining were non-users who used other alternative tef varieties like Boset, Dagim, Dursi, Flagot, Warekiyu, Hiber and Tesfa. Qualitative data were also collected from the pertinent key informants. The amount of tef production per hectare was used to measure household productivity, and a Household Commercialization Index (HCI) was used to determine the level of their commercialization. Welfare was proxied by measuring consumption per adult equivalent. One-way ANOVA was employed to investigate farmers' spending at various levels of commercialization. The Propensity Score Matching (PSM) method examined how the Korra tef impacted users' welfare compared to non-users. A strong correlation was found between the users' spending and commercialization. The use of the Korra tef showed a positive and significant impact on the expenditures of the users. Therefore, it is important to strengthen the value chain of tef and promote access to Korra tef. Governmental and non-governmental organizations should provide farmers with market-focused extension services to enable them to increase crop productivity and engage in the market, thereby enhancing their welfare.

Keywords: *Korra tef; Agricultural Growth Program II; Household welfare; Users; Non-users; Consumption expenditure*

5.2. Introduction

World agriculture will need to go through significant changes in the upcoming decades to fulfill the future food needs of a growing, increasingly wealthy, and urbanized population (Fan & Rue, 2020). In light of this, smallholder farmers are expected to play a significant role since they make up a sizeable portion of farmers worldwide and continue to be a major source of food and income for the world's rural population in general and the developing world in particular (FAO, 2014; Wolfenson, 2013). The study conducted by the Food and Agriculture Organization (FAO) of the United Nations indicates that 70-80% of the world's food is being produced by smallholder farmers who own less than two hectares of farmland and whose farm activities are primarily managed by family labor (FAO, 2014; Wolfenson, 2013) These farmers make up more than 60% of the population in sub-Saharan Africa, and they generate around 23% of the region's GDP (Goedde et al., 2019). Likewise, smallholder farming systems make up the majority of Ethiopia's agricultural sector (Diriba, 2020); smallholder farmers produce around 95% of the country's food crops, including cereals, pulses, oilseeds, vegetables, root crops, fruits, and cash crops (Gelaw, 2017). About 77.3% of the working force in the country still relies primarily on the crop subsector for their means of subsistence, and the crop subsector has been the major contributor to the overall growth of the agricultural sector (Wondimagegnhu et al., 2019). Considering these, smallholder farmers have been a focus of agricultural development programs by the Ethiopian government, development partners, and those in the private sector, partly due to increased pressure on farmlands and low agricultural productivity (Diriba, 2018b).

Massive pressure on agricultural land and the resulting low agricultural productivity highlighted the importance of using agricultural technologies (Kamara et al., 2019). In line with this, Ethiopia's rapidly shrinking farm sizes and low agricultural productivity have led to the assumption that encouraging the use of agricultural technology is one way to enhance smallholder farmers' capacity to meet food demand, reduce poverty, and improve the welfare of users through higher crop yields that result in higher consumption (Diriba, 2020; Feyisa, 2020; Zeng et al., 2017; Zerssa et al., 2021). For instance, the government has prioritized accelerated growth in agricultural production with a gradual shift towards high-value crops to improve people's well-being and reduce poverty (Mellor & Dorosh, 2010). As a result, the government and development partners have been working together to improve the welfare of farm households. The AGP II is one of these collaborative initiatives. AGP II is meant to support agricultural productivity and commercialization, thereby contributing to the higher-

level goal of food security by utilizing the untapped potential of well-endowed areas (MoA(b), 2015). Besides, the program's primary development goal is to increase the dietary diversity and consumption of the targeted smallholder farmers at the household level (MoA(a), 2015).

Given that food and non-food consumption are crucial elements of household welfare, AGP II's consumption-related target is closely tied to welfare (Deaton, 2005; Hentschel & Lanjouw, 2000). Therefore, it could be argued that improving the welfare of the beneficiary farm households is the program's very last goal. The program relies on using various agricultural technologies in the settings in which it intervenes. For instance, in the *Wara-Jarso woreda*, where there is a significant potential for crop production, it has introduced the genetically modified and high-yielding *tef* variety, *Korra*.

Despite introducing a new variety of *tef*, its impacts need to be thoroughly studied. The majority of impact studies focused on [staple] crops like maize (*Zea mays*), wheat (*Triticum Aestivum*), and horticulture crops (Aman et al., 2014; Amsalu, 2014; Edosa, 2018; Endalew et al., 2020c; Getahun et al., 2019; Negussie, 2020; Tesfaye et al., 2016; Wordofa et al., 2021). These studies examined how improved crop cultivation methods affected smallholders' livelihoods. Besides, these studies revealed that the productivity, income, and commercialization of smallholder farmers were shown to be significantly and positively impacted by improved seeds. Other studies (Asfaw et al., 2012; Biru et al., 2020; Endalkachew et al., 2014; Teka and Lee, 2020) have focused on the impacts of agricultural development programs and contemporary agricultural technologies on rural people's welfare, vulnerability, and poverty. Others focused on the welfare impact of improved food legume technologies (Degefu, 2016), the effects of nutrition-sensitive agriculture on the welfare of rural people (Shenggen et al., 2019), the effects of linking small-scale farmers to the wheat value chain on production and well-being (Biggeri et al., 2018), the impacts of cash crop production, and Moringa market participation on household welfare (Beyene, 2008; Garbero and Songsermsawas, 2018; Mezgebo et al., 2014; Natnael, 2019a; Ruder, 2018; Weldemeskel et al., 2020). Few studies (Beyene, 2008; Gezahegn et al., 2019; Natnael, 2019a; Samuel and Kay, 2008) have examined the impacts of improved *tef* seed varieties on farmers' production, income, and livelihood. The effectiveness of two improved *tef* varieties (*Tseday* and *Boset*) has also been studied (Kebede & Korji, 2017). Previous studies on *tef*'s improved varieties rarely examine the *Korra* variety. When it comes to varieties other than *Korra* (such as the

Tseday and *Boset tef* varieties), it has yet to estimate how those impacts will affect farmers' productivity, income, and commercialization. Therefore, this study aims to investigate how using the *Korra tef* variety has impacted the welfare of user farm households in *Wara-Jarso woreda*, Central Ethiopia.

This study is expected to contribute by providing a micro perspective on the impacts of *Korra tef* [as one form of agricultural technology] on the welfare of smallholder farmers, with a focus on the area that predominately grows *tef*. It will specifically contribute to the literature in three ways: It will first contribute to the body of empirical research on the impact of *Korra tef* on farm households' welfare. Second, most earlier studies solely examined consumption to determine how improved seed varieties affected welfare. Before estimating the impact through consumption expenditures, this study examined the farm households' productivity, income, and level of commercialization. It also examined the correlation between these levels of commercialization and consumption expenditures. This makes our analysis more thorough. Third, to the researchers' knowledge, this study is the first to use comprehensive lists of farm households' consumption. This, in turn, enables us to have the relatively best welfare measure. The study is particularly significant for Ethiopia since crop production accounts for about 23.8% of the country's GDP (Mellor & Dorosh, 2010). The study will also contribute to understanding smallholder farmers' welfare dynamics. In doing so, it can also provide feedback for agricultural development initiatives like AGP II. Overall, given that *tef* accounts for the largest area cultivated under all cereals, accounting for 29.5% of the total cultivated area and 19.7% of total cereal production (Diriba, 2020), the results of this study can help by providing useful information for setting priorities for redesigning existing agricultural development programs as well as for the development of agricultural policies and programs aimed at enhancing household welfare.

5.3. Conceptual framework

The conceptual framework shown in Figure 12 is based on the relevant literature on the impact of adopting improved crop seeds on farm households' welfare and the researchers' understanding of the same in the study area. The characteristics of farm households on the left side were chosen as the reasonably common variables among the comparison groups. AGP II allegedly introduced the *Korra tef* to increase output and commercialization. According to the studies by (Abate et al., 2018; Natnael, 2019a; Tesfaye et al., 2016), the utilization of crop technologies has increased the productivity and income of smallholder

farmers. Additionally, a positive correlation exists between crop technology use and farm households' crop commercialization (Afework & Endrias, 2016; Assefa, 2022). The commercialization of smallholders is also believed to increase household members' food consumption, which may enhance their dietary and health status (Ogutu et al., 2020). In general, increasing smallholder production and commercialization are considered ways to increase household consumption as measured by factors like household income, food, nutrition status, health, and the like (Osmani et al., 2014). On the other hand, this implies the presence of interconnectedness among the use of agricultural technology, agricultural productivity, and commercialization (Adejobi & Akinola, 2013; Asfaw et al., 2012; Krause et al., 2019).

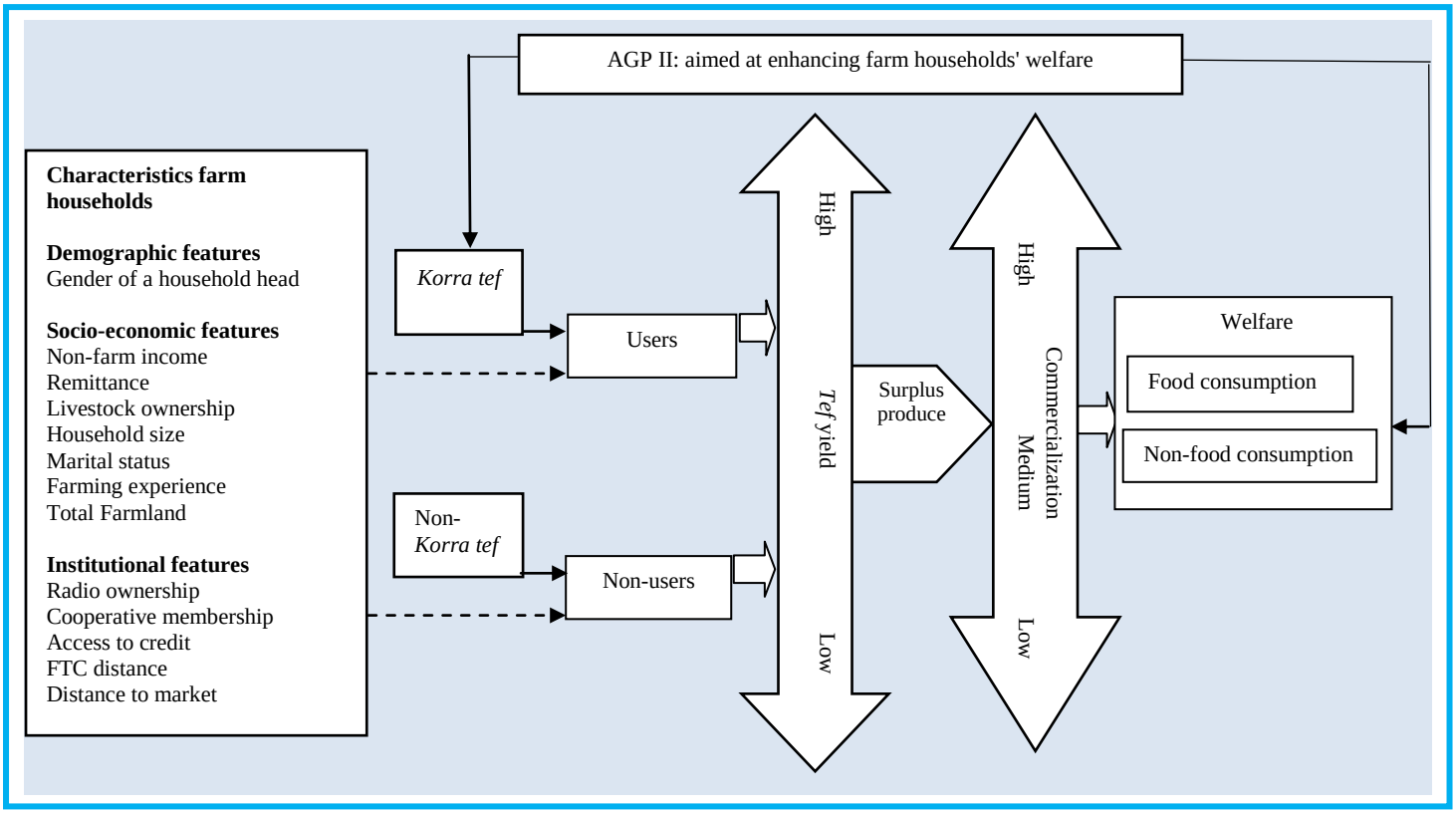


Figure 12: *Korra tef* use and farm households' welfare
Sources: Author's construction

5.4. Research methodology

5.4.1. Research design

The study used a mixed research approach and a cross-sectional survey design. Both the explanatory and descriptive purposes were taken into consideration. The Concurrent Embedded Strategy, one of the mixed research methods, was employed, using the

quantitative data as a guide and the qualitative data embedded into it to support its interpretation (Creswell & Creswell, 2017). Quantitative data analysis was done using the STATA version 16 software package. Below is an explanation of the specifications for the descriptive and econometric models used in the analysis.

5.4.2. Sampling procedures and data sources

The target population for this study was the *Wara-Jarso woreda*'s *Korra tef* growers during the 2020 cropping season. A multistage sampling technique (*i.e*. a three-stage sampling procedure) was used to select a study *woreda, kebeles,* and sample households. Two *woredas, Wara-Jarso* and *Kuyu,* were purposefully chosen for the initial stage. Based on its use of the *Korra tef* variety introduced by AGP II, the *Wara-Jarso* woreda was designated as the treatment *woreda*. Due to its similarities to the treatment woreda, the absence of AGP II interventions and *Korra tef* variety, *Kuyu woreda* was designated the control group. Thus, the latter was used to compare the results of farm households in the treated group and estimate the counterfactual from a sample of eligible non-participants. The *woredas* were divided into major agro-ecological zones to ensure sample representativeness. Two *kebeles* were chosen from each major agro-ecological zone by grouping the *kebeles* located in each agro-ecological zone as high and medium *tef* producers (*i.e. Korra tef* in the treatment *kebeles* whereas non-*Korra tef* in the control *kebeles*). Hence, twelve *kebeles*, six from the treatment group and the other six from the control group, were considered for the study. The sample size was finally determined using Yamane (1967) sample size calculation formula at the acceptable level of precision of 95% due to the finite size of the population under study (Equation 1). Four hundred seventy-nine farm households in total were selected. Two hundred twenty-one farm households were selected from the treatment group. The remaining 258 were selected from the control group to use an impact assessment model and establish a balance between the two groups. A systematic sampling technique was used to choose samples from the sampling frames of both *woredas.* As shown in Table 1, the sample sizes for each *kebele* were calculated using the PPS technique.

The survey data were collected in September and October, 2020 using a structured questionnaire administered by trained enumerators. The questionnaire was initially developed in English, translated into *Afan Oromo*, and interviewed by the latter. The questionnaire was pre-tested, and a pilot study was conducted to ensure the validity of the data collection instrument and the dependability of the data gathered. One DA from each agro-ecology zone,

six *Korra tef* producer farmers (two farmers from each agro-ecology labelled as high and medium producers), the study *woreda*'s AGP II coordinator, zonal AGP II facilitator, and regional AGP II monitoring and evaluation officer were on the other hand considered KIIs for the qualitative data. The study's lead investigator conducted the interviews with the stated key informants using interview guides simultaneously during the quantitative data collection. In addition, for secondary data, documents from the AGP II coordination office of the study *woreda*, relevant journal publications, and websites were reviewed.

5.4.3. Tools and techniques of data analysis

5.4.3.1. Measuring household welfare

The potential levels of material living standards are often measured in income and wealth. In contrast, actual levels are measured by consumption or spending during a particular time (OECD, 2013). Besides, consumption is considered a better measure of welfare as it is easier to understand conceptually, less sensitive, and more accurate (Berik, 2018). As to this study, since data collection on households' assets and liabilities is difficult for reasons such as greater sensitivity and differences in accounting periods and reporting units, consumption expenditure is relatively more stable over time. This is consistent with Grootaert (1986)'s suggestion that an expenditure dataset of sample households is considered an adequate measure of household welfare [particularly in developing countries] as it can better capture a household's consumption capabilities. More importantly, Dercon et al. (2009) argued for the reliability of consumption expenditure since it is less prone to measurement errors and seasonal fluctuations. For Atkinson (1992), the data for consumption expenditure reflects a household's decision on nutrition and health. By building on these rationales, this study considers farm households' consumption as a proxy indicator of their welfare. Accordingly, the consumption expenditure adjusted by the number of nutrition (calorie) based adult equivalents (Appendix F) was used as a measure.

However, measuring consumption is not easy because it (consumption) should be comprehensive to obtain a good measure of welfare; in a way, it includes consumption of food and non-food items, housing expenditures, and consumer durables (Deaton, 2005). Hence, to capture as much consumption as possible and learn the approximate welfare impacts of adopting *Korra tef* variety, data on consumption were considered in detail as presented under the two broad categories of food and non-food consumption (see Table 27). The consumption expenditure data obtained were for the preceding 12 months upon the data

collection. The welfare of farm households in Ethiopia and overseas has been measured by prior studies using their consumption expenditures, including studies by (Ahmed, 2017; Ahmed & Mesfin, 2017; Awotide et al., 2016; Gebreselassie & Sharp, 2007; Mossie et al., 2021; Osmani et al., 2014).

Studies have shown that commercialization significantly impacts smallholder farmers' welfare (Amsalu, 2014; Camara, 2017; Krause et al., 2019; Weldemeskel et al., 2020). Additionally, it is stated that commercialization is assumed to increase household members' food consumption through the income-food-consumption linkage (Awotide et al., 2016). The HCI was used first to determine the degree of commercialization of the farm households under study. The index measures the proportion of the total value of agricultural produce attributable to sales. The formula for the index, which was taken from (Von Braun, 1995), is mathematically represented as:

$$\text{HCI} = \frac{\text{Gross Value of } Korra \text{ variety } tef \text{ sale of farmer i at year j}}{\text{Gross Value of all } Korra\ tef \text{ production of farmer i at year j}} \text{x100} \dots\dots\dots\dots\dots [11]$$

Where HCI is the percentage representing the ratio of the total value of sales to the total value of *tef* production. Household Commercialization Index has a value that ranges from 0 to 100, inclusive. A value closer to zero and one hundred indicates households primarily focused on subsistence and commercialization-based, respectively (Gebremedhin & Jaleta, 2010; Govereh et al., 1999). Every household's level of commercialization is provided independently by the index. The households were divided into three categories based on market orientation to determine the commercialization level: subsistence, semi-commercial, and commercial. In a system known as subsistence farming, the focus is on the household and maintaining food self-sufficiency. Semi-commercial farmers are more inclined to gain marketable surplus while maintaining the food security of their households. Commercial farmers are more motivated by profit maximization than by maintaining household food security (Tesso, 2016). One-way ANOVA was used to examine the welfare impacts of *tef* commercialization of farm households following the approach used by (Gebreselassie & Sharp, 2007; Osmani et al., 2014). The categories of food and non-food consumption expenditures of the users and non-users were compared in line with their levels of commercialization.

Table 27: Consumption expenditures considered for calculating household welfare

Consumption category (ETB/person/annum)	
Food	**Non-food**
Cereals	Safe and potable water
Vegetables	Cooking fuel and electricity
Animal and animal products	Health (human and animal)
Other food items	Schooling
	Consumer durables
	Production equipment/farm implements
	non-land assets
	Personal care items and social and religion-based activities
	Other non-food items

Source: The authors' list of consumption based on welfare literature, and contextualized for the study area.

The quantitative data analysis was done using the STATA version 16 software package. Below is an explanation of the specifications for the descriptive and econometric models used in the analysis.

5.4.3.2. Descriptive statistical analysis

Mean, standard deviation, proportions, frequency and percentages were used as descriptive statistical analysis tools. The Chi-square (x^2) test, t-test and F-test were used to assess the extent of crop commercialization and determine whether user and non-user farm households differed in any way that could be statistically verified.

5.4.3.3. Econometric analysis

The welfare of farm households was examined using the PSM technique. The *Korra tef* variety was adopted through the program placement (*i.e.* AGP II). This makes it impossible to assign the subjects for the treatment randomly. As a result, we focused on estimating the ATT). The following is how the ATE is determined:

$$\tau ATE = E[Y|X, d = 1] - E[Y|X, d = 0] \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots [12]$$

The (τATE) assumes that the consumption level of non-users at the time of data collection E (Y_0 |D=0) may be roughly compared to that of users before their use E (Y_0 |D=1). However, it is not easy to estimate ATE using the given method because we only observe E (Y_1 |D=1) and E (Y_0 |D=0), not E (Y_0 |D=1). They would also be less likely to be statistically equivalent to the comparison group due to the potential for biased estimation resulting from program placement (self-selection bias). The PSM, which Rosenbaum and Rubin (1983) defined as the

conditional probability of receiving a treatment given pre-treatment characteristics, was used to remove this bias.

$$p(x) = P_r[d = 1|x] = E[d|x] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [13]$$

Where, d = {0, 1} is the indicator of exposure to treatment and
x is the multidimensional vector of pre-treatment characteristics.

The CIA and the CSC must be met for the PSM method's results to be reliable. When matching, the assumptions were considered. For instance, users and non-users with substantial overlap or a common support region were considered for matching. The major matching algorithms, including nearest neighbour, radius, caliper, and kernel, were used to obtain adequate common support and for an optimal estimation procedure.

As the basic requirement for the PSM, the variables unaffected by whether or not people adopt were selected (Heckman et al., 1997) (see Table 3). The VIF and C tests were then used to determine whether multicollinearity among the chosen variables was likely to exist. Additionally, a probit regression model was used to estimate the p-score of the selected variables after checking for multicollinearity issues. The findings and discussion section presented detailed discussions on the PSM procedures.

5.4.4. Definition of variables and working hypothesis

The welfare of farm households was considered the study's dependent variable, and it was calculated using their consumption level. Adopting the *Korra tef* variety was treated as the study's treatment variable. Based on the conceptual and empirical literature, the variables listed in Table 3 were found to impact the farm households' consumption, making them the study's independent variables.

5.5. Results and discussion

5.5.1. Descriptive results

The analysis covers 479 households in total, of whom 221 (46.14%) were users of the *Korra tef* variety, and 258 (53.86%) were non-users of the *Korra tef* variety who used other alternative *tef* varieties like *Boset, Dagim, Dursi, Flagot, Warekiyu, Hiber* and *Tesfa* in 2020. The statistical analysis of the chi square-test distribution for the study's dummy and

categorical variables is shown in Table 4. Accordingly, statistically non-significant differences were observed in the gender of the household heads of the two groups (p=0.240) and their access to credit (p=0.858). However, the two groups were significantly different in their marital status (p=0.045), access to information (p=0.030) (as determined by radio ownership), and cooperative membership (p=0.003). The study by Biyase and Zwane (2018) indicated that the household heads' marital status significantly impacts their well-being. Another study has also shown that access to information positively impacts smallholder farmers' well-being (Haile et al., 2019). Besides, previous studies have shown that joining agricultural cooperatives positively impacts smallholder farmers' well-being (Ahmed & Mesfin, 2017; Mojo et al., 2017).

Table 5 shows the statistical analysis of the study's t-test for continuous variables. The differences between the groups were statistically significant in all the continuous variables ($p<0.05$), except for the incomes they earned from non-farm activities (p=0.4072). According to earlier studies (Alemu and Adesina, 2017; Bacha et al., 2011), farm experience, total land and livestock ownership, remittances, market access, and FTC have all positively impacted the level of household consumption. The same is likely true for the welfare of the farm households under study. However, household size negatively impacts their welfare (Alemu, 2011; Mekonnen, 2017; Teka & Lee, 2020). Overall, the simple descriptive statistics revealed that many of the factors listed in Tables 4 and 5 were statistically different between the user and non-user groups.

The very objective of this study is to measure the welfare status of farm households. However, it is imperative to look at their crop production per hectare, income, and degree of commercialization before measuring their welfare because the literature has shown that these factors are still primarily necessary for farmers' welfare outcomes (Gebreslassie et al., 2015; Krause et al., 2019; Muriithi & Matz, 2015; Osmani et al., 2014; Poulton, 2017).

5.5.1.1. *Tef* yield and income

The average *tef* yield was 2037.63 quintals for users and 1434.26 quintals for non-users. A significant difference between the yield gains was found at 1%. Users consistently reported higher *tef* income at the same significance level (Table 8).

5.5.1.2. Categories and levels of commercialization of *tef* producers

Following (Samuel and Kay, 2008; Tadele et al., 2017) studies, smallholders' commercialization was classified into three categories: less-commercialized farmers sold up to 25% of their output, semi-commercialized farmers sold between 25% and 50% of their output and commercialized farmers sold more than 50% of their produce. As per the results indicated in Table 24, the majority of users (84.07%) fall in the category of commercialized farmers, whereas the majority of non-users are semi-commercialized farmers. In the group of less commercialized farmers, there are much more non-users than users (exceeding 97.5%). The above-stated commercialization categories' data suggest users engage in *tef* marketing more than non-users.

As can be seen in Table 24, the sample households' average HCI was 46.95%, meaning they had sold about 47% of the *tef* produced during the 2020 cropping season. This result is consistent with earlier studies (Assefa, 2022; Degefa et al., 2022; Eshetu, 2018; Getahun et al., 2019). The amounts of *tef* produce sold differ between the two categories. About 59% of the produce grown by users was sold, compared to only about 37% by non-users. This shows that the users had the highest level of *tef* commercialization when comparing the two groups. The key informants have also confirmed *Korra tef*'s role in their higher commercialization status. Figure 11 provides more clarification by depicting the degree of engagement in the *tef* market of the two groups; users, represented by red colour, and non-users, represented by blue.

The general expenditures noted from the literature are computed based on the consumption per adult equivalent. Considering the face values of the farm households' expenditures, the t-test result showed statistically significant differences between the two groups in the total yearly expenditures at $p<0.01$, as shown in Table 28. This shows that the user group's average annual expenditures far outpaced the non-users regarding food and non-food consumption.

Table 28: The average expenditures of farm households

Category	Types of consumption	Household type			t (p-value)
		Users (ETB/person/annum)	Non-users (ETB/person/annum)	Combined (ETB/person/annum)	
Food	Cereals	11660.93	7523.044	9432.172	-19.5409 (0.0000***)
	Vegetables	5734.542	4371.718	5000.495	-12.2227 (0.0000***)
	Animal and animal products	4884.769	3443.874	4108.671	-6.2458 (0.0000***)
	Other food items	1157.887	637.438	877.5619	-3.4187 (0.0007***)
	Total food	23438.13	15976.08	19418.9	-15.2708 (0.0000***)
Non-food	Safe and potable water	80.15437	70.36431	74.88123	-3.8123 (0.0002***)
	Cooking fuel and electricity	162.0874	143.6173	152.139	-4.2465 (0.0000***)
	Health (human and animal)	355.7955	279.8092	314.8676	-1.5941 (0.1116)
	Schooling	601.9302	523.4925	559.6819	-3.4272 (0.0007***)
	Consumer durables	540.8616	472.4895	504.0349	-1.0974 (0.2730)
	Production equipment/farm implements	260.2021	182.5121	218.3565	-1.9697 (0.0495**)
	non-land assets	1173.288	906.1121	1029.381	-3.5805 (0.0004***)
	Personal care items and social and religion-based activities	1810.549	1276.977	1523.155	-12.9622 (0.0000***)
	Other non-food items	136.4982	76.14478	103.9905	-2.5287 (0.0118**)
	Total non-food	5121.366	3931.518	4480.488	-6.9951 (0.0000***)
	Total	28559.49	19907.59	23899.39	-14.7294 (0.0000***)

***p<0.01; **p<0.05; Standard errors in parenthesis

Source: Field survey, 2020

The t-test was again used to examine the aggregate consumption outcomes of farm households in line with the category of their commercialization. Comparisons were made between the two groups in each HCI category. Consequently, it was found that except for the non-food consumption for the households at the medium level of commercialization, the consumption levels between users and non-users were significantly different in the remaining food, non-food, and aggregate consumptions identified for the study (Table 29). This could mean users consume more than non-users, regardless of whether they live in low, medium, or high levels of commercialization, indicating a greater welfare status.

Table 29: The average expenditures of farm households (ETB/person/annum) vis-a-vis the HCI

Consumption category	HCI											
	Low				Medium				High			
	Users	Non-users	Combined	t (p-value)	Users	Non-users	Combined	t (p-value)	Users	Non-users	Combined	t (p-value)
Food	29460.5	14750.12	15117.87	-7.3210 (0.0000***)	24151.48	16196.95	17530.37	-8.3940 (0.0000***)	23265.85	17749.06	22387.07	-4.8132 (0.0000***)
Non-food	4908.5	3714.69	3744.53	-1.7034 (0.0925**)	4374.86	3958.146	4028	-1.2957 (0.1968)	5237.574	4294.806	5087.39	-2.3259 (0.0209**)
Total	34369	18464.69	18862.3	-6.9214 (0.0000***)	28526.31	20155.13	21558.39	-7.5732 (0.0000***)	28503.42	22043.89	27474.47	-4.6048 (0.0000***)

***p<0.01; **p<0.05; Standard errors in parenthesis

Source: Field survey, 2020

A one-way ANOVA test is conducted to examine farm households' welfare outcomes, categorized under three levels of *tef* commercialization. The user group's F-test result of (F=0.60; P= 0.5478) indicates that the difference in households' total expenditures on food and non-food items across the three commercialization categories was statistically insignificant. However, the differences between the mentioned commercialization categories were statistically significant at the 1% significance level (F=6.22; P= 0.0023) for the non-users; and their consumption showed an unswerving increasing pattern along the commercialization index, from low to high (Table 30). The result of the latter group suggests that with the mentioned consumption items, the higher the degree of commercialization, the more they invest in consumption.

The user group's one-way ANOVA test result was found to be inconsistent, while the non-user group's result was consistent with the earlier studies by (Gebreselassie and Sharp, 2007; Osmani et al., 2014), in which farm households at different levels of commercialization showed statistically significant variation in welfare outcomes (represented by expenditures) in both cases. The users' comparable consumption patterns among the three categories of commercialization could be attributed to the presence of AGP II at the treatment district because nutrition and dietary diversity were among the intervention pillars of the program by which various awareness-creation activities were conducted to improve the consumption patterns of the user farm households. The key informants' testimonies support this claim by stating that the AGP II frequently provided awareness-raising activities on consumption in general and nutrition and dietary diversity in particular for all users of *Korra tef*, which led to a notable change in their consumption habits. This implies that nutrition and dietary diversity activities done on the users positively contribute to their consumption irrespective of their commercialization statuses.

Even though no significant differences in total expenditures were observed within the user group along their commercialization index (the F-results shown in Table 30), the t-test result revealed a statistically significant difference at the 1% significance level (p=0.0000) between the users and non-users in their average total expenditures of both food and non-food items (Table 28). This entails that the users invested more money in consuming various items than the non-users. As a result, it could be inferred that keeping other factors unchanged, the user farm households' welfare improves compared to the non-users. Overall, these outcomes suggest that if welfare improvement of farm households is envisaged via the use of improved

tef seed, strategies and methods for consumption enhancement should be developed in addition to the requirement for an effective and efficient *tef* marketing system. It is also implied that comprehensive strategies for enhancing consumption should be tailored to reach farm households at various stages of commercialization.

Table 30: One-way ANOVA result for a comparison of expenditures of farm households with their commercialization level

Consumption	Expenditure items	Average expenditures of the users (ETB/person/annum)					Average expenditures of the non-users (ETB/person/annum)				
		HCI			F (Prob > F)		HCI			F (Prob > F)	
		Low	Medium	High			Low	Medium	High		
Food	Cereals	15067	11696.83	11619.62	1.87	(0.1563)	6948.71	7647.08	8271.13	5.56	(0.0043***)
	Vegetables	7254.5	6212.65	5645.53	3.71	(0.0261**)	4310.08	4336.59	4645.61	1.29	(0.2783)
	Animal and animal products	5920.5	5182.24	4828.49	0.35	(0.7019)	3063.79	3505.87	4019.08	2.23	(0.1101)
	Other food items	1218.5	1059.75	1172.22	0.04	(0.9609)	427.33	707.32	813.08	1.60	(0.2045)
	Total food expenditures	29460.5	24151.49	23265.85	1.23	(0.2941)	14750.11	16196.95	17749.05	6.06	(0.0027***)
Non-food	Safe and potable water	93.5	77.28	80.43	0.36	(0.6979)	51.67	75.92	88.86	38.80	(0.0000***)
	Cooking fuel and electricity	165.5	158.34	162.65	0.10	(0.9048)	138.68	142.08	160.36	2.98	(0.0526**)
	Health (human and animal)	54.5	291	368.88	0.66	(0.5177)	206.85	328.45	243.36	1.42	(0.2448)
	Schooling	651	540.55	610.75	1.12	0.3269	527.81	521.35	522.63	0.02	(0.9842)
	Consumer durables	387.5	346.65	572.14	1.02	(0.3618)	420	488.77	521.25	0.56	(0.5720)
	Production equipment/farm implements	798	213.65	261.65	1.23	(0.2942)	338.84	100.88	170.36	13.09	(0.0000***)
	non-land assets	804.5	912.21	1217	1.18	(0.3093)	723.01	952.87	1115.55	8.49	(0.0003***)
	Personal care items and social and religion-based activities	1840	1788.68	1813.58	0.05	(0.9521)	1234.52	1265.65	1414.33	1.88	(0.1548)
	Other non-food items	114	46.66	150.44	1.22	(0.2972)	73.12	82.25	58.36	0.29	(0.7497)
	Total non-food expenditures	4908.5	4374.86	5237.57	1.89	(0.1533)	3714.69	3958.14	4294.81	2.05	(0.1314)
	Total	34369	28526.31	28503.42	0.60	(0.5478)	18464.69	20155.12	22043.88	6.22	(0.0023***)

***p<0.01; **p<0.05; Standard errors in parenthesis

Source: Field survey, 2020

However, these comparisons did not account for the effects of other characteristics of farm households. In other words, the observed differences cannot be exclusively attributed to the use of *Korra tef* due to the issue of selection bias and non-compliance (Heckman & Vytlacil, 2005). Therefore, we used the PSM method to examine how the use of *Korra tef* has impacted the welfare of farm households.

5.5.2. Impact of the use of *Korra tef* on the user farm households' welfare (Consumption per adult equivalent)

Hypothesis: Using the *Korra tef* variety improves the welfare status of user farm households.

As can be seen from Table 9, the continuous variables have a VIF of less than 1.21 and a mean value of 1.09; while the discrete variables C were close to zero (Table 10). These results demonstrated that the variables are free of multicollinearity issues, enabling us to run further regression.

5.5.2.1. Estimation of propensity score

The results shown in Table 11 that users and non-users differed statistically in all variables - apart from gender, marital status, access to credit, and income from non-farm activities - indicate that confounders needed to be corrected before ATT estimates.

5.5.2.2. Testing the balance of propensity score and covariates

After matching was completed, a statistically insignificant correlation was found between the control and treatment groups. Then, the imbalance between them was minimized by lowering the percentage of bias from ranges of 1.6 and 45.6 before matching to ranges of 0.2 and 6.8. As a result, the proportion of bias has decreased below the acceptable cutoff value of 20% (Rosenbaum & Rubin, 1983). Table 12 shows a comparison of the variables before and after matching. Selecting a matching algorithm comes next once the covariates have been balanced.

5.5.2.3. Choice of the Matching Algorithm

All matching estimators that satisfy the PSM assumptions that the mean bias and β values should be less than 5% and 25%, respectively (Rubin, 2001), were performed to test the results' robustness and to find a better estimation algorithm (Table 13). The algorithm we chose, Kernel estimation with Bandwidth (0.1), has the lowest Ps R^2, mean bias, and B and R values. A lower Ps R^2 shows the absence of the users' distinctive characteristics (Caliendo &

Kopeinig, 2008). The results from other matching algorithms were comparable to those from the Kernell estimation algorithm with Bandwidth (0.1).

The calculated propensity score for the entire sample ranges from 0.0007765 to 0.9636034 and has a mean of 0.4580324. The p-scores for users range from 0.0653953 to 0.9636034, while those for non-users range from 0.0007765 to 0.8932305 (Table 14). Observations whose propensity scores are beyond the range of 0.065 and 0.893 are excluded from the sample using the Minima and Maxima criterion of the common support region, where the values of both groups can be obtained (Heinrich et al., 2010). Fortunately, only six observations in all matching estimators reported in Table 14 are beyond the common region support.

Figure 5's display of the wide common region support and the relatively reasonable distribution of p-scores between the treatment and control groups suggest a fair balance between the groups. This led to estimating the treatment's impact on the group under treatment.

5.5.2.4. Estimating treatment effect on the treated (impact of its use on the users)

Table 31 shows the estimation outcome for the ATT of the outcome variable using the Kernell estimation algorithm with Bandwidth (0.1). The impact estimate demonstrates that the use of the *Korra tef* variety has a positive and significant impact ($P<0.01$) on user farm households' welfare as measured by annual consumption expenditure per adult equivalent (9562.23 ETB). According to the findings, adults who are members of the user group consume 9562 ETB more on average than those who are members of the non-user group. This result is consistent with (Mulugeta and Hundie, 2012), who examined the impact of the utilization of improved wheat technologies on households' food consumption in Southeastern Ethiopia; (Asfaw et al., 2012), who looked into the welfare (consumption) effects of improved crop varieties; (Degefu, 2016), who investigated the welfare impact of improved food legume technologies; and (Awotide et al., 2016), who examined the impact of adopting improved rice varieties on total household expenditure (a proxy for welfare).

Table 31: Total expenditures per adult result of average treatment effect on the treated (ATT)

Variable	Sample	Treated	Controlled	Difference	S.E	T-stat
Total expenditures per adult	Unmatched	28559.4909	19907.5933	8651.89761	587.389419	14.73
	ATT	28669.2685	19107.0384	9562.23014	693.601734	13.79

Source: Field survey, 2020

5.5.2.5. Sensitivity analysis

Sensitivity analysis is used in observational studies to overcome the problem of uncontrolled confounding and assess how robust the PSM results are (Li et al., 2011; Liu et al., 2013). Based on this, the PSM result is subjected to a Rosenbaum bounds sensitivity analysis. The analysis result in Table 32 indicates that the lowest critical value (Γ) that includes zero for the outcome variable of total expenditures per adult is 20.9 (95% confidence interval). This shows that for the PSM result to be sensitive to unobserved effects, the two groups should have been dissimilar up to 1990% (e =20.9) in terms of unobserved covariates, which is unlikely to occur in the studied settings. This hidden bias magnitude result exhibits that the significant result in total expenditures between users and non-users is insensitive to unobserved selection bias, suggesting that adopting the *Korra tef* variety is exclusively responsible for the positive impact revealed.

Table 32: Rosenbaum bounds sensitivity analysis (Kernel matching algorithm, bandwidth = 0.1)

Outcome variable	*Gamma (hidden bias magnitude)	Significance level		Hodges-Lehmann point estimate		Confidence interval (95percent)	
		upper bound (sig+)	lower bound sig-	upper bound (t-hat+)	lower bound (t-hat-)	upper bound (CI+)	lower bound (CI-)
Total expenditures per adult	1	0	0	8754.23	8754.23	7926.92	9526.92
	10	0.000315	0	4135.77	16020.3	2822.2	19938.7
	20	0.021162	0	2870.52	19753.2	241.567	27514.3
	20.8	0.024966	0	2795.37	20041.2	6.21078	27727.2
	20.9	**0.025465**	**0**	**2785.63**	**20075.2**	**-42.2358**	**27798.7**
	21	0.02597	0	2778.98	20081.9	-58.2476	27824.8

* - gamma (Γ) - log odds of differential assignment due to unobserved factors

Note: The lowest critical value of gamma for 95% CI including zero is bolded.
Source: Field survey, 2020

5.6. Conclusion and recommendations

This study sought to shed light on the argument that using improved crop seed varieties may improve the welfare of the users by examining the welfare impact of using*the Korra tef*

variety. The *tef* yield and corresponding income of the user farm households were first examined, and their *tef* commercialization level was investigated using HCI. The amount spent on consumption by the users at various levels of commercialization was then examined. Finally, the PSM model was used to investigate the welfare impact of using *Korra tef*. The result showed that using *Korra tef* has positively impacted productivity (yield per hectare) and income (net income). The mean commercialization percentage for the studied farm households was 46.95%, indicating a moderate level of commercialization. However, the degree of commercialization varies between users and non-users, with the former falling into the commercialized (58.92%) and the latter into the semi-commercialized (36.7%) categories. With a relatively high level of commercialization, users had a markedly high annual expenditure per adult equivalent than non-users, implying a better welfare status from using *Korra tef.*

Hence, to improve the welfare of *Korra tef* user households, development policies and strategies aimed at introducing *Korra tef* should promote its productivity and commercialization and other supportive consumption enhancement activities. Detailed consumption enhancement strategies should also be customized in a way it touches farm households that potentially lie in different degrees of commercialization. In its broader sense, activities that encourage smallholder farmers' *tef* market access and participation, like extension services and market linkages, should be in focus while building and designing agriculture-based institutional support programs. Access to credit and rural savings should also be encouraged to promote smallholders' participation in commercial crops. Since *Korra tef users* were found at different levels of commercialization, scaling up the best practices of the users to other farmers can also be considered for area-specific recommendation while introducing new *tef* varieties.

Lastly, since the ATT values may exhibit a significant variation based on farm households' demographic, socio-economic, and institutional factors, further research is needed on the heterogeneous welfare effects of adopting *Korra tef*. This would aid in thoroughly understanding the differential impacts of adopting *Korra*. Furthermore, the determinants of *Korra tef* use in tandem with consumption should be investigated. This may help identify key characteristics or behaviours of farm households associated with more dynamic welfare paths.

CHAPTER SIX: Article five

6. Effects of Common Interest Groups on rural women and youth livelihood: A qualitative study from Central Ethiopia

6.1. Abstract

This study examined the effects of the Common Interest Group (CIG) on the livelihood of rural women and youth in the selected areas of the Wara-Jarso woreda, Central Ethiopia. The study focuses on the activities of the CIGs, their effectiveness, Strengths, Weaknesses, Opportunities, and Threats, along with the changes in the livelihood status of CIG members. Four CIGs that fit the study's aim were purposively selected from the CIGs operating in the woreda. Among a qualitative research approach, a case study was employed. The data were collected from January 1, 2021 to February 28, 2021. Primary data were gathered using Focus Group Discussions and Key Informant Interviews. A thorough desk review of official documents and other secondary sources was made as an auxiliary method to capture sets of relevant information. The MAXQDA 2020 qualitative data analysis package program did the data organization. The data were analyzed using thematic, relational, and content analysis methods. It was found that the CIGs have encouraged strong social capital among members and become an important alternative financial source. It was also found that the CIGs operation has encountered problems related to a lack of entrepreneurial education and skill training, monitoring and evaluation, workplace, coordination among stakeholders, adequate and proper financial use, and non-existence of market linkage. The CIGs' strengths, weaknesses, and opportunities were also indicated. For successful rural women and youth livelihood change through the CIGs scheme, the study recommends access to entrepreneurial skill training, coordination among relevant stakeholders, intense monitoring and evaluation, market linkage and workplace access, and adequate funding.

Keywords: *Agricultural Growth Program, Common Interest Group, Women and youth, Rural livelihood change, Case study, Ethiopia*

6.2. Introduction

Ethiopia is one of the most populous countries in Africa, with an estimated 104 million people. More than 28% of its population is between the ages of 15 and 29, and about 41% are under 15. Despite this high proportion of Ethiopian youth, youth unemployment has remained a great challenge for the country (USAID Fact sheet, 2017). Landlessness and lack of job opportunities in rural areas often lead to a rise in migration to urban areas (SNV, 2021). Even though most young people in developing nations desire to alter their current employment status, they want to avoid working in agriculture, exacerbating rural unemployment (OECD, 2018). Bezu and Holden (2014) found that only 9% of the rural youth in Ethiopia plan to pursue agriculture as their livelihood. Rural youth's limited access to agricultural land is one of the pushing factors that compel them to abandon agriculture in search of other livelihoods. It is also reported that despite their crucial roles in the rural economy, women face inequalities and challenges that hinder their access to decent work opportunities and improvements to their productivity (ILO, 2019).

Despite the long-held problems of landlessness, negligible rural job creation, and limited non-farm job opportunities constraining rural youths from having their share, agriculture remains an important livelihood for most youths (63%) and the overall population (Schmidt & Woldeyes, 2019). Job creation is thus one of the most urgent issues for the country's development. Many initiatives have been put in place by the government, NGOs, communities, and individual entrepreneurs in agriculture to encourage young people to entrepreneurship and job creation for self-employment. In line with this, the CIG scheme has been under implementation for rural youth and women through a collaborative effort between the government and NGOs under the program named AGP. The CIG is intended to augment the government's attempt to enhance rural employment by diversifying youth's and women's livelihoods. The scheme is considered an alternative livelihood approach for rural women and youths. Its importance weighs as rural women and youths' career aspirations are as high as their urban counterparts. However, the labor market offers few decent-wage employment opportunities (OECD, 2018). Engaging these segments of the community in the scheme could reduce unemployment problems. The priorities given for women and youths by the scheme are commendable since ensuring the livelihood for these large segments of society would help engage them fully in the required rural transformation. Livelihood in this context is meant for the livelihood definition suggested by (Chambers & Conway, 1992). For them, livelihood embraces the capabilities, material and social resource assets and other activities required for

life. Even though this comprehensive definition implicated the livelihoods concept is inclusive of material and non-material aspects of well-being, the research concerning livelihood in general and Income Generation Activities (IGAs) in particular have focused more on the need for finance and other capital assets than the need for skills and strengths, weaknesses, opportunities, and threats encountered in the endeavours of livelihood. The livelihood-related interventions by the CIG scheme have also been more concerned with loans and grants than vocational skills development and other social resources (Hajdu et al., 2011).

Various studies have been done on rural women and youth's livelihood change, which are comparable to the activities of the CIGs. For instance, among the youths engaged in the IGAs based on the arrangements of one to three grouping, 75.5%, 16%, and the remaining 8.5% were less diversified, moderately diversified, and highly diversified, respectively (Mekonen, 2019). The studies also found low educational access and quality, sex-based stereotyping culture in the community, age-based restriction of information access, low level of market accessibility, high dependency ratio, lack of road and transport access, and shortage of credit access as the principal factors for limited women and youth livelihood diversification and/or change (Adeyanju, 2019; Bekele & Worku, 2008; Demeke, 2016; Desalegn, 2016; Rim & Nsanganira, 2019; Seetanah et al., 2019; Singh & Belwal, 2008). Beyond analyzing the status and determinants of livelihood diversification, these studies did not determine how effective these diversified livelihoods are, the strengths, weaknesses, opportunities, and threats encountered. Yet, since "*youth is not a monolithic, uniform group – the challenges and constraints they face differ between age groups, ethnicities, education levels, and many other factors*" (Bezu and Holden, 2014, pp. 3), contextual studies of the livelihood trajectories they are in would be better, rather than putting generic success factors as it is stated above. However, one can have comparable findings as a hint for the in-depth analysis of the contexts of youths in many areas for which this specific study intends. Besides, several studies on rural women and youth have spotlighted a more detailed quantitative analysis of their employment, demographic and other livelihood aspects (Eneyew & Bekele, 2012; Schmidt & Bekele, 2016; Tedla, 2019; Worku & Woldetsadik, 2013).

The above-indicated empirical literature signifies that most studies on micro and Small and Medium-sized Enterprises (SMEs) and other CIG-like groupings have focused on

formally registered enterprises. However, even if tracing the CIG business is difficult because of its informal arrangement compared to women and youths in micro and SMEs, it is not impossible. Methodologically, these studies were inclined to the quantitative design since most examine their success and/or failure determinants. Also, in the mid-term evaluation of the AGP II, the quantification of the CIGs has been given a great emphasis like other components of the program. With this, it merely characterizes the CIGs with the number of its beneficiaries, the amount of money they took, the businesses they have engaged in, and other generic features (Alebel et al., 2019). The SWOT of the CIGs are essential as they affect their sustainability and implementation trajectories. Such aspects of the CIGs need to be addressed through deeper and closer qualitative analysis. However, these studies were conducted at the neglect of a qualitative method which is indispensable in capturing the meanings and processes of factors and challenges for both the failure and success of these CIGs. In other words, although knowing the livelihood of rural women and youths in numerical aspects is imperative, particularly in projects and interventions like the AGP in general and the CIG in particular, it should not be at the expense of the issues they have been encountering in the processes of changes in their livelihood.

Overall, because of the restriction of studies of the youth and women-based CIGs and alike enterprises on the determinants of livelihood diversification, more needs to be done to know the meaning and the processes these segments of the community pass through in the activities directly affecting their livelihood. To the researchers' knowledge, a concern about the effectiveness of the CIGs and their SWOT is not sufficiently studied in the study area and elsewhere. Since the CIGs are not profoundly investigated and qualified through qualitative designs, more studies on CIGs' contribution to the rural youth's and women's livelihood change need to be conducted. Exploring the Effects of the CIGs on their beneficiaries is also pivotal for drawing lessons that could strengthen their implementation and inform implementers of what modifications should be made to enhance the efficiency and effectiveness of CIGs. The current study is aimed at filling the mentioned gaps by exploring the role of the CIGs in rural women and youth livelihood changes in Northwest Ethiopia; with the thesis that it is by giving a due emphasis on both quantifiable and qualifiable aspects, we could have full-fledged data on changes in the livelihood of the CIG beneficiaries. It was specifically meant to assess the CIGs' activities, explore their performances or investigate their effectiveness, examine SWOTs from their execution, and suggest the way forward for their successful implementation. Comparable studies on CIG like

SMEs have come up with the welfare impacts of such enterprises on their members', including consumption capability, economy, and education. However, all these are beyond the scope of this study since welfare, economy, education, and other quantifiable aspects require baseline data and/or other well-documented trajectories of their performance, which is non-existent in our case.

6.3. Research methodology

6.3.1. Physical description of the study area

The study was conducted in *Wara-Jarso woreda,* located in the North *Shewa* zone of *Oromia* Regional State, Ethiopia. Structurally, *woreda* is equivalent to a district and is the second smallest administrative level above the *kebele* and below the zone in Ethiopia, except the capital, Addis Ababa. The study *woreda* is located between $9^0$47' to $10^0$11' North Latitude and $38^0$27^0 to $38^0$43' East Longitude (Fig 13). It has 25 *kebeles* (the smallest administrative unit) and four municipal administrations. Mixed farming is the primary source of the farmers' livelihood. *Tef* (a staple food crop to millions of people in Ethiopia), wheat, maize, barley, horse bean, field peas, potatoes, flax, and niger seed are the dominant crops grown in this area. The *woreda* has three major agro-ecologies: highland (7.3%), temperate (43.4%), and lowland (49.5%) (National Meteorological Agency of Ethiopia [NMAE], 2020). Functional CIGs are found in the highland and temperate zones (Wara Jarso woreda Agriculture and Natural Resource Office, 2019).

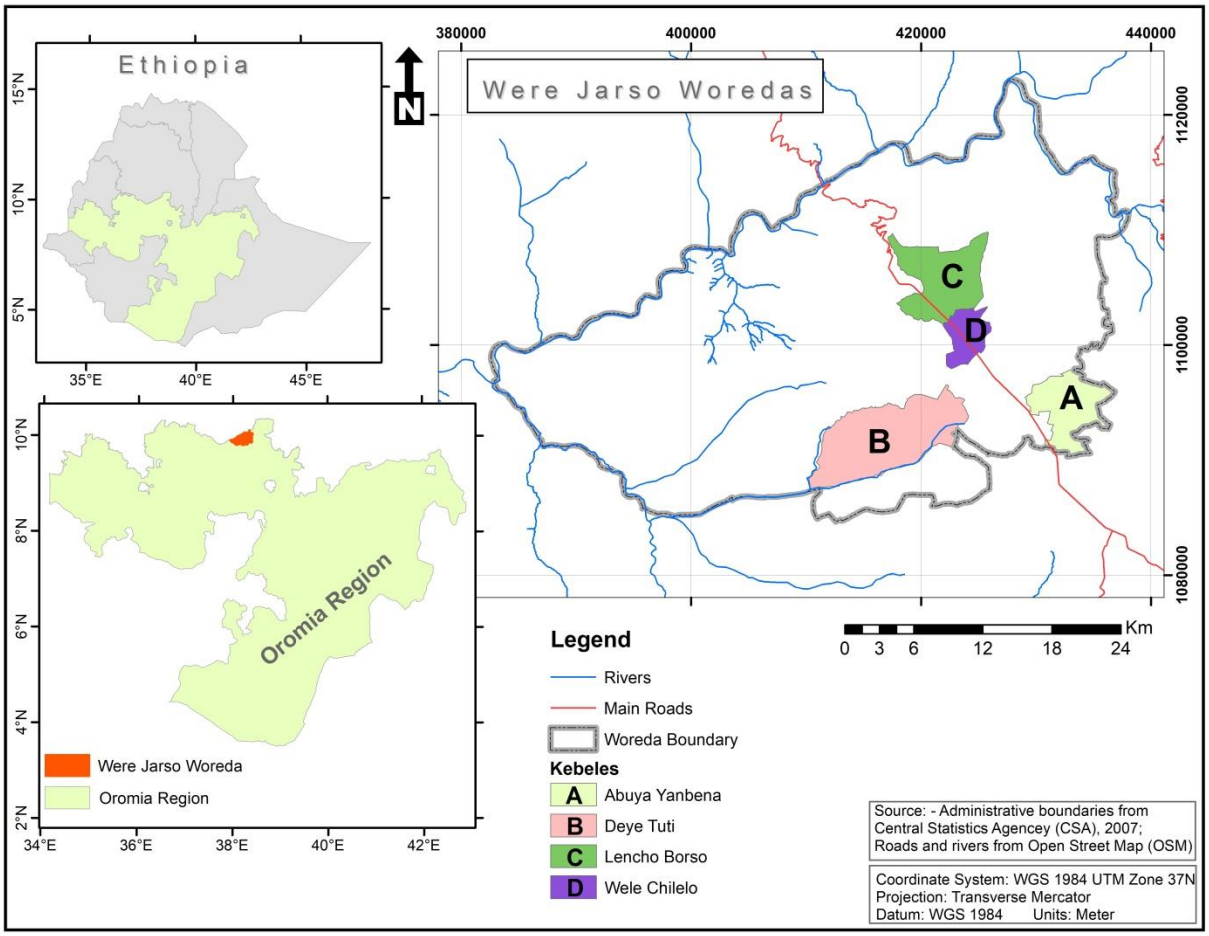


Figure 13: Map of the CIGs study areas (For the study objective 5)

6.3.2. The context: CIG in the study area

The issue of CIG, which AGP II introduces, was chosen to get concrete, contextual, and in-depth knowledge about it. Such an investigation has allowed us to explore the key facets and implications of the CIG implementation. The program promotes and supports CIGs comprising women and youth. During the AGP II implementation period, 46 CIGs were established and had been operating since then. AGP II coordination offices at the federal, regional, zonal, and district and various district-level governmental lead stakeholders are in charge of supporting the CIGs starting from their establishment. Regional and zonal representatives of the AGP II have contacts with the *woreda* AGP II coordination office and hence follow its progress. For the sake of specificity, the CIGs in the study area were disaggregated by the types of farming activities they had been engaged in. Accordingly, four categories of the CIGs were formed: those engaged in dairy farms, sheep fattening, poultry production, and oxen fattening. For deeper investigation and analysis, one CIG was chosen from each category. Four CIGs were therefore considered for this particular study. The

particular *kebeles* from where the CIGs were considered are shown in the map indicated above (Figure 13).

6.3.3. Research design

A qualitative research approach was used to respond to the objective of this study. The collective case study was used among the three main types of the case study (*i.e.* intrinsic, instrumental, and collective). *"The collective case study involves studying multiple cases simultaneously or sequentially to generate a broader appreciation of a particular issue*." (Crowe et al., 2011, pp. 2). In this study, we have focused on the effects of the CIGs scheme on rural women and youth livelihood. The issue under investigation seems single, but the cases in it are many requiring cross-case analysis, allowing us for deeper investigation. Employing a cross-case analysis permitted the exploration of detailed and in-depth data from both primary and secondary data types from multiple sources.

The fieldwork was conducted from January 1, 2021 to February 28, 2021. Four FGDs were conducted with the four CIGs selected per the types of businesses they engaged in (*i.e.* one CIG from each business category). Key informant interviews were also conducted using semi-structured interview guides with the CIG implementing officers at federal, regional, zonal, *woreda*, and *kebele* levels. In addition to the AGP II coordination office, Cooperative establishment and development office, Livestock and fishery development office, and Women and youth empowerment office were the *woreda*-level offices contacted for interviews. DAs of the four *kebeles* in which the selected CIGs operate were also interviewed. Farm activities of some CIGs were observed. Secondary data was obtained from the performance reports and related documents of the *woreda* AGP II coordination office. No new themes, dimensions, or insights into the issues under study did emerge after the priori-specified interviews were analyzed. This led us to decide on the sufficiency of the planned sample sizes of the study. Thus, data saturation is achieved during the pre-planned interviews.

Regarding the technical aspect of the design, double-barreled, long, and complex questions were avoided for smooth communication and quality data. The data quality was also ensured by building a good rapport with the study participants. The thematic guides with detailed research questions were framed from the study's objectives. Probing questions were used to enable participants to elaborate on their ideas.

6.3.3.1. Tools and techniques of data analysis

Text interpretation (*i.e.* thematic coding) was used as the data analysis method since it brings all relevant aspects of the study together and helps to have a clear picture of the subject under the study. Thematic analysis is used to identify themes or patterns in the data that are important to the issue (Clarke & Braun, 2013). Thus, the processes of thematic analysis were started by coding, classifying, and categorizing the data. A content analysis was then used for coding and analyzing transcripts and field notes. In content analysis, data are presented in words and themes, making it possible to interpret the results (Bengtsson, 2016). In light of this, audio recordings from the discussions and interviews were transcribed verbatim and reviewed for accuracy. Transcripts were organized using the MAXQDA 2020 software, a qualitative data analysis package program. Segments of raw data that conveyed ideas relevant to the study objectives were coded using open coding. Code is defined as a tool for identifying the content of a document, classifying it and making it easier to find it again, and coding is the process of assigning one or more codes to a segment that one has selected (MAXQDA 2020, 2019). Given this, first-order categories were inductively identified and classified (*i.e.* first-order code) based on segments of the raw transcript generated through open coding. Segments with common ideas were coded into second-order themes. Themes that address related ideas were then grouped into common categories in the third phase (*i.e.* aggregate dimension).

Since several categories or codes were identified in the third phase (*i.e.* in the aggregate dimension), themes that address interrelated ideas were again condensed into broader themes for the findings and discussion section. The latter themes were generated using a relational analysis as part of qualitative content analysis. In relational analysis, themes were developed by examining the relationships between concepts in a text (*i.e.* concept mapping) (Bengtsson, 2016); concepts in the aggregate dimension in this study. The broad themes were directly generated from the research questions, considering each as a theme to avoid leaving the study objectives untouched. The relationships between the concepts generated from the data in the aggregate dimension were explored and fed into the themes identified for the presentation of results and discussion. In relational analysis, the focus is to look for meaningful relationships; individual concepts are viewed as having no inherent meaning; meaning is a product of the relationships among concepts in a text (Busch et al., 2005). Based on this assumption, the study's major findings were discussed following the predetermined themes developed based on the research objectives. Under these themes, data were

interpreted and triangulated with each other and with a broader aim of the CIG, relevant literature, the ensuing theory, model, and tool. In-text references were cited by the study participants' pseudonyms, numbers labelled to the FGDs (FGD 1, FGD 2, FGD 3, and FGD 4), and dates of the interview and/or discussion. When quotations were deemed necessary, they were labelled by the respondents' pseudonyms and gender if it is KII and by the number of their group if it is FGD.

6.3.4. Theoretical underpinnings

The CIGs under study are considered teams because their arrangement is more inclined to the definition of teamwork, which refers to a group of people working together for a common goal, with each member contributing to the project or program (Chron, 2021). The study used Belbin's Theory of Teamwork and Asset Based Community Development (ABCD) model as interpretive tools. Belbin's theory examines the roles of the team working collectively for a common interest (Belbin, 2010; BohatALA, 2019; Fisher et al., 2000; Partington & Harris, 1999). According to this theory, an effective team requires various personality types that can assume different roles. Assigning team roles based on members' strengths and shortcomings is an effective way to build a team since people are far better at tasks that draw on their strengths (Indeed Editorial Team, 2021). This theory is chosen against other comparable theories of teamwork as it better fits the situations of CIGs by specifying the roles to be played and the support that needs to be rendered for the teams in general and their members in particular. For instance, in Tuckman's most famous teamwork theory, the behaviour of small groups is studied from different perspectives; and a given team is analyzed with the help of four stages (*i.e.* forming, storming, norming, and performing). However, the very aim of this study is not to trace these stages.

The hierarchy of Needs theory also creates building blocks for successful teamwork. However, it cannot be applicable to the CIGs as it requires going for the assessments of teams regarding food, safety, health, love and belongings, and morality. Had the focus been a mere study of the nature of teams, these theories would have been compatible. The same holds for Carl Color, Strength, and Analysis theories on the effectiveness of teamwork; since they dwell on determining the behaviour of team members to examine what went wrong and what the team should do (BohatALA, 2019). Seminal Teamwork theory is also confined to evaluating individual members using a formal inventory system (Chron, 2021). These theories, in general, are more specific and urge to emphasize a particular dimension of a

given team. Otherwise, Belbin's theory possesses a broad framework that includes nine roles that every team should keep in mind while working in a team, namely: plant where the team is performing its task, resource allocation and investigation, coordination with other team members, shaping team members attitude towards task achievement, monitoring the task of each member, team worker, implementing a strategy of the team, working collectively to finish the task, and lastly the team member should be specialist in his/her work (BohatALA, 2019). The theory established that the stated nine roles must be fulfilled for a team and/or group to perform well and successfully achieve its objectives. This study does not merely examine a broad concept of teamwork or team. Instead, it is geared towards investigating the activities conducted by the CIGs (teams in this case), their effectiveness, their SWOT, and the way forward for their efficiency and effectiveness. With these, the nine roles stated in Belbin's theory serve as lenses by which we look into what is and what should be of the CIGs.

The ABCD, on the other hand, is a model for sustainable community-driven development. Its premise is that communities can drive development by identifying and mobilizing existing but often unrecognized assets (Kretzmann & Green, 1998). The model's unit of analysis is basically a community. However, this study has adopted it to the group to inform teamwork's efficiency and effectiveness. Accordingly, among the five core principles of the ABCD model (namely: citizen-led, relationship-oriented, asset-based, inclusion-focused and place-based), the first four were largely emphasized in analyzing the major findings of this study.

Additionally, the SWOT analysis tool is used to investigate the crucial part of the study, *i.e.* strengths, weaknesses, opportunities, and threats, encountered in implementing the CIGs. It was used to categorize attributes of the CIGs (*i.e.* strengths and weaknesses) and attributes of the environment (*i.e.* opportunities and threats). The SWOT analysis can be understood as examining an organization's internal strengths and weaknesses and the opportunities and threats faced by the organization due to its environment (Gibis et al., 2001). It is a modus operandi that helps organizations to build a strategic plan to meet goals, improve operations and keep the business relevant (White, 2019). Even though it is usually used by businesses in the industrial environment (Gibis et al., 2001), it is also a common tool for strategic planning (Hill and Westbrook, 1997), intended for use in the preliminary stages of decision-making and as a precursor to strategic planning in various types of applications (Kahveci &

Meads, 2008). It is a flexible analysis tool that can be applied to various businesses, from information technology to marketing to operations (White, 2019). This technique has so far been widely used to evaluate organizations' market-based positions (Designorate Team, 2015; Shepherd, 2005) and rarely in the context of groups like CIGs. In this study, however, SWOT analysis is applied within the context of CIGs to identify their attributes (*i.e.* strengths and weaknesses) for their current performance and attributes of the environment (*i.e.* opportunities and threats), mainly for areas of their future growth. This way, it was tried to develop a way forward for building more integrated and comprehensive CIG-based women and youth empowerment system. At last, lessons learned from the practical implementation of the CIGs are explained in the form of implications of the study so that it helps shape and accelerate similar interventions. Specific ideas that could be generalized into principles for others to apply were also indicated.

6.3.5. Analytical framework

A mix of conceptual and theoretical frameworks of the study was illustrated in the analytical framework indicated in Figure 14. After categorizing the major CIG activities introduced by the AGP II in the study area, the next step was identifying the objectives and the methodologies used (research design, data type, analytical tools, and theories and models). The expected outcomes from the CIGs were presented with the expected presence of interplay among several outcomes. The interplay indicated that the pattern of their relationship is not expected to be linear but instead reciprocal. The expected pattern of coaction among the themes identified in the performances of the CIGs implicates the overall outcomes of the CIG activities.

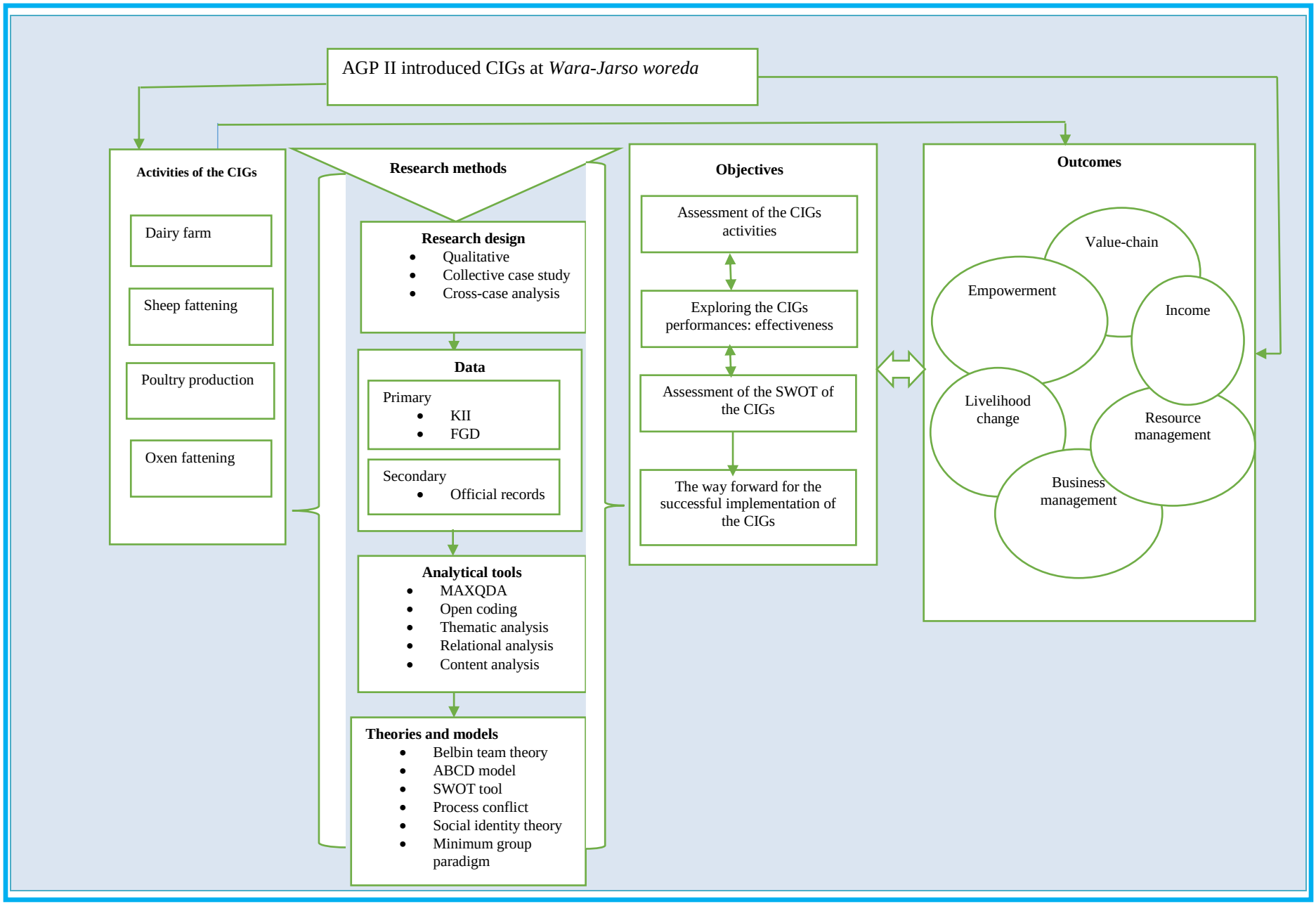


Figure 14: Analytical framework for the study on the CIGs and their effects on rural women and youth livelihood in Northwestern Ethiopia.
Source: Author's construction

6.4. Results and discussion

6.4.1. Characteristics of the study participants

6.4.1.1. The profile of the KIIs

Eleven respondents were considered as the KIIs (Table 33). The first four were representatives from the *woreda* level stakeholders; the next four were DAs from the four study *kebeles*; and the last three interviewees were from the AGP II offices at the federal, regional and zonal levels. The study participants' names should be anonymous to maintain the principle of beneficence (Saunders et al., 2015; Wiles & Janine, 2016). Thus, pseudonyms are used to effectively portray the participants' stories, maintain the human element, and make the data more reflective of real life.

Table 33: Profile of the KIIs

S.Nº	Pseudonym	Sex	Office
1	*Bekele*	M	*Wara-Jarso woreda's AGP II coordination office*
2	*Fitsum*	M	*Wara-Jarso woreda's* Women and youth empowerment office
3	Seyoum	M	*Wara-Jarso woreda's* cooperative establishment and development office
4	*Zerihun*	M	*Wara-Jarso woreda's* Livestock and fishery development office
5	*Fasil*	M	*DA at Lencho-Borsu kebele*
6	*Bereket*	M	*DA at Dhaye-Tuti kebele*
7	*Firehiwot*	M	*DA at Wale-Chilalo kebele*
8	*Tiruneh*	M	*DA at Abo-Yayambana kebele*
9	*Mohammed*	M	*Technical Advisor of the AGP II at the Ministry of Agriculture*
10	*Edosa*	M	*AGP II monitoring expert at Oromia regional government*
11	*Ayelech*	F	*AGP II facilitator at North Shoa zone, Oromia regional government*

Source: Field survey, 2020

6.4.1.2. The profile of FGDs participants

The profile of FGDs participants: the activities they engaged in, their location, number of group members, and the number of discussants who participated during the discussion were presented in Table 34. The largest and the smallest CIGs comprise 19 and 12 members, respectively.

Table 34: Profile of the discussants of the FGDs

S. Nº	Group	Business type	Location [*Kebele*]	Members	Number of participants in the FGD
1	FGD 1	*Dairy farm*	*Lencho-Borsu*	19	12
2	FGD 2	*Sheep fattening*	*Dhaye-Tuti*	12	10
3	FGD 3	*Poultry production*	*Wale-Chilalo*	16	7
4	FGD 4	*Oxen fattening*	*Abo-Yayambana*	12	8

Source: Field survey, 2020

The data structure model in Table 35 illustrates how data was developed from interviews to the initial codes, the second-order categories, and the aggregate dimensions.

Table 35: Flow of data from first-order categories to aggregate dimensions

First-order concepts	Second-order themes	Aggregate dimensions
An overview of the CIGs	An overview of the CIGs	**An overview of the CIGs**
Support from the AGP II coordination office	The purpose of forming CIGs	The purpose of forming CIGs
The CIGs and the local people other than its members	Processes of group formation	Processes of group formation
Members' engagement in the group activities	How the groups gained the working place	How members use the money of their groups
The purpose of forming CIGs	Members' engagement in the group activities	How the groups gained the working place
The way forward to benefit from the CIGs	Roles and responsibilities of the members	Groups' participation in the livestock procurement processes
Threats the groups encountered	Perception of the members towards working in a group	Roles and responsibilities of the members
Opportunities both for the members and local people	Support gained from stakeholders	Perception of the members toward working in group
Weaknesses of the groups	Support from the AGP II coordination office	**The support gained from stakeholders**
Strengths of the groups	The relationship between CIGs and other comparable groups	**The situation of market linkage**
Start-up capital groups contribute, and their perception	Groups' use of money up-on their formation	**Performance of the CIGs**
The relationship between CIGs and other comparable groups	Start-up capital groups contribute, and their perception	Strengths of the groups
Perception of the members towards working in a group	Groups' participation in the livestock procurement	Weaknesses of the groups
Members' perspectives on the futurity of their group	The groups' expenditure	Opportunities both for the members and local people
The benefits members gained	The variation between their expenditure and income	Threats the groups encountered
How the groups gained the working place	The benefits members gained	**The way forward to benefit from the CIGs**
The situation of market linkage	Performance of the CIGs	Members' perspectives on the futurity of their groups
The variation between their expenditure and income	The CIGs and the local people other than its members	
The groups' expenditure	The situation of market linkage	
Roles and responsibilities of the members	Threats the groups encountered	
Problems the CIGs have encountered	Problems the CIGs have encountered	
Groups' participation in the procurement of the livestock	Opportunities both for the members and local people	
How members of the groups use money up-on their groups' formation	Weaknesses of the groups	
Processes of group formation	Strengths of the groups	
Performance or effectiveness of the CIGs	The way forward to benefit from the CIGs	
The support from stakeholders	Members' perspectives on the futurity of their groups	

Source: MAXQDA 2020 qualitative data analysis program used by the author (2020)

The aggregated dimensions were condensed into the broader themes to be presented in the findings and discussion section. Accordingly, four themes were developed based on the study's objectives (Figure 15). The first three themes were discussed separately. The fourth, the way forward to benefit from the CIGs, and intervention strategies to be designed for its successful implementation were presented in the recommendation sub-section. The study's main findings are discussed and supported by sufficient relevant literature in Ethiopia and abroad. Studies conducted in the Ethiopian context were emphasized to contextualize the study and advance its dependability. The basic tenets of the proposed theory, model, and analysis tool were also discussed in light of the study's findings. Bearing the study's findings and other comparable studies in mind, the researchers have also incorporated their reflections.

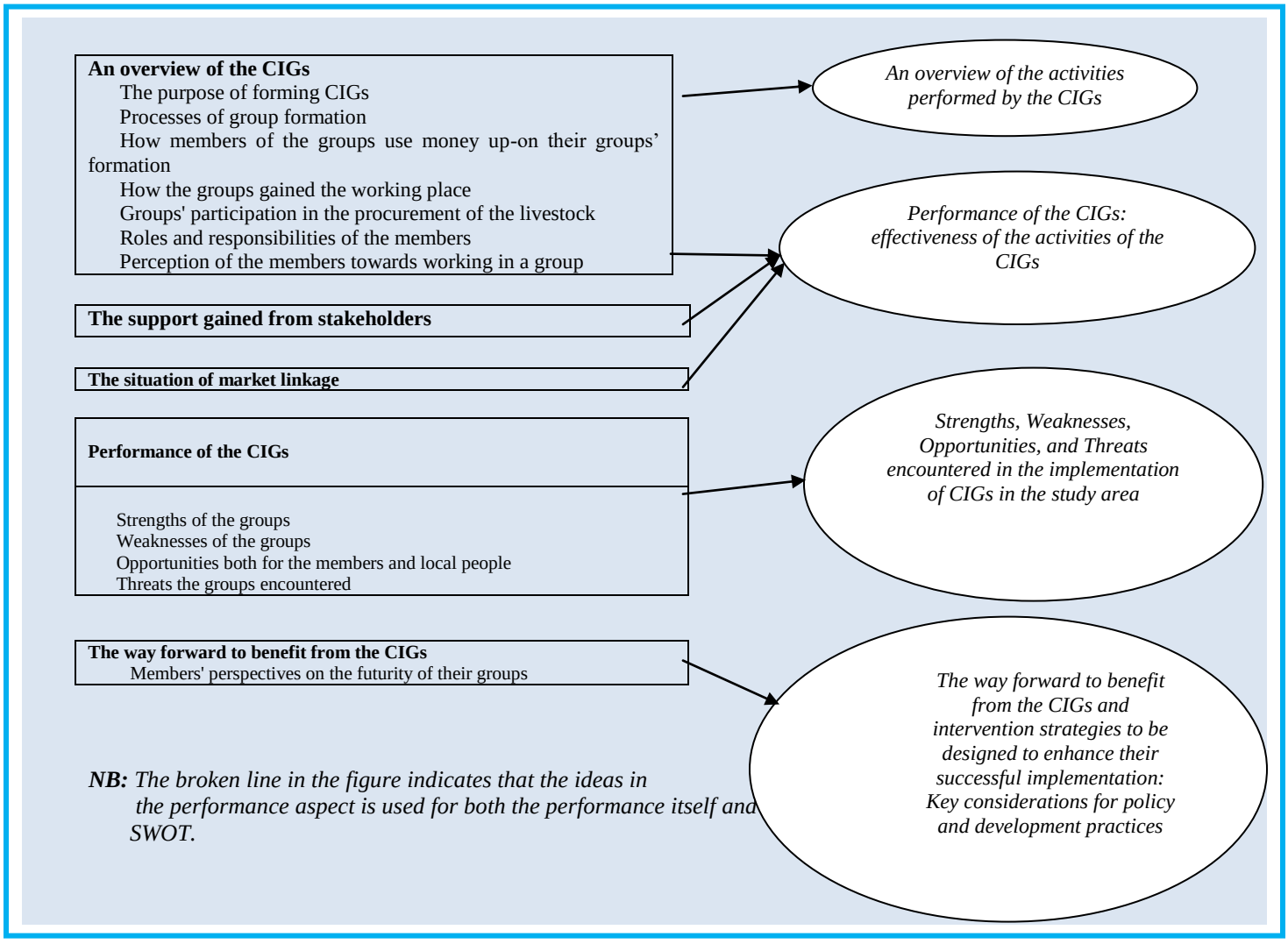


Figure 15: Data structure flows from aggregate dimensions to the main themes of the study.
Source: Author's construction from MAXQDA 2020 qualitative data analysis program (2020)

6.4.2. An overview of the activities performed by the CIGs

With the plan to establish two CIGs in each *kebele* (*i.e.* 50 CIGs in 25 *kebeles*), about 46 CIGs were established. Though not actualized, the implementers planned to establish gender-disaggregated CIGs in each *kebele* (Bekele, personal communication, October 11, 2020). Even though this discrepancy seems unproblematic, it indicates the implementers did not closely monitor what was done at the beginning of establishing the CIGs. The AGP II helped 75% of the start-up capital while members contributed the rest. The contribution by members was meant to initiate the business and saved for risk aversion. The discussants were asked about the start-up money they contributed and whether they assumed it was expensive. The contribution was not demanding for many of them, and some members felt a bit of pressure to fulfill the expectations easily and quickly.

The very purpose of working together is justified in that working as a group towards a common goal helps them pool resources and minimize barriers. They set the criteria for membership to their group, such as possessing similar interests, being from nearby areas, being free from any credit and being 18-55 years old. Individuals from the same family were also allowed to be members of the same CIG. Homogenizing members for smooth and strengthened communication was the rationale behind these criteria (Ayelech, personal communication, October 9, 2020; Bekele, personal communication, October 11, 2020; Mohammed, personal communication, October 2, 2020). However, it would have been better if members possessed heterogeneous characteristics. The group's aim should be common and a guiding principle, as stated in the AGP-II's Program Design Document, pp. 55, instead of members' sameness. This idea is in harmony with the basic tenet of Belbin's Team theory which suggests a personality type that can assume different roles for an effective team. Assigning team roles as per members' strengths and shortcomings effectively builds a team (Belbin, 2010). With this, the best way to assess members' assets or strengths and weaknesses is to go for what the ABCD model suggests. The model endows the beneficiaries (*i.e.* women and youths in this case) to recognize their strengths and focus on what they possess than what is missing (Ennis & West, 2010; Mathie & Cunningham, 2003). It appreciates the value of existing skills, knowledge, and other assets.

Discussants of the FGD1 stated that they have participated in the procurement of their cattle. They alleged that such participation had increased their sense of group business ownership

and belongingness (FGD 1, October 27, 2020). It was also found that the CIG, which participated in procuring their livestock, developed a sense of ownership of their business and performed better than those who did not participate (FGD 4, October 30, 2020). Some groups did not participate because of various reasons. For instance, only the AGP coordinator and the representatives from the *woreda* livestock and finance offices have participated in the oxen procurement. On the other side, other stakeholders (such as women, youth, and cooperative development offices) lament the lack of a transparent procurement system. The lack of such a system negatively affects their initiation and causes them to doubt their convictions.

The participating groups affirmed that their engagement has allowed them to procure cattle that better adapt to the local weather condition and gave a better product (FGD 1, October 27, 2020). On the other hand, the groups that did not participate complained that they felt as if they disowned their businesses because of non-engagement. It was indicated that most CIG beneficiaries wanted to participate in the procurement. A participant (M) of the FGD4 stated:

> "…*had the woreda officials allowed us and our local administrators to participate in the livestock procurement, it would have been good to choose our assets and take a risk by ourselves*…"

Even though the AGP personnel told the CIGs that they would be provided with a workplace, they failed them. The CIGs, instead, were forced to rent and/or use members' gardens or farmland as a workplace. From the program's side, it was alleged that the budget limitation prevented them from fulfilling their promise of providing workplaces (Bekele, personal communication, October 11, 2020). Apart from this, knowing the strengths and weaknesses of each member, as per the ABCD model, enables them to harness their assets which may help to minimize the mentioned problems (Mathie & Cunningham, 2003).

Regarding the roles and responsibilities of members, many discussants and key informants have reported that most members have acted per their responsibilities. However, the responsibility assigned to members is seemingly habitual, like watching after the cattle, feeding and cleaning their abode turn by turn, punctuality during their meetings and saving their income in the local bank on time and withdrawing based on the group's request (FGD 1, October 27, 2020; FGD 3, October 29, 2020). The regulatory body from the *woreda* also checks whether they are in line

with the mentioned requirements (Ayelech, personal communication, October 9, 2020; Bekele, personal communication, October 11, 2020; Edosa, personal communication, October 5, 2020; Seyoum, personal communication, October 14, 2020). The problem here is that they should have given them big responsibilities of going beyond the routine expectations, like seeking the market linkage and mobilizing additional resources. This is inconsistent with the basic tenet of Belbin's theory of teamwork, which states that the roles of the team underlie its success. By team role, the theory suggests that an effective team requires various personality types that can assume different roles. People in a team need to assume different roles, like the monitor evaluator, the specialist, the shaper, the implementer, and the coordinator, among others, rather than limiting them to ordinary and customary roles. These roles, in turn, will create a tendency to behave, contribute and interrelate with others in a particular way (Belbin, 2010). If the CIGs members could play the roles they are good at, which will be explored through the ABCD model, they would have reversed what they have yet to contribute.

Findings regarding the perception of the CIGs members towards working in a group align with studies of youth's perception of group-based tasks. The study by Caruso and Williams (2008) found that teamwork paves a road for members to work interdependently, fostering synergistic collaboration. Another study by Buljac-Samardzic et al. (2011) found the worth of working in a group and emphasized members' interaction as the most important input for the effectiveness of a team. Likewise, the study participants asserted that being in the group possesses a positive vibe because it gives them a perception of fulfilling tasks they could not realize individually at ease. Though minimal, the FGDs participants have confirmed that membership in the CIGs has created additional means of livelihood and employment (FGD 2, October 28, 2020; FGD 4, October 30, 2020). This indicates that a mere positive attitude towards the group-based task is not adequate; instead, it should be reasonably supported by some technicalities like a clear statement of roles to be played by members. When members know what to expect from each other and their team, it becomes easier to create strong operational bonds within a group (Root, 2021).

The number of members a given CIG comprises has complained. One (M) of the discussants from the FGD4 stated:

> *"…as the number of group members increased, our effectiveness diminishes because there would be increasing interest among the members, and the probability of having a divergent idea is wide. But had our group comprised 3-5 members, we could have relatively comparable ideas and become more effective …*"

This opinion is in line with other studies. For instance, according to Andersone (2004), large group size in teamwork has resulted in an improper division of labor, creating a lack of initiation and motivation among members. Lack of role specification among members could result in role ambiguity. It also reduces the benefits that could be gained through specialization and experience. The studies by Osgood et al. (1996) and Tucker et al. (2001) also indicated that youth who spend amorphous time with peers show increased problematic behaviours.

Regarding the support provided, the stakeholders have tried to assist even though the support is yet to reach the desired level. Awareness of the benefits of saving, the benefit of the CIG membership, and conflict-solving skills were the major supports given (Bekele, personal communication, October 11, 2020; Fasil, personal communication, October 19, 2020; FGD 1, October 27, 2020; FGD 3, October 29, 2020; Frehiwet, personal communication, October 26, 2020). Despite the momentous of the government agencies in the provision of monitoring and regulatory services, it was found that the lead stakeholders did not put their coordinated effort into the operation of CIGs (Tiruneh, personal communication, October 28, 2020; Zerihun, personal communication, October 15, 2020). Even the minimal support provided was on an independent basis, not in a coordinated manner (Seyoum, personal communication, October 14, 2020). Let alone other substantive supports, regular meetings with the CIGs and among themselves about the CIGs were not reported (Fasil, personal communication, October 19, 2020). Seyoum explained the stakeholders' loose engagement as follows:

> *"…loose coordination among the CIG stakeholders is manifested. This could be because the kebeles are geographically far from each other, and some are bounded by large geological features prohibiting the frequent access of stakeholders. The absence of required dedication from the DAs has also contributed a lot. Most DAs do not discharge their responsibilities on the ground but usually come with monthly basis reports and annual reports indicating their progress…"* (Seyoum, personal communication, October 14, 2020).

Consistent monitoring would enhance the stakeholders' efforts for the best possible performance of the CIGs. Had the stakeholders been able to manage their activities unswervingly, they would have smoothed the CIGs' operation. Stakeholders' coordination is the key to success, yet it is a demanding and time-consuming for any project (UNNExT, 2011). Participation of the stakeholders from the planning and design stage and regular and proper communication between them should be set for the proper operation of the CIGs. As to Belbin's team role theory, identifying a role a team member can play may help to work more efficiently as a team (Belbin, 2010; Indeed Editorial Team, 2021). In the case of the study under consideration, if members were assigned to the roles of the coordinator and the implementer, they could contribute a lot; coordinators by ensuring that a team uses each member's strengths appropriately, and implementers implement feasible strategies to ensure their team completes tasks quickly and effectively. These contribute to a timely update on progress made and required changes to the plan.

It was also found that the CIGs were stuck to the business activities they had started at the very beginning of their establishment; there was no room for change and modification in the meantime (FGD 3, October 29, 2020; Fitsum, personal communication, October 13, 2020; Frehiwet, personal communication, October 26, 2020). However, had the stakeholders been continuously informed, they would have dealt with what and how change should be made whenever needed. It should also be noted that stakeholder engagement requires open communication (Enright et al., 2016); communicating early, often, and clearly with stakeholders helps manage expectations and avoid risks, potential conflicts, and project delays (Eftimie et al., 2014). Concerning the market linkage, the study participants complained that the value chain opportunity was not created for them; they were not linked with markets. An opportunity to diversify livelihoods from engagement in various activities is almost non-existent (Fasil, personal communication, October 19, 2020; FGD 1, October 27, 2020; FGD 2, October 28, 2020; FGD 3, October 29, 2020; FGD 4, October 30, 2020; Seyoum, personal communication, October 14, 2020). Bereket, for instance, stated:

> *"…the government entities, AGP II coordination offices, and other concerned stakeholders are all reluctant to engage in market linkage activities, regardless of the group's attempts to produce more sheep as the years pass…"* (Bereket, personal communication, October 22, 2020).

Studies on value chain opportunities for women and young people in livestock production in Ethiopia found similar result where their involvement in the value chains has remained insignificant (Gebremedhin et al., 2016; Legese & Fadiga, 2014). The value chain problem was also indicated in the Kenyan dairy industry focused on smallholder milk production (Awino et al., 2022). What is absurd in the present study is that, as reported by the discussants and interviewees, despite the production potential of dairy farming in the area and demand by the nearby markets, commerce-based dairy farming is inexistent (Bekele, personal communication, October 11, 2020; Fasil, personal communication, October 19, 2020; FGD 1, October 27, 2020; Seyoum, personal communication, October 14, 2020). More specifically, Seyoum asserted:

> *"…it is obvious that market linkage is needed for the CIGs, but they are not yet developed enough to the level they require market linkage. Market linkage is essential when the CIGs are strengthened. The dairy-based groups could be beneficial in this regard, but their product is negligible. So, there is no motive to link them with the relevant business organizations in nearby areas or elsewhere. We would likely arrange market linkage in the future…"* (Seyoum, personal communication, October 14, 2020).

The CIGs' production capacity principally influences the likelihood of their market participation. This is comparable to the study in the *Jimma* zone of Ethiopia on vegetables, stating that despite its production potential and importance, because of its negligible production, it was found to be less market-oriented, resulting in a limited opportunity for livelihood diversification from vegetable production (Regasa et al., 2020). In addition to lower production volume, lack of market infrastructures, proximity to market centers, minimal access to market information, and lack of market-related knowledge and skills were reported (Edosa, personal communication, October 5, 2020; FGD 2, October 28, 2020; FGD 3, October 29, 2020; Tiruneh, personal communication, October 28, 2020). Thus, the production size should be prioritized since it is after a surplus marketable product is produced that market-related issues follow. This requires creating a conducive environment for commerce-based production. Devising a strategy of role division among members would also enhance groups' access to the market. For instance, the role of resource investigator, suggested by Belbin's team role theory, could lead to making new business contacts, exploring new opportunities, and investigating new developments (Indeed Editorial Team, 2021).

6.4.3. Performances of the CIGs: Effectiveness

Performance is how well or poorly something is done or works (Njuki et al., 2013). The study found that being members of the CIGs enhances the livelihood of some members who could not afford it individually (Bekele, personal communication, October 11, 2020; FGD 4, October 30, 2020; Tiruneh, personal communication, October 28, 2020). The CIGs have received benefits like meagre income (by which some, for instance, bought agricultural inputs), motivation and experience, and social capital (social bondage among members) at the very beginning of their establishment. Nevertheless, the benefits they have had declined as time went on. As to the discussants, the CIGs have only helped them to some extent, like buying agricultural inputs. The benefits they have to receive were impacted by several factors like lack of monitoring, supportive supervision from the relevant stakeholders, conflict within many CIGs, lack of farm inputs like livestock feeds and drugs, and costly fodder. These factors largely contributed to the dissolution of many CIGs and prohibited others from expanding and diversifying their businesses (FGD 1, October 27, 2020; FGD 2, October 28, 2020; Fitsum, personal communication, October 13, 2020; Seyoum, personal communication, October 14, 2020). Tiruneh remarked on the performance of oxen fattening CIG at his locality as follows:

> *"…the group's productivity has been going well and remained hopeful, but it declined as time passed, and the group was dissolved then. Nevertheless, the members had benefited from the CIG as their income and livelihood were improved because they at least shared the cattle population up on dissolution…"* (Tiruneh, personal communication, October 28, 2020).

Similar to the current finding, studies by Omore (2012) and Twine et al. (2018) associated the persistently low level of dairy farm productivity with an inadequate supply of animal health and breeding services and fodder. The long delay in disbursement of start-up capital was also mentioned as the problem which impacted the CIGs' performance (Bekele, personal communication, October 11, 2020; Bereket, personal communication, October 22, 2020; FGD 3, October 29, 2020). Likewise Tekele (2019) and Zapalska et al. (2003) found financial, capacity, and government regulations-related constraints as the key environmental factors that affected the operation of SMEs. The CIG beneficiaries' concern about a start-up capital problem was huge (FGD 1, October 27, 2020; FGD 4, October 30, 2020). This indicated that the CIG was largely overwhelmed with grants (money in the form of start-up capital) at the

expense of other empowerment mechanisms. A very loose bustle towards monitoring, supervision, and controlling, the need for vocational skills and marketing skills, etc., also signifies that the CIG activities have focused more on the need for capital than holistic empowerment.

As part of the factors affecting their performance, the study participants mentioned the mismatch between the cost of production and the income they have garnered. For instance, discussants of the FGD1 stated that an immense expenditure of the group is buying fodder for the cattle. This expenditure dramatically increases over time; for example, if the grass was previously 2000 ETB, it was reported as 5000 ETB during data collection. The by-product of *tef*, 200 ETB two years ago, costs as high as 500 ETB during data collection. One (M) of the participants from the same group explained:

> *"…the cost we expend for the production of butter does not commensurate with the income we garner from its sale because of the problems related to transportation, electricity, and fodder. The income from the butter can be 500 ETB per month on average, but the expenditure would stretch up to 4000 ETB per month. However, we somehow benefited from the group because we could buy seven more cows in the last three years. Nonetheless, the income we are supposed to have is highly reduced, and the benefit we have earned is lesser than our expectation…"* (FGD 1, October 27, 2020).

The profits the CIGs gained at the beginning clued up that if they had strengthened their group engagement and minimized the stated failures, it would have been more profitable and helpful. In light of this, attempting to empower them with their capital (by the money they are required to save as a pre-requisite for start-up capital) is a good strategy for their economic empowerment. This would create a sense of belongingness in their groups and play a constructive role by moderating the barrier between financial services and rural women and youth. Yet, granting them cash as seed money creates a problem, for instance, when conflict occurs in their group, and members tend to disburse their money among themselves (FGD 4, October 30, 2020; Tiruneh, personal communication, October 28, 2020). Had the leverage been set in place, like taking the money as a loan and paying it back, the likelihood of solving their conflict on their own would have been wide.

The respondents highlighted the importance of skill training, access to additional capital, and improvements in market linkage (Ayelech, personal communication, October 9, 2020; Bekele, personal communication, October 11, 2020; FGD 1, October 27, 2020; FGD 2, October 28, 2020; FGD 3, October 29, 2020; FGD 4, October 30, 2020; Seyoum, personal communication, October 14, 2020). This assertion is consistent with Engidaw (2021)'s study stating that entrepreneurship training, access to credit facilities, and market access positively influence the performance of women and youth-owned enterprises. Other studies also emphasized the importance of entrepreneurial skills stating that since young people have the numbers and are full of energy (if it is tapped), they could inspire innovation in their enterprises, easily create employment for their fellow and could increase their country's production capacity and create jobs if entrepreneurship is nurtured in them (Ahmed & Ahmed, 2021; Kilimani, 2017).

A loose linkage between the CIGs and implementing stakeholders and no linkage among the CIGs were also found. Designating and implementing proper stakeholder management increase a positive impact and minimize a negative impact for in and out stakeholders (Griffiths et al., 2008; Pedersen, 2006; Volchok, 2007; World Economic Forum, 2017). Thus, for the CIGs under study, a proper engagement of stakeholders would improve their performances to the desired level. As part of internal stakeholders, had the linkages been created among the CIGs, it would have been beneficial for sharing information and exchanging knowledge, among others. Strong communication among themselves would also strengthen their lobbying power for their interest.

Irrespective of the lopsided performances of the CIGs throughout the study *kebeles*, the study *woreda*'s AGP II coordinator rated their performance at an average level. He elucidated:

> *"…there is a difference in the performances among the CIGs. Few CIGs are exemplary in their performances. Only some of them could be considered better-performing ones. Some kebeles have low-performing CIGs due to the dearth of follow-up. In areas where stakeholders and members integrate well, the CIGs could be rated as better-performing ones. However, the other way happens when the stakeholders and the member cannot discharge their responsibilities. Overall, we could say that the performance of the CIGs in our woreda is at an average level…"* (Bekele, personal communication, October 11, 2020).

6.4.4. SWOTs of the CIGs

An indispensable part of this discussion is the SWOT analysis of the CIGs. Provided that the SWOT analysis does not have to be mechanistic and superficial (Pickton and Wright, 1998), the major findings in this aspect are analyzed and discussed subsequently, emphasizing its process values and outputs. Accordingly, the lists of major findings generated from the SWOT analysis tool and indicated in Table 36 are presented in terms of their importance (from most important to least important in affecting their performance).

Table 36: SWOT assessment matrix

Strengths What are the greatest strengths of the CIGs in the *Wara-Jarso woreda*?	***Weaknesses*** What are the greatest weaknesses of the CIGs in the *Wara-Jarso woreda*?
1) It helped members diversify their livelihood and creates income, though not to the desired level. 2) It creates job opportunities, though minimal. 3) It created social networking and solidarity among its beneficiaries. 4) Boost members' saving ability and work experience. 5) They have pooled their resources, which enhances their sense of ownership to a certain extent. 6) Consideration of members' interest in the establishment of CIGs.	1) Lack of all-rounded knowledge regarding the scientific way of protecting, rearing, and proactive means of securing livestock businesses. 2) Conventional feeding practice, lack of modern feed/fodder. 3) Prevalent pessimism towards their groups' functionality and conflicts happened among members. 4) Members lack the sentiment or interest to work together as a group. 5) Absence of written normative standards that regulate conduct. 6) The very heterogeneous character of the CIG members; is principally indicated by the presence of farmers and university/college graduate youths in one CIG. 7) Dissolution of many CIGs.
Opportunities As you reflect on the performance/operation of the CIGs in your *woreda*, what do you see as opportunities for their advancement?	***Threats*** As you reflect on the performance/operation of the CIGs in your *woreda*, what do you see as threats to their advancement?
1) The presence of supportive women and youth-based initiatives to create job opportunities for them. 2) Availability of seed money as start-up capital. 3) The CIG operation has proved that the area has a potential for cattle breeding and fattening. 4) The CIG intervention remains a lesson for local people that the fattening and production of livestock is a relevant and feasible business in the area and enables some to engage in similar businesses practically.	1) Lack of support by the stakeholders, inadequate monitoring, controlling, and supportive supervision. 2) Absence of uniform knowledge about the CIGs among the stakeholders. 3) Inadequate start-up capital. 4) Insufficient extension services on livestock in general and poultry production in particular.

5) Micro and small-scale businesses and other businesses comparable to the CIG inspire youths, and it remains a lesson that anyone who engages in some task could diversify his/her livelihoods. 6) Availability of improved breeds.	5) DAs consideration of the AGP activities in general and CIG activities in particular as an extra task. 6) Livestock procurement excludes DAs and members of the CIGs; only members of one CIG have participated. 7) Dearth in the infrastructure like paved roads and electricity. 8) Not possessing an adequate workspace or lacking a 'well-established' workplace or area. 9) Costly forage/fodder. 10) Non-existence of a market linkage.

Source: MAXQDA 2020 qualitative data analysis program used by the author (2020)

The strengths identified noticeably entail that women's and youth's engagement in the CIG helped to generate income and diversify their livelihood while not to the desired level. Hitherto, it could be alleged that tiny job opportunities were created (Bekele, personal communication, October 11, 2020; FGD 1, October 27, 2020; FGD 2, October 28, 2020; Seyoum, personal communication, October 14, 2020). Social networking and solidarity among members, which helped them during the hardships, were also assets of their engagement in the CIGs (FGD 2, October 28, 2020). Members' saving capability and contribution to start-up capital were also considered strengths. In addition to assisting members to start businesses, pooling resources helped develop a sense of belongingness (FGD 1, October 27, 2020). It was also found that members with divergent interests and aims were brought together in the same group (FGD 4, October 30, 2020). That being so, members' interests should be systematically assessed to bring them to relatively comparable interests to enhance their commonalities. For this, the principle of 'citizen-led' from the practices of the ABCD model is vital. By this principle, members are expected to ask each other: 'What can we do best for ourselves and each other?' By addressing such a question, members are empowered to identify, connect and mobilize what they have to make change happen. They take the lead by using what they have to secure what they need. Members can also assume a decisive lead in directing outside helpers in how best they can be helpful (Hipwell, 2009; Kretzmann & Green, 1998; Snow, 2001). As to this model, members need to know what they have, which is local and within their control, to know what they need from outside.

Lack of all-rounded knowledge regarding the scientific way of protecting, rearing, and proactive means of securing livestock businesses was found to be the prime weakness (FGD 1, October 27, 2020; FGD 3, October 29, 2020; FGD 4, October 30, 2020; Frehiwet, personal communication, October 26, 2020; Seyoum, personal communication, October 14, 2020; Tiruneh, personal communication, October 28, 2020). It was also found that the CIGs beneficiaries have been expecting too much from the program (Bekele, personal communication, October 11, 2020; Fasil, personal communication, October 19, 2020; Fitsum, personal communication, October 13, 2020). As to the key informants, the beneficiary youths usually expect a free offer. This is consistent with the studies by Allen et al. (2016) and Musyoka et al. (2020), which stated that most of the time, youth expect a 'free handout' where they would not have to build their skills and opportunities. Related to this, implementers should be cautious about not slackening the support to be offered for the CIGs because of the generic label that "youth usually expect a free handout". Instead, assistance needs to be given basing careful assessments of groups so that it will not be provided at the expense of creating a sense of dependency. Unfortunately, the intervention for the CIGs under study is based on the principle of the need-based approach, on the assumption that beneficiaries require 'this and that' without proper consultation with them. Even the need-based approach is supposed to be properly implemented because, in the case of some of the CIGs under study, it was found that the implementers merely picked what they thought was crucial for the livelihood of rural women and youths of the area. The asset-based empowerment approach is of great importance in reversing this situation. By this approach, first, assets of women and youths should be enlisted, and then their needs should be identified before any intervention. This model's asset or capacity inventory includes all human, natural, social, physical, financial, political, and spiritual capitals (Chirisa, 2009). Thus, the model's assumption could be contextualized to the CIGs in which it seems plausible to enlist and assess many of the mentioned assets for its beneficiaries.

Assessing the situation of youths and women would allow for identifying their prospects and challenges and enable them to know their strengths. Since the asset-based approach has opened room for the discourse from a deficit perspective, it has changed people's perception of how they understand their local communities. The same holds for the CIGs members, as it would contribute to identifying their assets and minimizing the weaknesses they have mentioned. The

study on youths also contended that understanding the roles, opportunities, and constraints youths and women face is decisive in promoting their value chain (Gebremedhin et al., 2016). The non-existence of normative standards and legislation, lack of access to modern fodder, conventional feeding practices, and deficiency in modern livestock management practices were also found as weaknesses contributing to the CIGs' malfunctioning and dissolution (FGD 1, October 27, 2020; FGD 2, October 28, 2020; FGD 3, October 29, 2020; FGD 4, October 30, 2020). The inexistence of written normative standards is perhaps due to the very informal arrangement of the CIG's structure. Its structure is more inclined towards informal association than a business enterprise. The CIGs are expected to operate as formal business enterprises, so they must be incentivized to have binding standards and legislation to abide by common and group ethics for better performance.

The study found that the lack of heterogeneous characteristics among members has contributed to their failure to deliver the expected services (Edosa, personal communication, October 5, 2020; FGD 1, October 27, 2020; FGD 2, October 28, 2020; Frehiwet, personal communication, October 26, 2020; Seyoum, personal communication, October 14, 2020). Members leaning towards their alike character may reflect natural human inclinations toward one's semblance. From the perspective of social identity theory and the minimum group paradigm, tiny differences can create perceptions of "us" versus "them" (Diehl, 1988). Differences in perceptions shall be curbed with the formation of groups with members' heterogeneous characters basing the Belbin Team Roles theory. Also, the roles to be played by each member could be explored by applying the ABCD model. It is also found that in some CIGs, members' contribution of money remained a mere factor binding them as a group. These groups shared their money and dissolved shortly. Pessimism towards the functionality of their groups that contributes to a shrink in members' sentiment to work as a group was also found (FGD 3, October 29, 2020; FGD 4, October 30, 2020). These paved the way for intra-group conflicts. Such conflicts could be categorized under the type of conflict identified by recent studies and labelled as 'process conflict' (Korsgaard et al., 2014; Zeitzoff, 2014) than the four well-known types of organizational conflict: interpersonal conflict, intragroup conflict, intergroup conflict, and inter-organizational conflict (Tjosvold, 2006). Process conflict is the consciousness of disagreements featuring different facets of task accomplishment. It precisely refers to matters of

responsibility and resource allocation, like who will do what and to what extent he/she will be held responsible for his/her acts (Jehn & Mannix, 2001). This is congruent with the main reason for the conflicts that occurred among members of the CIGs. Allocating roles and responsibilities for all relevant stakeholders (in and out) of the CIGs are imperative to avoid or minimize such conflicts.

The political goodwill in the country indicated by the presence of the National Youth Policy was found as a big opportunity for youth-based interventions. This policy allows youths to achieve meaningful results and benefit from it by actively and widely participating in the country's development efforts through the basic principle of youth's economic development (Ministry of Youth, Sport and Culture, 2004). A zeal for women and youth-based initiatives and a concerted effort to build public-private partnerships to create job opportunities for women and youths were also mentioned as opportunities for the better implementation of CIGs (Ayelech, personal communication, October 9, 2020; Bekele, personal communication, October 11, 2020; Edosa, personal communication, October 5, 2020; Mohammed, personal communication, October 2, 2020). These opportunities implied that stakeholders need to take advantage of the political goodwill and exert effort for its better use (Gebremedhin et al., 2016; Lemma & Tesema, 2016). The CIG development fund from AGP II was also reported as an opportunity for the local people as it enabled them to engage in livestock businesses. The CIG activities by themselves brought other opportunities. For instance, it proved that the area has a potential for cattle breeding and fattening. This enables youths to build upon their potential and remain a lesson for local people that livestock fattening and production is a relevant and feasible business in the area. It also inspires youths and practically teaches that anyone who engages in some task could get benefits and means of livelihood (FGD 1, October 27, 2020; FGD 2, October 28, 2020; FGD 3, October 29, 2020). As an encouragement, villagers had offered grazing land for one CIG engaged in oxen fattening (FGD 4, October 30, 2020). This implies, from the perspective of the ABCD model, the presence of supportive community assets for women and youth empowerment. Had such capital and social assets been tapped, it would have contributed a lot to the group's effectiveness.

The SWOT analysis has also identified the study participants' perceptions of threats and/or barriers to success. The greatest threat to the CIGs' activities was found to be the mere support

provided. This is indicated by inadequate monitoring, controlling, and supervision from within and outside and insufficient start-up capital (FGD 1, October 27, 2020; FGD 3, October 29, 2020; FGD 4, October 30, 2020). The stakeholders, for instance, barely meet two or three times per year to check the status of the CIGs together with other activities of the AGP II. This put up to the problem of lack of balanced apprehension of the CIGs among the stakeholders, which in turn remains the cause and consequence of their malfunctioning (Bekele, personal communication, October 11, 2020; Seyoum, personal communication, October 14, 2020; Tiruneh, personal communication, October 28, 2020). Inadequate start-up capital causes them not to fully engage in their businesses (FGD 3, October 29, 2020; FGD 4, October 30, 2020; Seyoum, personal communication, October 14, 2020). This is in agreement with the study stating that negligible capital has limited women's and youth's performance and growth in livestock production (Gebremedhin et al., 2016). This barrier is, however, incongruent with the presence of strong political goodwill and supportive women and youth-based initiatives in the country. The stated presence of a combined effort to build public-private partnerships to create job opportunities, particularly for women and youth by (Ayelech, personal communication, October 9, 2020; Bekele, personal communication, October 11, 2020; Edosa, personal communication, October 5, 2020; Mohammed, personal communication, October 2, 2020) is also contrary to the mentioned financial problem. Thus, a determined effort is required from the AGP II's lead stakeholders to work towards tapping these opportunities.

It was also found that the CIGs did not get adequate access to extension services. They only had a brief orientation shortly before the disbursement of start-up money (FGD 1, October 27, 2020; FGD 2, October 28, 2020; FGD 3, October 29, 2020; FGD 4, October 30, 2020). This implied that the beneficiaries might need to gain the required skills and expertise upon establishing their groups. There is consensus that Entrepreneurship and Vocational Education (EVE) are vital in opening the door for youth employment in this 21st century (Olaniran & Mncube, 2018). It is also believed that EVE is essential for youth empowerment and economic development (Adenle, 2017; Chimucheka, 2014; Dzisi et al., 2018). The ABCD model would serve as a tool for assessing the CIGs members' assets on EVE by identifying and organizing their needs (*i.e.* the gaps to be filled). The perception among the CIGs members that many DAs consider their activities as an extra task was also found as a threat to the CIG operations

(FGD 1, October 27, 2020; FGD 3, October 29, 2020; FGD 4, October 30, 2020). Some felt that much of this thought was due to a lack of finance for monitoring and supervision activities (FGD 1, October 27, 2020). This was verified by the interview with the key informants, from the AGP II's regional coordination office up to the DAs, who reported that insufficient budget for monitoring and supervision contributed greatly to their failure to deliver the expected services in this regard. Since it is believed that perceptions by themselves can be real in the mind of the participants (Stefanucci and Proffitt, 2009), continuous and effective communication among stakeholders is required to play down skepticism and build a system of monitoring and evaluation backed by sufficient funding within an integrated system of women and youth empowerment.

The complete exclusion of DAs and many members of the CIGs in the procurement was found as another threat to the groups' success (Bereket, personal communication, October 22, 2020; Fasil, personal communication, October 19, 2020; Frehiwet, personal communication, October 26, 2020; Tiruneh, personal communication, October 28, 2020; Zerihun, personal communication, October 15, 2020). Bekele explained:

> *"…even though DAs are in charge of facilitating the main activities of the CIGs, they did not participate in procuring the cattle and oxen. Instead, I and officers from our woreda's cooperative development office and finance office conducted it. This made them feel and consider the AGP activities as an extra-work, resulting in not giving due attention…"* (Bekele, personal communication, October 11, 2020).

Since the respondents have stated that their non-engagement has primarily emanated from a lack of per-diam to be paid for the DAs during the procurement (Bekele, personal communication, October 11, 2020; Seyoum, personal communication, October 14, 2020), the allocation of an adequate budget would help to fill this gap. DAs should be considered the key internal stakeholders and given special attention because of their position to follow the groups on a routine basis closely. Since DAs are the primary and close stakeholders for the CIGs, they need to participate in all activities of the groups so that they do not consider it an extra task. Participatory monitoring and evaluation should be ensured for their effective performance. It should also be noted that even though all interventions by the AGP are intermingled in the agricultural extension services run by the government, it is still labelled as "the regular work" vs.

"the AGP work" (Bekele, personal communication, October 11, 2020; Fitsum, personal communication, October 13, 2020; Tiruneh, personal communication, October 28, 2020). So, it needs to embrace all stakeholders and be conducted in a way that blurs the imaginary line between these two alleged types of works. With this, members of the CIGs should be treated as the first stakeholders and engaged in all procedures for the sake of transparency and upholding a sense of belongingness to their businesses.

The dearth of infrastructures like paved roads and electricity was also viewed as a threat to the groups' businesses (Bekele, personal communication, October 11, 2020; Fasil, personal communication, October 19, 2020; FGD 1, October 27, 2020). This finding is congruent with the studies conducted in rural Ethiopia (Mohammed, 2019; Tigabu & Gebeyehu, 2020; Wolde & Geta, 2015). For instance, Tigabu and Gebeyehu (2020) noted poor infrastructure (roads, electricity, information, etc.) as a serious problem in the country's rural areas, deterring rural youth from job opportunities. Consistently, in the study under consideration, non-paved roads contributed to the absence of transportation services to the nearby markets. This, in turn, discourages the CIGs from producing more milk because milk business requires a supply of fresh milk for consumers. The group was instead inclined towards producing butter, which is less profitable than fresh milk. The absence of electricity, on the other hand, caused them not to have a refrigerator, an essential input for dairy farming (Fasil, personal communication, October 19, 2020; FGD 1, October 27, 2020). One (F) of the FGD1 participants affirmed:

> *"…we do not have electric power in the kebele to use a refrigerator for the milk. We also have been facing problems with the inputs for the cattle (for cows and calves). We use the local grass since the cost of improved fodder is skyrocketing. Besides, the money we received from the AGP was quite small to unlock our potential in milk production. We had to buy low-quality cows. Had the budget not been low, we could have bought improved cow breeds…"*

The absence of a 'well-established and conducive' workplace for the CIGs was also stated as a barrier. Their confinement to the traditional workspace (like for poultry, sheep, and oxen production) led them to a traditional rearing practice which in turn lessens their production capacity and, in some instances, exposes their poultry, sheep, and oxen to death. Timings of input transfer have also worsened their business (Bekele, personal communication, October 11, 2020; FGD 3, October 29, 2020; FGD 4, October 30, 2020; Frehiwet, personal

communication, October 26, 2020; Tiruneh, personal communication, October 28, 2020). For instance, poultries were given during the rainy season to the group engaged in poultry production. However, poultry production requires a warmer time and/or place. Because of this, the group labelled their business as 'Dead on Arrival,' indicating that it was doomed from the start (FGD 3, October 29, 2020). No effort was made for the value chain at the local, regional and national levels (Bekele, personal communication, October 11, 2020; Fasil, personal communication, October 19, 2020; FGD 1, October 27, 2020). This contrasts the AGP-II's Program Design Document idea stating 'efforts will be made to link the CIGs with Micro-Finance Institution (MFI) and facilitate market linkages by linking them to agricultural output markets'. However, investment on CIGs and CIG-like business infrastructures would create market opportunities enabling them to trade, connect to the market and power their businesses (Puentes, 2015). A market linkage needs to be established so the groups' products easily reach their target customers through direct interaction without the involvement of intermediaries. Inventory of a communal asset would also contribute to filling the infrastructure gap since the community may contribute some of its assets for water and electricity, and members of the groups may contribute to access and provision of the workplace.

Costly feed, mainly poultry feed, was found as another threat to the groups' businesses (FGD 3, October 29, 2020; Frehiwet, personal communication, October 26, 2020). The other CIGs also entirely depend on the communally owned grassland and/or privately owned by members of the groups, if there is any. This is congruent with the study on livestock production and management practices in Kenya, stating that smallholder farmers face constraints related to lack of access and high cost of feed inputs, inadequate and poor quality feed, and poor storage facilities for feed conservation. The study added that farmers' predominant dependence on a grazing system where their livestock graze freely on public or private land decreases livestock productivity (Lukuyu et al., 2011). However, using cheap and readily available local feed resources has great potential to increase livestock productivity (Mburu et al., 2007; Ramsbottom et al., 2015).

Environmental analysis is critical to a SWOT analysis (Pickton & Wright, 1998). From the above discussions on each specific situation of the SWOT, it is evident that the studied CIGs' attributes of the environment (*i.e.* opportunities and threats) outweigh their internal attributes

(*i.e.* strengths and weaknesses). The number of threat factors surpasses the number of other factors, *i.e.* strengths, weaknesses, and opportunities. This indicates that the source of many barriers the CIGs have been facing is environmental. It could then be generalized that the CIG intervention is affected mainly by externalities. The same is true for opportunities; the result indicated the presence of vast opportunities for the CIGs to grow. Hence, had the factors reported as threats been reduced and opportunities tapped, they would have been more likely to flourish.

6.5. Conclusion and recommendations

6.5.1. Conclusion

The study showed that various attempts had been made to establish and strengthen CIGs as per the objective set in 'Support to Farmers' Organizations' indicated in the 'AGP-II's Program Design Document. The core activities involve mobilizing eligible women and youths, delivering orientation, identifying their business needs, and forming groups. The CIGs have enhanced the social capital of its members. Some CIGs have also remained a source of income for some of its members, though very loose, negligible, and not sustainable when compared to its aim of changing rural livelihood by boosting the collective bargaining power of farmers and improving efficient and sustainable service delivery. The SWOT analysis indicated that the bigger problems the CIGs have faced have mainly stemmed from the environmental factors for which most of its interventions are affected by externalities. The finding related to immense opportunities for the CIG implies the likelihood of flourishing. Overall, it could be concluded that even though no ground-breaking new development has been unveiled for the livelihood of women and youths because of the CIGs in the study area, the findings have imperative policy and practice implications for interventions to be designed for the empowerment of women and youths at the study and other comparable areas. With the assumption that drawing a policy recommendation from a micro-level qualitative study is hard, if not impossible, its key considerations are more inclined toward specific recommendations for development practitioners. The generic policy-level implications are also forwarded. Furthermore, basing this micro-level investigation, the study recommends a comparable high-level study with a broader scope on CIGs to look for possible similarities to have a more informative policy implication. In doing so, it would be

better if CIGs from other areas with proper documentation are considered to capture additional attributes of its implementation.

6.5.2. Recommendations

Based on the findings of the study, the following specific recommendations are made:

- While designing the intervention methods for CIGs, it is important to consider the value of knowledge and skill-based training both upon their establishment and while in operation (on-the-job training). Members need to have a common objective and interest, which should be established through thorough training. The ABCD model suggests the need for assessments before any intervention and explicates procedures for the assessments to be done.

- A normative guideline in which all members participate in its preparation should be a pre-requisite for CIGs formation because setting a normative standard simplifies expected behaviour from the respective members and help identify a group and express its central values to others. This recommendation is consistent with one of the basic tenets of the ABCD model, which emphasizes the importance of engaging beneficiaries so that it better enables them to identify, connect and mobilize what they have and go per what they set in their later activities (Mathie & Cunningham, 2003; Snow, 2001). Majurin (2008) added that members of particular groups need to comprehend why principles or rules are imperative for the better functioning of their groups. The study participants assumed that setting written guidelines would strengthen a sense of group ownership. Basing the suggestion from the study area's AGP II coordinator:

> *"…the respective group members should develop guidelines, and they should feel a sense of group belongingness. It should be timely and needs to be updated and strictly enforced. When, why, and on what precondition members leave should be clearly stated. Whether and if the profit should be shared or its timings of share should also be taken into account…"* (Bekele, personal communication, October 11, 2020).

- Considering guidelines as one criterion for group formation is highly advised. A reward for good doers and sanctions on transgressors should be informed. Stakeholders and their roles and responsibilities should also be stated. This encourages stakeholders' engagement per identified roles and responsibilities. Stating stakeholders' roles will also help to identify types of stakeholders as main, primary, secondary, technical, etc. Belbin's team roles theory supports the idea of role division. As to the theory, the division of roles among members of a particular group is considered a strong cementing factor that augments members' perseverance by allowing them to discharge their responsibility (Belbin, 2010). In addition to enhancing members' commitment, the role division will help to smoothen and strengthen the relationship between CIGs and stakeholders. It is in the clear statement of roles that stakeholders would effectively participate in the activities of CIGs. Yet, the role of external stakeholders should not surpass advice and mere facilitation so that it will not disregard members' sense of belongingness towards their group.

- CIGs monitoring, evaluation, and control require revision. Categorizing stakeholders would help to strengthen coordination among them, serve as a reinforcing factor for monitoring and evaluation, and alter the big threat of their blindness towards the roles they should have to play. The activity of coordinating stakeholders should primarily be assigned to the AGP II coordination office of the study *woreda*. Stakeholders need to be categorized by the tasks they are required to execute. One way of doing this could be categorizing them into primary key stakeholders, primary stakeholders, secondary stakeholders, and the like. It should also be noted that building continuous and effective communication between stakeholders requires a proper and robust communication channel that keeps them all in one system (UNNExT, 2011).

- An adequate budget should be allocated for regular and continuous monitoring and supportive supervision activities. Since the CIGs are scattered throughout the *kebeles*, a sufficient budget is needed for transportation, among others. A separate budget allocation for the DAs is also deemed necessary by the study participants. An independent budget allocation does have two-way implications. First, it positively contributes to the operation of CIGs as it allows tight and continuous monitoring and evaluation. Second, since the activities of CIGs are intermingled with the regular governmental services, an independent

budget allocation may create room for all stakeholders, in general, and DAs in particular, to consider the CIG activities as a self-contained endeavour. This will create a sense of seeking additional help in all aspects other than budget. So, rather than an independent budget allocation, including it in the regular budget would be better. Thus, an independent budget allocation demanded by the study participants should be responded to by allocating an adequate and proper budget for the CIGs within a broader framework of the AGP activities and other agricultural extension services.

- The value chain should also be considered for the CIGs. Before creating a market linkage, CIGs members need to work on production (in terms of quantity and quality) and productivity. Even though the CIGs need to be capacitated first, they should not wait for the market linkage until they start abundant production; rather, the platform of market linkage should start small.

- Provided that the non-existence of workplaces was a major problem for the CIGs' business, allowing them access to workplaces could be a springboard to facilitate their operation. Diversification of the CIGs businesses was suggested. Hence, rather than limiting them to a mere livestock business, it would be helpful if they diversify their businesses basing their preferences and market assessments. A more diversified business would benefit more by creating new jobs for women and youths.

- Members of a CIG should also be reduced to a manageable size. This may depend on the contribution of each member to his/her group. An individual should be a member only by basing the direct contribution he/she would provide for his/her group. The contribution could be by skills or knowledge or any other asset to be identified upon allocating roles and responsibilities for members. This would enhance their sense of ownership at an individual level and strengthen their solidarity as a group. Minimizing the number of members in a group is also believed to enhance members' commitment and the group's functioning, which is a pre-requisite for their efficiency and effectiveness. Considering the ABCD model for assessing group assets, one should minimize the number of participants for doing a proper, efficient and effective asset inventory. The more the number of participants is reduced, the more one can get closer to knowing what these participants possess. These

procedures ease the pooling processes of participants' resources and simplify the management of the respective groups.

- After the groups' internal functioning is smoothened and strengthened, a union among them is needed. This would help them fortify their power of influence, augment their productivity and support their value chain. The study *woreda*'s AGP II coordination office should be responsible for forming a union. The issue of the power of influence is harmonious with the very aim of the CIGs of boosting the collective bargaining power of the smallholder farmers and efficient and sustainable service delivery (MoA(a), 2015).

- The start-up capital should be given to the beneficiaries in the form of credit so that they pay it back. It should not be in the form of seed money given in kind. Urging them to pay back may enhance their saving capability. Saving, in turn, facilitates further investment and their economic capacities. A change in the lending scheme may also reinforce the groups' dynamics and reduce members' loafing.

- The AGP II Program Design Document stated that the CIGs should be supported in preparing viable business plans and technical support in the execution of their selected business activities. In light of this, the businesses they would engage in should be assessed and supported by a business plan. The district's cooperative development office should mainly equip the CIGs in business plan preparation and related accounting services upon their establishment and operation.

- Finally, regarding the futurity of their groups, though members had shown dissatisfaction with their performances so far, they affirmed that they want to keep on with the businesses of their groups. They indicated that more is needed to boost their endeavours. All the reported problems contributing to the malfunctioning of their groups should be improved, and the opportunities should be tapped for the best possible reward.

CHAPTER SEVEN

7. SYNTHESIS

This final chapter presents general conclusions from chapters, general recommendations and suggestions for future research. The first part of this chapter starts with the research objectives set in the introductory chapter. It separately exhibits the summary of the finding and the general conclusions drawn from each research objective. Next, as part of the synthesis, the interconnectedeness of the study objectives are discussed in light of the main theses of the study and with the basic assumptions of the theories and/or models used. With this, the synthesis draws heavily on the analytical framework established in chapter one. The second part of the chapter provides general recommendations for policy and practices for the attainments of secured rural livelihood in the study area and beyond. The final part addresses limitation of the study and suggested directions for future research.

7.1. General conclusions

This study investigated four interrelated issues and one related issue. First, it examined the impacts of adopting *Korra tef* on the users' productivity and income. Second, it investigated the productivity effects of plot-level *Korra tef* seed rate. Third, it examined the impact of *Korra tef* use on the users' commercialization status. Fourth, it investigated the impact of the use of *Korra tef* on the users' welfare. Fifth and lastly, it examined the effects of the CIG on rural women and youth's livelihood. Generally, the study has addressed five issues of relevance in an attempt to attain a secure livelihood for farm households and rural women and youths.

Chapter one describes and discusses the background, a succinct overview of the literature, the problem statement, the objectives, the methodology, and other elements of the dissertation. Chapter two presents an analysis of the impacts of adopting the *Korra tef* variety on the productivity and income of the user farmers. This enables us to better comprehend the role of improved *tef* seed variety (*Korra tef* in this case) in enhancing the productivity and income of smallholder farmers. The study confirms that the use of *Korra tef*, on average increased *tef* productivity of the users by about six quintals per ha^{-1} than the non-users. A significant positive association was also observed between using the *Korra tef* and the average Net Income of the

users, in which the users' income was about 29500 ETB per ha^{-1} greater than the non-users. These prove that using *Korra tef* variety has significantly impacted user farm households' productivity and income.

Chapter three focuses on the productivity effects of plot-level *Korra tef* seed rate. The productivity effect of plot-level *Korra tef* seed rate was empirically tested. The findings indicate that *Korra tef* yield has noticeably increased with the use of seed rate per the recommendation. The data revealed a significant yield difference between farmers who use below, per, and above the recommended seed rates, indicating that the seeding rate significantly affected the *Korra tef* yield. This implies that efforts made by AGP II to promote the utilization of seed per the recommended dose have achieved notable results. Based on our findings, we suggest slightly modifying the average seed rate recommended for the area (*i.e.* the previously 15-18$kgha^{-1}$ into 20$kgha^{-1)}$ for a reasonably optimum *Korra tef* yield. The plot-level seed rate analysis further indicated that the *Korra tef* seed rate is important in determining productivity.

Chapter four analyses the impact of using *Korra tef* variety on *tef* commercialization of farm households. This chapter emphasized identifying the relationship between the use of *Korra tef* and the users' status of *tef* commercialization. This micro-level information would enable us to analyze commercialization at the level of smallholder farmers and suggest practical strategies to enhance farm households' crop commercialization status, which in turn help to design pro-poor development policies and/or strategies. The analysis of HCI revealed that the average level of commercialization of the sample households is 46.95%. The two groups have differed in the extent of commercialization, in which the users and non-users account for 58.92% and 36.7%, respectively. This placed the users in the category of commercialized farmers and the non-users in the category of semi-commercialized farmers. The index further indicated that most users, 190 (84.07%), are commercialized farmers. In comparison, 144 (83.24%) of the non-users lie in the category of semi-commercialized farmers. The PSM result further shows that use of the *Korra tef* significantly and positively affects users, who are more commercialized than their non-user counterparts, by 23.43%. Consistent with this, the qualitative data revealed that enhanced productivity of the *Korra tef* variety remains a fertile ground for the marketable surpluses of the *tef* production, promoting its commercialization. These all imply that intensifying the *Korra tef*

variety would help boost smallholder farmers' commercialization status, which in turn provides evidence for the relevant practitioners and policy-makers to tailor appropriate policies to local conditions for further promotion of the commercialization of the crop under study and other comparable crops. However, it is also indicated that another package of agricultural inputs that need to go with this improved seed variety aimed at enhancing the commercialization of farm households should be meticulously studied.

Chapter five examines the impact of using *Korra tef* on users' welfare. The annual average per adult equivalent expenditures were taken as the proxy measure of welfare; food and non-food consumptions were the indexes considered for measuring the expenditures. The findings show that efforts made to increase *tef* production and productivity via the use of *Korra tef* in the study area have produced notable welfare results indicated by a significant surpass of the average per adult equivalent annual expenditures of the users. Better welfare statuses of the users were also shown up in all categories of commercialization. However, in most of the food and non-food consumptions considered for the study, the expenditure patterns of the users remain the same as they move from low to high levels of commercialization. This could be attributed to two reasons: one, to the deliberate activities done by AGP II to increase *tef* production, including the introduction of the *Korra tef* variety, which would have led to increases in household-level consumption. The second, again AGP II intervention on the nutrition diversity of the program beneficiary farm households would contribute to increments in consumptions irrespective of their commercialization statuses. The latter implies that in addition to introducing high-yielding crop varieties, one should consider activities geared towards enhancing consumption.

Chapter six presents the fifth and the last objective of the research, which focuses on investigating the roles of CIG in the livelihood change of rural women and youths. The qualitative data were pulled and organized into various concepts. Then they threaded into four major but interrelated themes: activities performed by the CIGs, the effectiveness of these activities, SWOT of the CIGs' implementation, and intervention strategies to enhance their successful operation. Since the analysis of CIG enabled the qualification of the stated issues, it provides input for women and youth-based empowerment practitioners and policy-makers, which the quantification could otherwise not capture. The qualifications of the mentioned issues

on the CIG initiative make the study the first of its kind. The analysis results show that the CIG initiative has enhanced the social capital of its members. Some CIGs also generated income for their members. However, members' income is so minimal that it was labelled as not to the desired level. The result from the SWOT analysis indicated that most of the CIGs' activities had been affected by environmental factors. The data also revealed the presence of enormous opportunities for their likelihood of growing. This indicates that if these opportunities are tapped, they will contribute to the groups' efficiency and effectiveness, implying positive contributions to the empowerment of women and youths. The findings in this regard would have vital policy and practice implications for similar interventions.

To sum up, the studies on the impacts of AGP II introduced *Korra tef* on the user farm households productivity, income, commercialization, welfare, and the productivity effects of plot-level seed rate, and on the effects of CIG on rural women and youths livelihood provides a complete picture of the analysis of micro-level program based interventions aimed at attaining secured rural livelihood. The analysis showed that the program-based agricultural development interventions have improved farm households' welfare and have had a positive impact on tapping the potential of rural women and youths. Altogether, the findings of this study confirmed the thesis underpinning our study. As per the study's thesis stating 'the promotion of smallholder farmers use of agricultural technologies augment their productivity and income and determines their commercialization status and consequently, their welfare', our results have demonstrated the importance of crop and/or agricultural technologies in enhancing the welfare of the technology user farmers via productivity, income and commercialization (see Appendix G). The study has also revealed the linkages between productivity and plot-level seed rates. Notably, the findings align with the basic tenet of the Sustainable Development Goals (SDGs) established by the United Nations, which claims that human activity of production and consumption is intricately interconnected and has complicated value chains (UN, 2022).

Additionally, the study results are congruent with the basic tenets of the models used in the study (*i.e.* the Target Input Model of Adoption and the Dynamic Learning Model). Both models assume learning by doing to derive implications for the use and profitability of new technologies, which is consistent with the finding of this study in which the study area's farmers devote more

of their farmland to the new technology (*i.e. Korra tef* variety) with the alleged assurance of the profitability of the new technology under consideration. More particularly, as to the Target Input Model of Adoption, the producer knows the production function with certainty, except for the optimal input, which is subject to idiosyncratic variation among the respective users. Consistently, the study results indicate that the *Korra tef* users know and/or assume that the new crop variety they have used would help them garner better productivity, income, commercialization and welfare; but do not know the exact or the optimum agricultural inputs they are required to invest. This uncertainty is indicated by the variations in the production costs of *tef* observed among the users with the mean and standard deviation values of 23223.3 ETB and 2902.19 ETB, respectively (see Appendix H). The users' assumption that adopting high-yielding crop variety would improve their earnings showed they were Bayesian and forward-looking. This is in agreement with the basic tenet of the Dynamic Learning Model, stating that people accept certain technology based on being Bayesian and forward-looking. The models and/or theories we set out to explain the CIGs and their successful implementation also provide a hint or a way out for efforts to enhance their performances and assist the study area's women and youths' potential utilized.

To the investigators knowledge, this impact evaluation is the first study, at least in the study area, which has attempted to show the linkages among the major crop and/or agricultural technology-related concepts (*i.e.* productivity and income, productivity and plot-level seed rate, commercialization and welfare). By doing so, it adds to the continuity thread of conceptualizing, theorizing and measuring use of agricultural technologies in general and *tef* seeds in particular.

Methodologically, first, the results of the studies related to the impact evaluation highlight the importance of evaluating the impact of crop technology use via rigorous methods such as PSM. It shows how the PSM contributes to the more precise estimation of treatment response. In other words, the rigorous procedures followed in the model, could remain as a lesson on how to balance the distribution of observable and unobservable characteristics of the treatment and comparison groups, and reduce the potential for bias in conducting a more robust comparison between the two groups on the issues of use of agricultural/crop technology. Second, in the context of seed rate and crop productivity, using the Dose-Response Model allows for the

estimation of the optimal seed rate that maximizes crop productivity. This can help farmers to determine the most effective seed rate to use in their fields, which can improve crop productivity and reduce costs. As a result, this model also remains a lesson for other comparable studies to be done on the relationship between seed rate and agricultural/crop productivity. Lastly, an in-depth exploration of the case of CIGs, which provides a richer understanding of its context and complexities and the experiences of the involved women and youths, could also be considered as the takeaways from employing a case study with multiple theories and models.

Since this study indicates the connections between interrelated concepts of agricultural development, it would assist policy-makers and practitioners in guiding crop and/or agricultural technology-based empowerment of farmers. It is also hoped that it will contribute to a growing impact evaluation literature by identifying the causal effect of crop and/or agricultural technology interventions on the mentioned dimensions of agricultural development. By and large, from such analysis, a valuable lesson would be learned on how to enhance the welfare of farm households via agricultural/crop technologies, which has been an overarching aim of many agricultural development programs in Ethiopia in general and in the study area in particular.

7.2. General recommendations

The research findings have led to the following recommendations. Details of the recommendations and/or policy implications are set in each objective of the study; the subsequent can be viewed as the general recommendations:

1. The use of *Korra tef* seed should be promoted. In light of this, it is essential to implement regulations that encourage using *Korra tef* seed. The policy should primarily focus on providing extension services for farmers on the potential advantages of using the *Korra tef*. Efficient and effective credit and input supply systems should support the availability of *Korra tef* variety. The policies or interventions in this regard should also consider education and extension services on the proper and effective utilization of technologies that significantly affect *tef*'s productivity and income. Besides, the agricultural extension services in the study area, in particular, and other comparable areas, in general, should get more human, financial, and logistical resources from the federal, regional, and development partners for these activities.

2. Another important outcome of the study is that *Korra tef* yield has remarkably increased with the use of seed rate per the recommendation. Thus, even though drawing any firm conclusions from a study of one season and one location is difficult, we propose using the *Korra tef* seed rate per the recommendation with a slight variation on the seed rate determined as optimal for the study area (*i.e.* 15-18kgha^{-1}). We further estimate that, with all other factors staying constant, the *Korra tef* variety in the study area can obtain a reasonably optimal yield by applying a seeding rate of roughly 20 kgha^{-1}.

3. The study shows that efforts to increase *Korra tef* commercialization had produced commendable results. Hence, to strengthen the linkage between smallholder *tef* producers and the output markets, policies, plans, and programs should consider the availability of improved *tef* varieties with all relevant inputs necessary for the production of *Korra tef*. By strengthening extension services and improving market access, the concerned government structures at all levels in general and the agricultural offices in particular need to encourage the use of *Korra tef* and other improved *tef* varieties.

4. The study found better welfare statuses of the *Korra tef* users than non-users. The fact that the studied households' welfare status is concomitant with their productivity, income and commercialization status implies that farm households should be assisted in using the *Korra tef* and with the activities that enhance its productivity, income and commercialization. Besides, they should be assisted in acquiring strategies and mechanisms to enhance their household-level consumption of food and non-food items. In light of this, training them on consumption (what to consume and how to consume, and issues related to dietary diversity) would effectively benefit them to increase their consumption. The comprehensive strategies for enhancing consumption should be tailored to reach farm households at various stages of commercialization. Building and planning agriculture-based institutional support programs should focus on activities that promote smallholder farmers' access to and involvement in the crop market, such as strengthening marketing extension services, training, and market links among varied market players. Access to credit and rural savings should also be fostered to encourage smallholders' involvement in commercial crops. To improve welfare in the area while

introducing new *tef* varieties, scaling up the best practices of the users to other farmers can also be considered for area-specific recommendations.

5. For the CIG-based findings of the study, first, it is important to consider the value of training both before and throughout the CIG's operation, including on-the-job training. Training that emphasizes knowledge and skills are essential for these groups to succeed. Members must share a similar goal and passion, determined through a thorough orientation and training. Training should be provided based on assessments of the members' capacities. As a result, the training provided to members ought to focus on their knowledge and skill gaps and may even cover ideas related to project management and leadership.

    - It would have been preferable if the preparation of guidelines had been set as a pre-requisite for establishing CIGs. The creation of normative guidelines should involve all participants in the various groupings. It is strongly encouraged to consider rules as one factor for group creation. Accomplishments should be rewarded, and wrongdoers should face the consequences. It is important to identify stakeholders and their respective roles and obligations. This promotes stakeholders' participation in their assigned roles and obligations. Defining stakeholders will ease categorizing them as key, secondary, technical, *etc.* The role division increases members' commitment and strengthens and improves the relationship between CIGs and their stakeholders.

    - The monitoring, assessment, and control of CIGs need to be revised. Stakeholders' blindness to their responsibilities poses a serious hazard, which can be addressed by categorizing them and improving coordination among them. The AGP II coordination office of the study *woreda* should primarily organize stakeholders. The stakeholders could be categorized based on the tasks allotted to each. Classifying them into primary key, primary, and secondary stakeholders is one approach to accomplish this.

- A sufficient budget should be set aside for ongoing monitoring and supportive supervisory activities. Given that the CIGs are dispersed throughout the *kebeles*, substantial funding is required, among other things, for transportation. The value chain should also be taken into account. Before establishing a link to the market, CIGs members must improve production and productivity (both in terms of quantity and quality). The market linkage platform should start modestly rather than waiting until abundant production exists.

- Since the lack of workspaces was discovered as the significant bottleneck for the CIGs' operations, allowing them access to the workplace could help them run more smoothly. Besides, the sizes of CIG members ought to be scaled back to a working number. This may depend on how each member contributes to the organization. Only based on a person's direct contribution to the group may they be considered for membership. When members' roles and responsibilities are assigned, any other asset that may be identified, such as skills or knowledge, must be considered a contribution. Doing these will tighten members' interaction, increase their sense of ownership, and deepen their sense of belongingness to their groups.

- Businesses the CIGs would engage in should be examined and supported by a business strategy/plan. The cooperative development office of the study woreda should focus primarily on supplying the CIGs with business plans and related accounting services before their formation and throughout their operation. Additionally, startup cash should be provided for the beneficiaries of CIGs based on credit. It should not be provided as in-kind seed funding because encouragement to pay back could improve their ability to save. Savings then enable additional investment and economic potential.

- A union between the CIGs is required when their internal functioning is already reinforced and improved. Doing so could strengthen their ability to influence others, increase their productivity, and boost their value chain. These altogether would strengthen their collective bargaining power.

7.3. Limitations of the study and suggestions for future research

The first limitation of this study is the inconsistent use of the name "Northwestern Ethiopia" and "Central Ethiopia" to refer to the study area. The title and general objective states that the study was conducted in Central Ethiopia, but one of the published manuscripts refers to Northwestern Ethiopia. This inconsistency could be confusing for readers, as it is not clear which location is the focus of the study. The researchers requested the respective Journal to change the name of the study area in the title and objective to "Central Ethiopia" to provide more clarity. However, the editor did not approve this change. As a result, the manuscript was published with the inconsistent names with other manuscripts. This limitation could be addressed in future studies by carefully considering the names of the study areas and ensuring that they are consistent throughout the manuscripts. Even though the indicated location would broadly represent the study area, and the researchers homogenized the naming with other articles in the dissertation, it is still important to be consistent with the names of the study areas to avoid confusion.

Interrelated issues that range from the impacts of using the *Korra tef* variety on the users' productivity, income, commercialization, and welfare and the productivity effects of plot-level *Korra tef* seed rates to the effects of CIG on the livelihood of rural women and youths were raised and discussed in this study. However, the study's three interrelated objectives (*i.e.* studies related to productivity and income, commercialization and welfare) posseses one limitation. Even though we applied the PSM to control the effects of other complementary programs and/or variables in the study areas and, as a result, came up with a reasonably accurate estimate of the impacts of using the *Korra tef* variety on specific outcomes of the users' productivity, income, commercialization, and welfare and have a commonsensible conjucture that one outcome could cause another given their interconnectedness, this inference does not prove our assumption. This is because neither our models nor we attempted to establish a causal relationship between these variables as it is beyond the scope of this study. If we had used such a model, we would have been able to identify the ad hoc relationships and connections among the variables under consideration, as well as the extent to which one variable influences the occurrence of another.

Another limitation of this study pertains to the methodology's utilization of a relatively higher non-response rate of 25%. While this decision was made with the intention of accounting for

potential non-response, ensuring an adequate sample size, and with the believe that oversampling in the Propensity Score Matching (PSM) can address the problem of small sample size and improve the accuracy of the estimates (Bottigliengo et al., 2021), it is important to acknowledge the potential implications it may have on the presence of bias if the non-respondents differ systematically from the respondents. In the existing literature, it is commonly recommended to employ a non-response rate ranging from 5% to 10%, as this assumes a smaller proportion of non-respondents and subsequently diminishes the risk of introducing bias. By adhering to the recommended lower non-response rate, the study could have potentially enhanced the representativeness of the sample and fostered greater confidence in the reliability of the study's findings. Therefore, the decision to employ a higher non-response rate, although intended to address potential non-response concerns, should be considered as another limitation of this study. It is essential to recognize and account for the implications associated with a higher non-response rate when interpreting and generalizing the study's outcomes.

The presence of limitations indicates that there are still studies to be done on the issues under consideration. First, basing the limitation indicated above, if the model-based causal relationship among the study's major outcome variables will be studied (*i.e.* the extent to which one variable influences the occurrence of another); it would serve as a basis for further clarification and understanding on the issue under consideration. Other specific future research recommendations on each objective of study include the following:

1. The study provided evidence that the *Korra tef* farm can help farm households achieve their goal of increased productivity and income. Future research could build on these findings to see whether using the *Korra tef* variety has varied consequences based on the users' agro-ecological zones, the amount of farmland allotted for *tef* production, and/or the degree of their use. These might lessen the likelihood of incorrect impact estimations, conclusions, and recommendations.

2. The yield impacts of *Korra tef* seed rates for various soil types, tillage frequency, socio-economic settings, weather conditions, spatial arrangements, and other agricultural inputs (like fertilizers) should also be investigated. Doing so will enrich the existing discussions and knowledge on the yield impacts of plot-level seed rates. In addition to what has

already been indicated, the current study needs to be repeated over the years with similar settings at multiple sites to confirm the results and develop solid and more conclusive recommendation that can be used by the farmers that grow *Korra tef*.

3. Future studies could address determinants of using *Korra tef* in the study area and/or other comparable areas to better understand its commercialization impacts and gain additional insight into its commercialization implications.

4. Further research is needed to investigate the heterogeneous welfare effects of using the *Korra tef* over household characteristics. The ATT values may differ significantly depending on farm households' institutional, socio-economic, and demographic characteristics. This must be explored to fully comprehend the differential impacts of using *Korra tef.* Additionally, it is essential to investigate factors that influence using in tandem with consumption to identify farmers' essential traits or actions linked to more dynamic welfare paths.

5. Even though it is not impossible, it is difficult to formulate a policy recommendation from a micro-level qualitative study like the CIG-based analysis. As a result, a comparable high-level study with a broader scope on CIGs is suggested to look out for potential similarities and have a more informative policy implication. CIGs from other areas with appropriate documentation should be considered to capture additional characteristics of its implementation. Looking for the CIGs that possesses the recordings [of their activities, business plans, and accounting-related documentation] would help corroborate self-report statistical data.

References

Abadie, A., & Cattaneo, M. D. (2018). Econometric methods for program evaluation. *Annual Review of Economics*, *10*(1).

Abara, I. O. C., & Singh, S. (1993). Ethics and biases in technology adoption: The small-firm argument. *Technological Forecasting and Social Change*, *43*(3–4), 289–300. https://doi.org/10.1016/0040-1625(93)90057-E

Abate, G. T., Bernard, T., de Brauw, A., & Minot, N. (2018). The impact of the use of new technologies on farmers' wheat yield in Ethiopia: Evidence from a randomized control trial. *Agricultural Economics*, *49*(4), 409–421.

Abate, Shiferaw, B., Menkir, A., Wegary, D., Kebede, Y., Tesfaye, K., Kassie, M., Bogale, G., Tadesse, B., & Keno, T. (2015). Factors that transformed maize productivity in Ethiopia. Food Secur. 7, 965–981. *Link: Https://Bit. Ly/2WlY0sY*.

Abebe, G., & Alemu, A. (2017). Role of improved seeds towards improving livelihood and food security at Ethiopia. *International Journal of Research-Granthaalayah*, *5*(2), 338–356.

Abesha, N., Assefa, E., & Petrova, M. A. (2022). Large-scale agricultural investment in Ethiopia: Development, challenges and policy responses. *Land Use Policy*, *117*, 106091.

Abraha, A., Daniel, A., & Negasi, T. (2020). Response of Teff (Eragrostis tef (Zucc) Trotter) to Seeding Rate and Methods of Sowing on Yield and Yield Attributes in a Subhumid Environment, Northern Ethiopia. *International Journal of Agronomy*, *2020*. https://doi.org/10.1155/2020/1516790

Abraham, R., Nigussie, D., & Kebebew, A. (2018). Evaluation of seed rates and sowing methods on growth, yield and yield attributes of tef [Eragrostis tef (Zucc.) Trotter] in Ada District, East Shewa, Ethiopia. *J. Biol*, *4*, 171–172. https://doi.org/10.5829/idosi.aejaes.2018.34.49

Achandi, E. L., & Mujawamariya, G. (2016). Market participation by smallholder rice farmers in Tanzania: A double hurdle analysis. *Studies in Agricultural Economics*, *118*(2), 112–115.

Adams, J., Khan, H. T., Raeside, R., & White, D. I. (2007). *Research methods for graduate business and social science students*. SAGE publications India.

Adejobi, A. O., & Akinola, C. A. (Eds.). (2013). *An Analysis of the Effects of Agricultural Output Commercialization on Household Welfare in Osun State of Nigeria*. https://doi.org/10.22004/ag.econ.160136

Adenle, A. A. (2017). Building the African economy: Is President Obama's entrepreneurial public management program sustainable in Africa? *Journal of Entrepreneurship and Public Policy*. https://doi.org/10.1108/JEPP-12-2015-0036

Adeyanju, D. F. (2019). *Impact Of Agricultural Training Programmes On Youth Agripreneurship Performance And Empowerment In Nigeria* [PhD Thesis, University of Nairobi]. http://erepository.uonbi.ac.ke/handle/11295/108201

Aemiro, B. W., Iohannes, S. D., Miculan, M., Caproni, L., Jemal Seid Ahmed, Desta, Fadda, C., Pè, M. E., & Dell'Acqua, M. (2021). Data-driven, participatory characterization of traditional farmer varieties discloses teff (Eragrostis tef) adaptive and breeding potential under current and future climates. *BioRxiv*. https://doi.org/10.1101/2021.08.27.457623

Afework, H., & Endrias, G. (2016). Review on small holders agriculture commercialization in Ethiopia: What are the driving factors to focused on? *Journal of Development and Agricultural Economics*, *8*(4), 65–76.

AGRA. (2017). *Africa Agriculture Status Report. The Business of Smallholder Agriculture in Sub-Saharan Africa. Nairobi, Kenya: Alliance for a Green Revolution in Africa (AGRA). Issue No. 5.* https://www.google.com/search?q=Africa+Agriculture+Status+Report.+(2017).

Ahmed. (2017). *The impact of agricultural cooperatives membership on the wellbeing of smallholder farmers: Empirical evidence from eastern Ethiopia*. 20.

Ahmed, & Ahmed, Y. A. (2021). Constraints of youth entrepreneurs in Ethiopia. *Journal of Global Entrepreneurship Research*. https://doi.org/10.1007/s40497-021-00292-z

Ahmed, & Mesfin, H. M. (2017). The impact of agricultural cooperatives membership on the wellbeing of smallholder farmers: Empirical evidence from eastern Ethiopia. *Agricultural and Food Economics*, *5*(1), 6. https://doi.org/10.1186/s40100-017-0075-z

Alebel, B., Tadesse, K., Mekonnen, B., Tigabu, G., Gebeyhu, M., Seid, Y., Minyahil, D., & Abenezer, W. (2019). *Second Agricultural Growth Program: Midterm Quantitative Evaluation Report*. Policy Study Institute1. https://www.google.com/search?q=Second+Agricultural+Growth+Program%3A+Midterm+Qualitative+Evaluation+Report

Alemu. (2011). *Farmer-Based Seed Multiplication in the Ethiopian Seed System: Approaches, Priorities and Performance*. 14.

Alemu, & Adesina, J. O. (2017). In search of rural entrepreneurship: Non-farm household enterprises (NFEs) as instruments of rural transformation in Ethiopia. *African Development Review*, *29*(2), 259–271.

Alemu, D., & Berhanu, K. (2018). *The Political Economy of Agricultural Commercialisation in Ethiopia: Discourses, Actors and Structural Impediments*.

Allen, L., Garst, B. A., Bowers, E. P., & Onyiko, K. K. (2016). *Building a Youth Development System in Kenya: Comparing Kenyan Perceptions of Local and National Systems*. http://localhost:8080/xmlui/handle/123456789/4773

Aman, T., Adam, B., & Lemma, Z. (2014). Determinants of smallholder commercialization of horticultural crops in Gemechis District, West Hararghe Zone, Ethiopia. *African Journal of Agricultural Research*, *9*(3), 310–319.

Amare, A., & Adane, L. (2015). Determination of seed rate and variety on the growth and yield of teff in Eastern Amhara Region, Ethiopia. *Journal of Biology, Agriculture and Healthcare*, *5*(5), 27–33.

Amsalu, M. (2014). Impact of smallholder farmers agricultural commercialization on rural households' poverty. *International Journal of Applied Economics and Finance*, *8*(2), 51–61.

Anderson, J. R., & Feder, G. (2007). Agricultural extension. *Handbook of Agricultural Economics*, *3*, 2343–2378.

Andersone, R. (2004). Social Skills Development through the Basic School Course of Natural Science. *Journal of Baltic Science Education*, *3*(1). http://www.scientiasocialis.lt/jbse/files/pdf/vol3/42-48.Andersone_JBSE_Vol.3_No.1.pdf

Angassa, D. (2007). *Effect of sowing method and seeding rate on yield and yield components of rainfed rice (Oryza sativa L.) varieties in Woliso, South-West Shoa Zone, Ethiopia* [PhD Thesis]. MSc. Thesis, Haramaya University, Ethiopia.

Arega, A., & Yemgnushal, F. (2018). *Effect of Seed Rate on Yield and Yield Components of Tef ((Eragrostic Tef) Trotter) at Konso and Arbaminch, Southern Ethiopia*. file:///C:/Users/k/Downloads/EffectofSeedRateonYieldandYieldComponentsofTef.pdf

Asfaw, S., Shiferaw, B., Simtowe, F., & Lipper, L. (2012). Impact of modern agricultural technologies on smallholder welfare: Evidence from Tanzania and Ethiopia. *Food Policy*, *37*(3), 283–295. https://doi.org/10.1016/j.foodpol.2012.02.013

Assefa. (2022). *Smallholder Farmers Tef Commercialization and its Impact on Food Security: The Case of Andabet District, Amhara Region, Ethiopia* [PhD Thesis].

Assefa, K., Chanyalew, S., & Tadele, Z. (2013). *Achievements and Prospects of Tef Improvement-Proceedings of the Second International Workshop, November 7-9, 2011, Debre Zeit, Ethiopia*. Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia.

ATA. (2013). *Agricultural Transformation Agency. Results of 2012 New Tef Technologies Demonstration Trials Draft Report VF". Addis Ababa, Ethiopia*.

ATA. (2015). *Agricultural Transformation Agency. A Training Manual on Cereal Production; ATA (Agricultural Transformation Agency): Addis Ababa, Ethiopia*.

ATA. (2017). *Ethiopia's Agricultural Extension Strategy (Draft): Vision, Systemic Bottlenecks and Priority Interventions*. Agricultural Transformation Agency.

Atkinson, A. B. (1992). Measuring poverty and differences in family composition. *Economica*, 1–16.

Awino, Z., Bolo, Lorika, J., & Obonyo, P. (2022). *Effectiveness of the value chain strategy in the selected producer-owned dairy groups in Kenya*. https://www.researchgate.net/profile/Zachary-Awino/publication/265926432_Effectiveness_of_the_value_chain_strategy_in_the_selected_producer-owned_dairy_groups_in_Kenya

Awotide, B. A., Awoyemi, T. T., Omonona, B. T., & Diagne, A. (2016). Impact of improved agricultural technology adoption on sustainable rice productivity and rural farmers' welfare in Nigeria. *Inclusive Growth in Africa: Policies, Practice, and Lessons Learnt*, 216–237.

Ayelech. (2020, October 9). *An interview with the AGP II facilitator at North Shoa zone, oromia regional government* [In Person].

Azzarri, C., Carletto, G., Davis, B., & Zezza, A. (2006). Monitoring poverty without consumption data: An application using the Albania panel survey. *Eastern European Economics*, *44*(1), 59–82.

Babbie, E. (2010). The practice of social research (Twelfth). *Wadsworth, Cengage Learning*.

Bacha, D., Namara, R., Bogale, A., & Tesfaye, A. (2011). Impact of small-scale irrigation on household poverty: Empirical evidence from the Ambo district in Ethiopia. *Irrigation and Drainage*, *60*(1), 1–10.

Bachewe, F. N., Koru, B., & Taffesse, A. S. (2019). Productivity and efficiency of smallholder teff farmers in Ethiopia. *Gates Open Res*, *3*(208), 208.

Baloch, A. W., Soomro, A. M., Javed, M. A., Ahmed, M., Bughio, H. R., Bughio, M. S., & Mastoi, N. N. (2002). Optimum plant density for high yield in rice (Oryza sativa L.). *Asian J. Plant Sci*, *1*(1), 25–27.

Bekalu, A., & Arega, A. (2016). Effect of Seed Rate on Yield and Yield Components of Tef [(Eragrostic tef) Trotter] at Shebedino, Southern Ethiopia. *Journal of Natural Sciences Research. Www. Iiste. Org*, *6*(21). https://core.ac.uk/download/pdf/234656703.pdf

Bekele. (2020, October 11). *An interview with Wara-Jarso district's AGP II coordination office* [In Person].

Bekele, Chanyalew, S., Damte, T., Husien, N., Genet, Y., Assefa, K., Nigussie, D., & Tadele, Z. (2019). Cost-benefit analysis of New Tef (Eragrostis tef) varieties under lead farmers' production management in the Central Ethiopia. *Ethiopian Journal of Agricultural Sciences*, *29*(1), 109–123.

Bekele, & Worku, Z. (2008). Factors that affect the long-term survival of micro, small and medium enterprises in Ethiopia. *South African Journal of Economics*, *76*(3), 548–568. https://doi.org/10.1111/j.1813-6982.2008.00207.x

Belbin, R. M. (2010). *Management teams: Why they succeed or fail*. Butterworth-Heinemann. http://www.dawsonera.com/depp/reader/protected/external/AbstractView/S9780080963594

Bengtsson, M. (2016). How to plan and perform a qualitative study using content analysis. *NursingPlus Open*, *2*, 8–14. https://doi.org/10.1016/j.npls.2016.01.001

Bereket. (2020, October 22). *An interview with DA at Dhaye-Tuti kebele* [In Person].

Berhane, G., Ragasa, C., Abate, G. T., & Assefa, T. W. (2018). *The state of agricultural extension services in Ethiopia and their contribution to agricultural productivity*. Intl Food Policy Res Inst.

Berhanu, K., & Poulton, C. (2014). The political economy of agricultural extension policy in Ethiopia: Economic growth and political control. *Development Policy Review*, *32*(s2), s197–s213.

Berik, G. (2018). *Toward more inclusive measures of economic well-being: Debates and practices*. Research Paper. ILO future of work research paper series. https://www.ilo.org/wcmsp5/groups/public/---dgreports/---cabinet/documents/publication/wcms_630602.pdf

Besley, T. (2002). *Welfare Economics and Public Choice, London School of Economics and Political Science*.

Besley, T., & Case, A. (1994). *Diffusion as a learning process: Evidence from HYV cotton*.

Beyene. (2008). *Adoption of improved tef and wheat production technologies in crop-livestock mixed systems in northern and western Shewa zones of Ethiopia* [PhD Thesis]. University of Pretoria.

Beyene, A. (2018). *Agricultural transformation in Ethiopia: State policy and smallholder farming*. Bloomsbury Publishing.

Bezu, S., & Holden, S. (2014). Are rural youth in Ethiopia abandoning agriculture? *World Development*, *64*, 259–272. https://www.sciencedirect.com/science/article/pii/S0305750X14001727

Bhattacherjee, A. (2012). *Social science research: Principles, methods, and practices*.

Biggeri, M., Burchi, F., Ciani, F., & Herrmann, R. (2018). Linking small-scale farmers to the durum wheat value chain in Ethiopia: Assessing the effects on production and wellbeing. *Food Policy*, *79*, 77–91. https://doi.org/10.1016/j.foodpol.2018.06.001

Binswanger, H. P., & Braun, J. von. (1991). Technological change and commercialization in agriculture: The effect on the poor. *The World Bank Research Observer*, *6*(1), 57–80.

Biru, W. D., Zeller, M., & Loos, T. K. (2020). The impact of agricultural technologies on poverty and vulnerability of smallholders in Ethiopia: A panel data analysis. *Social Indicators Research*, *147*(2), 517–544.

Bishaw, Z., Struik, P. C., & Van Gastel, A. J. G. (2012). Farmers' seed sources and seed quality: 1. physical and physiological quality. *Journal of Crop Improvement*, *26*(5), 655–692.

Biyase, M., & Zwane, T. (2018). An empirical analysis of the determinants of poverty and household welfare in South Africa. *The Journal of Developing Areas*, *52*(1), 115–130.

BoFED. (2018). *Bureau of Finance and Economic Development: Physical and Socio- Economic Profile of Oromiya (Third Edition). Oromiya Bureau of Finance and Economic Development, National Regional State of Oromiya*. www.usaidlandtenure.net/sites/default/.../USAID_Land_Tenure_Ethiopia_Profile.pdf

BohatALA. (2019, October 12). *Theories on Teamwork and Role of Group Members*. https://bohatala.com/theories-on-teamwork-and-role-of-group-members/

Boka, G. T. (2017). Climate Change Challenges, Smallholders' Commercialization, and Progress out of Poverty in Ethiopia, Working Paper Series N° 253, African Development Bank, Abidjan, Côte d'Ivoire. *African Development Bank Group*, 42.

Bottigliengo, D., Baldi, I., Lanera, C., Lorenzoni, G., Bejko, J., Bottio, T., Tarzia, V., Carrozzinni, M., Gerosa, G., Berchialla, P., & Gregori, D. (2021). Oversampling and replacement strategies in propensity score matching: a critical review focused on small sample size in clinical settings. *BMC Med Res Methodol* 21, 256. https://doi.org/10.1186/s12874-021-01454-z

Boudot, C., Butler, A., & Dugal, N. (2013). Evaluating technologies for agricultural development: How to capture the true impact? *Science et Changements Planétaires/Sécheresse*, *24*(4), 374–384.

Braun, J. von, Bouis, H., & Kennedy, E. (1994). Conceptual framework. *Agricultural Commercialization, Economic Development, and Nutrition.*, 11–33.

Buehren, N., Goldstein, M., Molina, E., & Vaillant, J. (2017). The impact of strengthening agricultural extension services: Evidence from Ethiopia. *World Bank Policy Research Working Paper*, *8169*.

Buljac-Samardzic, M., Wijngaarden, J. D. H. van, Wijk, K. P. van, & Exel, N. J. A. van. (2011). Perceptions of team workers in youth care of what makes teamwork effective. *Health & Social Care in the Community*, *19*(3), 307–316. https://doi.org/10.1111/j.1365-2524.2010.00978.x

Busch, Carol, Paul S., D. M., Teresa, F., Rachel, K., Sheri, L., Brad, M., Matt, S., Robert, W., & Mike, P. (2005). *Content Analysis. Writing@CSU*. Colorado State University. https://writing.colostate.edu/guides/guide.cfm?guideid=61

Calabrese, E. J. (2014). Dose–Response Relationship. In *Encyclopedia of Toxicology* (pp. 224–226). Elsevier. https://doi.org/10.1016/B978-0-12-386454-3.00991-X

Caliendo, M., & Kopeinig, S. (2008). Some Practical Guidance for the Implementation of Propensity Score Matching. *Journal of Economic Surveys*, *22*(1), 31–72. https://doi.org/10.1111/j.1467-6419.2007.00527.x

Camara, A. (2017). An analysis of welfare effect of market participation of smallholder farm households in Guinea. *Economic Research Guardian*, *7*(1), 2.

Caruso, H. M., & Williams, W. A. (2008). Harnessing the power of emergent interdependence to promote diverse team collaboration. In K. W. Phillips (Ed.), *Diversity and Groups* (Vol. 11, pp. 245–266). Emerald Group Publishing Limited. https://doi.org/10.1016/S1534-0856(08)11011-8

Chambers, R. (1995). Poverty and Livelihoods: Whose Reality Counts? Routledge, London.Chambers, R., & Conway, G. (1992). *Sustainable rural livelihoods: Practical concepts for the 21st century*. Institute of Development Studies (UK). https://opendocs.ids.ac.uk/opendocs/handle/20.500.12413/775

Chandrasekhar, A. G., Larreguy, H., & Xandri, J. P. (2020). Testing models of social learning on networks: Evidence from two experiments. *Econometrica*, *88*(1), 1–32.

Cheber, D. (2018). Smallholder Agricultural Commercialization for Income Growth and Poverty Alleviation: A Review from Ethiopian Context. *College of Agriculture and Veterinary Medicine, Department of Rural Development and Agricultural Extension, Jimma University Ethiopia, PO Box*, *307*, 2225–0565.

Cherryholmes, C. H. (1992). Notes on pragmatism and scientific realism. *Educational Researcher*, *21*(6), 13–17.

Chikwama, C. (2014). Does agriculture play an important role in economic growth and structural transformation. *DFID: The Agriculture and Growth Evidence Paper Series*.

Chimucheka, T. (2014). Entrepreneurship Education in South Africa. *Mediterranean Journal of Social Sciences*, *5*(2), Article 2.

Chirisa, I. (2009). Prospects for the asset-based community development approach in Epworth and Ruwa, Zimbabwe: A housing and environmental perspective. *African Journal of History and Culture*, *1*(2), 028–035. https://doi.org/10.5897/AJHC.9000025

Chron, C. (2021). *Theories on Teamwork*. https://work.chron.com/theories-teamwork-6545.html

Citro, C., Michael, R., Poverty, P. on, & Assistance, F. (1995). Measuring poverty: A new approach. *Undefined*. https://www.semanticscholar.org/paper/Measuring-poverty-%3A-a-new-approach-Citro-Michael/f61a8903f1a0597bb05a3874e102541a76d930ee

Clarke, V., & Braun, V. (2013). Teaching thematic analysis: Overcoming challenges and developing strategies for effective learning. *The Psychologist*, *26*(2). https://uwe-repository.worktribe.com/preview/937606/Teaching

Coelli, T. J., Rao, D. S. P., O'Donnell, C. J., & Battese, G. E. (2005). *An introduction to efficiency and productivity analysis*. springer science & business media.

Creswell, J. W. (2009). Research designs: Qualitative, quantitative, and mixed methods approaches. *Callifornia: Sage*.

Creswell, J. W., & Clark, V. L. P. (2017). *Designing and conducting mixed methods research*. Sage publications.

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Crowe, S., Cresswell, K., Robertson, A., Huby, G., Avery, A., & Sheikh, A. (2011). The case study approach. *BMC Medical Research Methodology*, *11*(1), 100. https://doi.org/10.1186/1471-2288-11-100

CSA. (2016). *Central Statistical Agency. Agricultural Sample Survey 2015/2016, Volume 1: Area and Production of Major Crops. Central Statistical Agency, Federal Democratic Republic of Ethiopia, Addis Ababa.*

CSA. (2018). *FDRE Central Statistical Agency, Population Projection of Ethiopia*. FDRE Central Statistical Agency, 2013,Population Projection of Ethiopia for All Regions At Wereda Level from 2014 – 2017

CSA. (2020). *Central Statistical Agency. Agricultural Sample Survey 2019/20(2012 E.C.) (September – December, 2019). Report on Farm Management Practices (Private Peasant Holdings, Meher Season)*. https://www.google.com/search?q=Agricultural+Sample+Survey+2019%2F2020%3A+Report+on+area+and+production+of+major+crops

Danso-Abbeam, G., Ehiakpor, D. S., & Aidoo, R. (2018). Agricultural extension and its effects on farm productivity and income: Insight from Northern Ghana. *Agriculture & Food Security*, *7*(1), 1–10.

Dargicho, D., Ermias, A., & Muluneh Menamo. (2020). Performance Evaluation and Selection of Improved Tef (Eragrostis tef L) varieties at Main Campus Site Hadiya Zone, Southern Ethiopia. *BioRxiv*. https://doi.org/10.1101/2020.08.28.267583

Das, V. K. (2016). Agricultural productivity growth in India: An analysis accounting for different land types. *The Journal of Developing Areas*, 349–366.

De Janvry, A., Macours, K., & Sadoulet, E. (2017). *Learning for adopting: Technology adoption in developing country agriculture*. Ferdi.

Deaton, A. (1997). *The analysis of household surveys: A microeconometric approach to development policy*. World Bank Publications.

Deaton, A. (2005). Measuring poverty in a growing world (or measuring growth in a poor world). *Review of Economics and Statistics*, *87*(1), 1–19.

Deaton, A., & Zaidi, S. (2002). *Guidelines for constructing consumption aggregates for welfare analysis* (Vol. 135). World Bank Publications.

Degefa, K., Abebe, G., & Biru, G. (2022). Determinants of market participation decision and intensity of market participation in western Ethiopia: Evidence from smallholder tef producers. *International Journal of Agricultural Science and Food Technology*, *8*(2), 125–133.

Degefu, Z. (2016). *Adoption and welfare impact of improved food legume technologies in Bale Highlands of Ethiopia: Intra and inter-household empirical analysis* [Thesis, Haramaya University]. https://cgspace.cgiar.org/handle/10568/78134

Delessa, A. (2017). Effect of Sowing Method and Seeding Rate on Yield and Yield Components of Rainfed Rice (*Oryza sativa* L.) Varieties in Woliso, South-West Shoa Zone, Ethiopia. *International Journal of Applied Agricultural Sciences*, *3*(5), Article 5. https://doi.org/10.11648/j.ijaas.20170305.11

Demeke, & Haji, J. (2014). *Econometric analysis of factors affecting market participation of smallholder farming in Central Ethiopia*.

Demeke, M., & Di Marcantonio, F. (2013). Analysis of incentives and disincentives for teff in Ethiopia (Technical Notes Series). *Rome: MAFAP, FAO*.

Demeke, T. (2016). Assessment of challenges and opportunities of women owned micro and small enterprises: A case of Asella town. *International Journal of Management, IT and Engineering*, *6*(12), 37–58. https://www.researchgate.net/publication/344494413

Dercon, S., Gilligan, D. O., Hoddinott, J., & Woldehanna, T. (2009). The impact of agricultural extension and roads on poverty and consumption growth in fifteen Ethiopian villages. *American Journal of Agricultural Economics*, *91*(4), 1007–1021.

Derso, D., Elemo, E., & Sawnet, Y. (2016). Determinants of the utilization of agricultural inputs and transfer of agricultural technologies. A review of literature on agricultural extension model. *J. Agric. Res. Develop*, *6*(2), 30–33.

Desalegn, B. A. (2016). Challenges and Opportunities of Micro and Small Munifacturing Enterprises the Case of Easter Zone of Tigray. *International Journal of Science and Research*, *5*(6), 1679–1686.

Designorate Team. (2015). *Six SWOT Analysis Tools and Applications*. https://www.designorate.com/six-swot-analysis-tools-and-applications/

DHS. (2016). *Ethiopia-Demographic-Health-Survey-Report-Key-Findings-2016—Google Search*.

Diehl, M. (1988). Social identity and minimal groups: The effects of interpersonal and intergroup attitudinal similarity on intergroup discrimination. *British Journal of Social Psychology*, *27*(4), 289–300. https://doi.org/10.1111/j.2044-8309.1988.tb00833.x

Diriba, G. (2018a). Agricultural and Rural Transformation in Ethiopia: *Ethiopian Journal of Economics*, *27*(2), Article 2.

Diriba, G. (2018b). *Overcoming Agricultural and Food Crises in Ethiopia: Institutional Evolution and the Path to Agricultural Transformation*. Independently published.

Diriba, G. (2020). *Agricultural and rural transformation in Ethiopia: Obstacles, triggers and reform considerations policy working paper*.

Diskin, P. (1997). *Agricultural productivity indicators measurement guide*. Food Security and Nutrition Monitoring (IMPACT) Project.

Dorward, A., Morrison, J., Wobst, P., Lofgren, H., & Tchale, H. (2004). Modelling pro-poor agricultural growth strategies in Malawi: Lessons for policy and analysis. *Wye, Ashford, UK, Centre for Development and Poverty Reduction, Department of Agricultural Sciences, Imperial College London*.

Duflo, E., & Suri, T. (2010). *Diffusion of technologies within social networks, evidence from a coffee training program in Rwanda. International Growth Centre Ref No*. F-4001-RWA-1.

Dutta, B., & Pattanaik, P. K. (2003). The scope and structure of Welfare Economics. *Welfare Economics and Social Choice*, 1–25.

Dzisi, S., Odoom, F. D., & Gligah, B. (2018). Entrepreneurship training and skills development in Africa: Evidence from Koforidua Technical University, Ghana. *International Journal of Economics and Business Research*, *15*(4), 509–523. https://doi.org/10.1504/IJEBR.2018.092154

Edosa. (2020, October 5). *An interview with the AGP II monitoring expert at Oromia regional government* [In Person].

Edosa, T. L. (2018). Determinants of commercialization of teff crop in Abay Chomen District, Horo Guduru wallaga zone, Oromia Regional State, Ethiopia. *Journal of Agricultural Extension and Rural Development*, *10*(12), 251–259. https://doi.org/10.5897/JAERD2018.0970

Eftimie, A. M., Darling, R., & Pollett, T. (2014). *A strategic approach to early stakeholder engagement: A good practice handbook for junior companies in the extractive industries*. https://policycommons.net/artifacts/1527451/a-strategic-approach-to-early-stakeholder-engagement/2216274/

EIAR, D. G. (2018). *Agricultural Growth Program-II (AGP2). Overview of the Program and Concise Account of the Research Component. Ethiopian Institute of Agricultural Research.*

Ellis, F. (2000). Rural Livelihoods and Diversity in Developing Countries. Oxford University Press, Oxford.

Ellis, F., & Biggs, S. (2001). Evolving themes in rural development 1950s-2000s. *Development Policy Review*, *19*(4), 437–448.

Emerick, K., & Dar, M. (2017). Enhancing the diffusion of information about agricultural technology. *Unpublished Manuscript*.

Endalew, B., Aynalem, M., Assefa, F., & Ayalew, Z. (2020a). Determinants of wheat commercialization among smallholder farmers in Debre Elias Woreda, Ethiopia. *Advances in Agriculture*, *2020*.

Endalew, B., Aynalem, M., Assefa, F., & Ayalew, Z. (2020b). Determinants of Wheat Commercialization among Smallholder Farmers in Debre Elias Woreda, Ethiopia. *Advances in Agriculture*, *2020*. https://doi.org/10.1155/2020/2195823

Endalew, B., Aynalem, M., Assefa, F., & Ayalew, Z. (2020c). Determinants of Wheat Commercialization among Smallholder Farmers in Debre Elias Woreda, Ethiopia. *Advances in Agriculture*, *2020*, 1–12. https://doi.org/10.1155/2020/2195823

Endalkachew, T., Sebsibie, S., & Asmare, W. (2014). *Agricultural Technology Adoption and Rural Poverty: A Study on Smallholders in Amhara Regional State, Ethiopia*.

Eneyew, A., & Bekele, W. (2012). Determinants of livelihood strategies in Wolaita, southern Ethiopia. *Agricultural Research and Reviews*, *1*(5), 153–161.

Engidaw, A. E. (2021). Exploring internal business factors and their impact on firm performance: Small business perspective in Ethiopia. *Journal of Innovation and Entrepreneurship*, *10*(1), Article 1. https://doi.org/10.1186/s13731-021-00167-3

Ennis, G., & West, D. (2010). Exploring the Potential of Social Network Analysis in Asset-based Community Development Practice and Research. *Australian Social Work*, *63*(4), 404–417. https://doi.org/10.1080/0312407X.2010.508167

Enos, J. L. (2008). *The adoption and diffusion of imported technology: The case of Korea*. Routledge.

Enright, S., McElrath, R., & Taylor, A. (2016). *The Future of Stakeholder Engagement. Transformative Engagement for Inclusive Business: Research Report on Business Leadership for an Inclusive Economy*. Business for Social Responsibility (BSR). https://www.bsr.org/reports/BSR_Future_of_Stakeholder_Engagement_Report.pdf

Eshetu, G. (2018). *Commercialization of Smallholder Tef Producers in Jamma District, South Wollo Zone, Ethiopia* [PhD Thesis]. Haramaya university.

Evenson, R. E., & Gollin, D. (2003). Assessing the Impact of the Green Revolution, 1960 to 2000. *Science*, *300*(5620), 758–762. https://doi.org/10.1126/science.1078710

Fan, S., & Rue, C. (2020). The Role of Smallholder Farms in a Changing World. In S. Gomez y Paloma, L. Riesgo, & K. Louhichi (Eds.), *The Role of Smallholder Farms in Food and Nutrition Security* (pp. 13–28). Springer International Publishing. https://doi.org/10.1007/978-3-030-42148-9_2

FAO. (2014). *Economic and Social Development Department. The State of Food and Agriculture (SOFA) 2014*. https://policycommons.net/artifacts/2071892/the-state-of-food-and-agriculture-sofa-2014/2827191/

Fasil. (2020, October 19). *An interview with DA at Lencho-Borsu kebele* [In Person].

Feyisa, B. W. (2020). Determinants of agricultural technology adoption in Ethiopia: A meta-analysis. *Cogent Food & Agriculture*, *6*(1), 1855817. https://doi.org/10.1080/23311932.2020.1855817

FGD 1. (2020, October 27). *Focus Group Discussion conducted at Lencho-Borsu Kebele with Dairy farm group on October 27, 2019* [Discussion].

FGD 2. (2020, October 28). *Focus Group Discussion conducted at Dhaye-Tuti Kebele with Sheep fattening group on October 28, 2019* [Discussion].

FGD 3. (2020, October 29). *Focus Group Discussion conducted at Wale-Chilalo Kebele with Poultry production group on October 29, 2019.* [Discussion].

FGD 4. (2020, October 30). *Focus Group Discussion conducted at Abo-Yayambana Kebele with Oxen fattening group on October 30, 2019* [Discussion].

Filmer, D., & Pritchett, L. (1999). The effect of household wealth on educational attainment: Evidence from 35 countries. *Population and Development Review*, *25*(1), 85–120.

Filmer, D., & Pritchett, L. H. (2001). Estimating wealth effects without expenditure data—or tears: An application to educational enrollments in states of India. *Demography*, *38*(1), 115–132.

Fisher, S. G., Hunter, T. A., & Macrosson, W. D. K. (2000). The distribution of Belbin team roles among UK managers. *Personnel Review*. https://doi.org/10.1108/00483480010295934

Fitsum. (2020, October 13). *An interview with the district's Women and youth empowerment office* [In Person].

Foster, A. D., & Rosenzweig, M. R. (2010). Microeconomics of Technology Adoption. *Annual Review of Economics*, *2*(1), 395–424. https://doi.org/10.1146/annurev.economics.102308.124433

Frehiwet. (2020, October 26). *An interview with DA at Wale-Chilalo kebele* [In Person].

Fufa, B., Behute, B., Simons, R., & Berhe, T. (2011). Tef Diagnostic Report: Strengthening the Tef Value Chain in Ethiopia. *Addis Ababa, Ethiopia*.

Garbero, A., & Songsermsawas, T. (2018). Impact of modern irrigation on household production and welfare outcomes: Evidence from the Participatory Small-Scale Irrigation Development Programme (PASIDP) project in Ethiopia. *IFAD Research Series*, *31*, 1–47.

Gebeyehu, M. G. (2016). The impact of technology adoption on agricultural productivity and production risk in Ethiopia: Evidence from rural Amhara household survey. *Open Access Library Journal*, *3*(2), 1–14.

Gebre-Ab, N. (2006). *Commercialization of smallholder agriculture in Ethiopia*. 22.

Gebremedhin, B., & Jaleta, M. (2010). *Commercialization of smallholders: Is market participation enough?*

Gebremedhin, B., Tesema, E., Tegegne, A., Hoekstra, D., & Nicola, S. (2016). *Value chain opportunities for women and young people in livestock production in Ethiopia: Lessons learned* [Working Paper]. International Livestock Research Institute. https://cgspace.cgiar.org/handle/10568/78636

Gebre-Selassie, A., & Bekele, T. (2012). A review of Ethiopian agriculture: Roles, policy and small-scale farming systems. *C. Bell & J. Prammer (Researchers), C. Eder, D. Kyd-*

Rebenburg, & J. Prammer (Eds.), Global Growing Casebook: Insights into African Agriculture, 36–65.

Gebreselassie, S., & Ludi, E. (2008). *Commercialisation in Coffee Growing Areas of Ethiopia1*.

Gebreselassie, S., & Sharp, K. (2007). Commercialisation Of Smallholder Agriculture In Selected Tef-Growing Areas Of Ethiopia. *Ethiopian Journal of Economics*, *16*(1), Article 1. https://doi.org/10.4314/eje.v16i1.39824

Gebreslassie, H., Kebede, M., & Kiros-Meles, A. (2015). Crop commercialization and smallholder farmerslivelihood in Tigray region, Ethiopia. *Journal of Development and Agricultural Economics*, *7*(9), 314–322.

Gelaw, A. (2017). *Climate Smart Agriculture in Ethiopia. Climate Smart Agriculture Country Profiles for Africa Series*.

Gerezgiher, A. (2016). *Small holder market access in Werie Leke District of Tigray National Regional State, Ethiopia: Implications for poverty reduction and food security* [PhD Thesis]. Addis Ababa university, Addis Ababa Ethiopia,.

Getahun, A. (2020). Smallholder Farmers Agricultural Commercialization in Ethiopia: A Review. *Agric For Fish*, *9*, 67.

Getahun, A., Goshu, D., & Bekele, A. (2019). *Determinants of Commercialization of Tef: The Case of Smallholder Farmers in Dendi District of Oromia, Central Ethiopia*.

Getahun, D., Tigist, A., & Adise, D. (2018). Influence of Seed Rate and Row Spacing on Growth and Yield of Tef (Eragrostis tef) Production at Assosa, Benishangul-Gumuz Regional State, Western Ethiopia. *Advances in Crop Science and Technology*, *06*(01). https://doi.org/10.4172/2329-8863.1000335

Gezahegn, A. M., Desta, B. T., Takele, A., & Eshetu, S. (2019). Productivity of tef [Eragrostis tef] under conservation tillage practices in central Ethiopia. *Cogent Food & Agriculture*, *5*(1), 1707038.

Gibis, B., Artiles, J., Corabian, P., Meiesaar, K., Koppel, A., Jacobs, P., Serrano, P., & Menon, D. (2001). Application of strengths, weaknesses, opportunities and threats analysis in the development of a health technology assessment program. *Health Policy*, *58*(1), 27–35. https://doi.org/10.1016/S0168-8510(01)00149-X

Goedde, L., Ooko-Ombaka, A., & Pais, G. (2019). Winning in Africa's agricultural market. *McKinsey & Company*.

Gollin, D., Morris, M., & Byerlee, D. (2005). Technology adoption in intensive post-green revolution systems. *American Journal of Agricultural Economics*, *87*(5), 1310–1316.

González, V., Ibarrarán, P., Maffioli, A., & Rozo, S. (2009). The impact of technology adoption on agricultural productivity: The case of the Dominican Republic. *Inter-American Development Bank, Office of Evaluation and Oversight (OVE), Washington, DC*.

Govereh, J., Nyoro, J., & Jayne T. S. (1999). *Smallholder Commercialization, Interlinked Markets and Food Crop Productivity: Cross-Country Evidence in Eastern and Southern Africa*.

Griffiths, J., Hayley, M., & Emma, G. (2008). *'Stakeholder Involvement' Background paper prepared for the WHO/WEF Joint Event on Preventing Noncommunicable Diseases in the Workplace (Dalian/ China, September 2007)*. World Health Organization. https://www.who.int/dietphysicalactivity/griffiths-stakeholder-involvement.pdf

Grootaert, C. (1986). The use of multiple diaries in a household expenditure survey in Hong Kong. *Journal of the American Statistical Association*, *81*(396), 938–944.

Guardabascio, B., & Ventura, M. (2014). Estimating the dose–response function through a generalized linear model approach. *The Stata Journal*, *14*(1), 141–158.

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. *Handbook of Qualitative Research*, *2*(163–194), 105.

Haile, T. G. (2015). Comparative Analysis for the SDPRP, PASDEP and GTP of the FDR of Ethiopia. *Global Journal of Business, Economics and Management: Current Issues*, *5*(1), 13–25.

Haile, Wossen, T., & Kalkuhl, M. (2019). Access to information, price expectations and welfare: The role of mobile phone adoption in Ethiopia. *Technological Forecasting and Social Change*, *145*, 82–92. https://doi.org/10.1016/j.techfore.2019.04.017

Hailu, Abrha, B. K., & Weldegiorgis, K. A. (2014). Adoption and impact of agricultural technologies on farm income: Evidence from Southern Tigray, Northern Ethiopia. *International Journal of Food and Agricultural Economics (IJFAEC)*, *2*(1128-2016–92058), 91–106.

Hajdu, F., Ansell, N., Robson, E., Van Blerk, L., & Chipeta, L. (2011). Income generating activities as components of sustainable rural livelihoods for young southern Africans-AIDS and other constraints. *The Geographical Journal*, *177*(3), 251–263. https://www.researchgate.net/profile/Flora-Hajdu-2/publication/230271930

Hameed, E., Shah, W. A., Shad, A. A., Taj, F. H., & Bakht, J. (2002). Yield and yield components of wheat as affected by different planting dates, seed rate and nitrogen levels. *Asian Journal of Plant Sciences*.

Heckman, J., Ichimura, H., & Todd, P. (1997). Matching As An Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Programme. *Review of Economic Studies*, *64*, 605–654. https://doi.org/10.2307/2971733

Heckman, & Vytlacil, E. (2005). Structural equations, treatment effects, and econometric policy evaluation 1. *Econometrica*, *73*(3), 669–738.

Heinrich, C., Maffioli, A., & Vazquez, G. (2010). A primer for applying propensity-score matching. *Inter-American Development Bank*.

Hentschel, J., & Lanjouw, P. (2000). Household welfare measurement and the pricing of basic services. *Journal of International Development*, *12*(1), 13–27. https://doi.org/10.1002/(SICI)1099-1328(200001)12:1<13::AID-JID568>3.0.CO;2-3

Hill, T., & Westbrook, R. (1997). SWOT analysis: It's time for a product recall. *Long Range Planning*, *30*(1), 46–52. https://doi.org/10.1016/S0024-6301(96)00095-7

Hipwell, W. T. (2009). An asset-based approach to indigenous development in Taiwan. *Asia Pacific Viewpoint*, *50*(3), 289–306. https://doi.org/10.1111/j.1467-8373.2009.01402.x

Hirano, K., & Imbens, G. W. (2004). The propensity score with continuous treatments. *Applied Bayesian Modeling and Causal Inference from Incomplete-Data Perspectives*, *226164*, 73–84.

Howe, L. D., Hargreaves, J. R., & Huttly, S. R. (2008). Issues in the construction of wealth indices for the measurement of socio-economic position in low-income countries. *Emerging Themes in Epidemiology*, *5*(1), 1–14.

Hussain, I., & Hanjra, M. A. (2004). Irrigation and poverty alleviation: Review of the empirical evidence. *Irrigation and Drainage*, *53*(1), 1–15.

ILO. (2019). *International Labor Organization. Empowering Women in the Rural Economy*. https://www.google.com/search?q=Empowering+Women+in+the+Rural+Economy&oq=Empowering+Women+in+the+Rural+Economy&aqs=chrome..69i57j69i60.1159j0j7&sourceid=chrome&ie=UTF-8

Indeed Editorial Team. (2021). *The 9 Belbin Team Roles (With Examples) | Indeed.com*. https://www.indeed.com/career-advice/career-development/belbin-team-roles

Jabbar, M. A., Ziauddin, A. T. M., & Abedin, M. Z. (2011). Impact of an Agricultural Development Project on Technology Adoption and Crop Yields of Resource Poor Farmers in Bangladesh. *Bangladesh Journal of Agricultural Economics*, *34*(454-2016–36675), 55–75.

Jaleta, M., Gebremedhin, B., & Hoekstra, D. (2009). Smallholder commercialization: Processes, determinants and impact. *ILRI Discussion Paper*.

Jehn, K. A., & Mannix, E. A. (2001). The Dynamic Nature of Conflict: A Longitudinal Study of Intragroup Conflict and Group Performance. *Academy of Management Journal*, *44*(2), 238–251. https://doi.org/10.5465/3069453

Ji-Yeun, R. (2018). *Better Policies for Better Youth Livelihoods*. 59.

Kahveci, R., & Meads, C. (2008). Analysis of strengths, weaknesses, opportunities, and threats in the development of a health technology assessment program in Turkey. *International Journal of Technology Assessment in Health Care*, *24*(2), 235–240. https://doi.org/10.1017/S026646230808032X

Kamara, A., Conteh, A., Rhodes, E. R., & Cooke, R. A. (2019). The relevance of smallholder farming to African agricultural growth and development. *African Journal of Food, Agriculture, Nutrition and Development*, *19*(1), Article 1. https://doi.org/10.4314/ajfand.v19i1

Kamruzzaman, M., & Takeya, H. (2008). Capacity building of the vegetable and rice farmers in Bangladesh: JICA intervention. *Journal of Sustainable Agriculture*, *31*(3), 145–161.

Kasirye, I. (2013). *Constraints to agricultural technology adoption in Uganda: Evidence from the 2005/06-2009/10 Uganda national panel survey*.

Kassa, M. D., Demissie, W. M., & Batu, M. M. (2019). Smallholders technical efficiency of teff production in Ethiopia. *African Journal of Agricultural Research*, *14*(33), 1641–1648.

Kassie, M., Shiferaw, B., & Muricho, G. (2011). Agricultural technology, crop income, and poverty alleviation in Uganda. *World Development*, *39*(10), 1784–1795.

Kebede, D., Ketema, M., Dechassa, N., & Hundessa, F. (2017). Determinants of adoption of wheat production technology package by smallholder farmers: Evidences from eastern Ethiopia. *Turkish Journal of Agriculture-Food Science and Technology*, *5*(3), 267–274.

Kebede, & Korji, D. (2017). Demonstration of improved teff varieties at selected midland districts of Guji zone, Oromia regional state, Ethiopia. *Asian Journal of Agriculture and Rural Development*, *7*(7), 131–135.

Keeley, J., Seide, W. M., Eid, A., & Kidewa, A. L. (2014). Large-scale land deals in Ethiopia. *International Institute for Environment and Development: London, UK*.

Khan, M. F., Nakano, Y., & Kurosaki, T. (2019). Impact of contract farming on land productivity and income of maize and potato growers in Pakistan. *Food Policy*, *85*, 28–39.

Kilimani, N. (2017). Youth Employment in Developing Economies: Evidence on Policies and Interventions. *IDS Bulletin*, *48*(3), Article 3. https://doi.org/10.19088/1968-2017.124

Kirchner, S. (2021). *The World Bank Aids Smallholder Farmers in Ethiopia. The Borgen Project. - Google Search*.

Kirimi, L., Gitau, R., & Olunga, M. (2013). *Household food security and commercialization among smallholder farmers in Kenya*.

Koko, I. S. (2012). Effects of Migration of Farmers on Sustainable Livelihood in Nigeria. *IOSR Journal of Business and Management*, *3*(3), 10–14. https://doi.org/10.9790/487X-0331014.

Korsgaard, M. A., Ployhart, R. E., & Ulrich, M. D. (2014). The emergence of intragroup conflict: Variations in conflict configurations. *Handbook of Conflict Management Research*. https://www.elgaronline.com/view/edcoll/9781781006931/9781781006931.00010.xml

Kothari, C. R. (2004). *Research methodology: Methods and techniques*. New Age International.

Koubová, E., Sumczynski, D., Šenkárová, L., Orsavová, J., & Fišera, M. (2018). Dietary Intakes of Minerals, Essential and Toxic Trace Elements for Adults from Eragrostis tef L.: A Nutritional Assessment. *Nutrients*, *10*(4), 479. https://doi.org/10.3390/nu10040479.

Krause, H., Faße, A., & Grote, U. (2019). Welfare and food security effects of commercializing African indigenous vegetables in Kenya. *Cogent Food & Agriculture*. https://www.tandfonline.com/doi/abs/10.1080/23311932.2019.1700031

Kretzmann, J. P., & Green, M. B. (1998). *Building the Bridge from Client to Citizen: A Community Toolbox for Welfare Reform*. 32.

Kumar, N., & Quisumbing, A. R. (2011). Access, adoption, and diffusion: Understanding the long-term impacts of improved vegetable and fish technologies in Bangladesh. *Journal of Development Effectiveness*, *3*(2), 193–219.

Lee, H. (2018). Teff, a rising global crop: Current status of teff production and value chain. *The Open Agriculture Journal*, *12*(1).

Leedy, P. D., & Ormrod, J. E. (2005). *Practical research* (Vol. 108). Pearson Custom Saddle River, NJ, USA.

Legese, G., & Fadiga, M. L. (2014). *Small ruminant value chain development in Ethiopia: Situation analysis and trends*. https://cgspace.cgiar.org/bitstream/handle/10568/52339/PR_EthiopiaSituationAnalysis_web.pdf?sequence=1.

Lemma, M., & Tesema, E. (2016). New Approaches and Methods for Addressing Gender Gaps in Extension Services: Experiences and Lessons from LIVES Project in Ethiopia. *Journal of Agricultural Economics, Extension and Rural Development*, *4*, 429–435.

Li, L., Shen, C., Wu, A. C., & Li, X. (2011). Propensity score-based sensitivity analysis method for uncontrolled confounding. *American Journal of Epidemiology*, *174*(3), 345–353.

Liu, W., Kuramoto, S. J., & Stuart, E. A. (2013). An Introduction to Sensitivity Analysis for Unobserved Confounding in Non-Experimental Prevention Research. *Prevention Science : The Official Journal of the Society for Prevention Research*, *14*(6), 570. https://doi.org/10.1007/s11121-012-0339-5.

Lukuyu, B., Franzel, S., Ongadi Mudavadi, P., & Duncan, A. (2011). Livestock feed resources: Current production and management practices in central and Northern rift valley provinces of Kenya. *Livestock Research for Rural Development*, *23*. https://orcid.org/0000-0002-9374-3553

Majurin, E. (2008). *Business Group Formation Empowering Women and Men in Developing Communities*. http://www.ilo.org/empent/Publications/WCMS_116164/lang--en/index.htm.

Malumfashi, A. H., & Kwara, M. A. (2013). Agricultural Commercialization and Food Security in Nigeria. *Int. Jour. Adv. Res. Mgt. Soc. Sci*, *2*(7), 111–120.

Marzin, J., Bonnet, P., Bessaoud, O., & Nu, C. T. (2016). *Study on small-scale family farming in the Near East and North Africa region: Synthesis* [PhD Thesis]. CIHEAM-IAMM; FAO.

Mathie, A., & Cunningham, G. (2003). From Clients to Citizens: Asset-Based Community Development as a Strategy for Community-Driven Development. *Development in Practice*, *13*(5), 474–486.

Matunhu, J. (2011). A critique of modernization and dependency theories in Africa: Critical assessment. *African Journal of History and Culture*, *3*(5), 65–72.

MAXQDA 2020. (2019). *Getting Started Guide: MAXQDA 2020, The art of data analysis. Free Guide English*. VERBI Software. Consult. Sozialforschung. GmbH, Berlin. https://www.maxqda.com/wp/wp-content/uploads/sites/2/GettingStarted-MAXQDA2020-EN.pdf.

Mazengia, Y. (2016). Smallholders commercialization of maize production in Guangua district, northwestern Ethiopia. *World Scientific News*, *58*, 65–83.

Mburu, L., Wakhungu, J. W., & Gitu, K. W. (2007). *Determinants of smallholder dairy farmers' adoption of various milk marketing channels in Kenya highlands*. *19*. http://lrrd.cipav.org.co/lrrd19/9/mbur19134.htm.

Mebratu, Raghavaiah, C. V., & Ashagre, H. (2016). Production potential of Tef (Eragrostis tef (Zucc.) Trotter) genotypes in relation to integrated nutrient management on vertisols of mid high lands of Oromia Region of Ethiopia, East Africa. *Advances in Crop Science and Technology4 (6), 249*.

Mebratu, S., & Kenea, T. (2020). *Review on Adoption of selected Improved Agricultural Technology on Production of Teff in Ethiopia*. https://www.semanticscholar.org/paper/Review-on-Adoption-of-selected-Improved-Technology-Mebratu-Kenea/c9f01c7fd2c83288115e86e92c70b049d27f33a0

Mekonen. (2019). *The Situation of Rural Youth Livelihood Diversification and Its Determinants in North Western Ethiopia*. https://core.ac.uk/download/pdf/276531577.pdf

Mekonnen, T. (2017). Productivity and household welfare impact of technology adoption: Micro-level evidence from rural Ethiopia. *UNU-MERIT Working Paper Series, 2017–007*.

Melesse, B. (2018). A review on factors affecting adoption of agricultural new technologies in Ethiopia. *Journal of Agricultural Science and Food Research*, *9*(3), 1–4.

Mellor, J. W., & Dorosh, P. (2010). *Agriculture and the economic transformation of Ethiopia*.

Mezgebo, T., Tesfay, M. G., & Ghrmay, D. T. (2014). *Commercialization of Small Scale Agriculture: Cash Crop Production Effect on Household Welfare, Technical Efficiency and Power Relation of the Family in the Case of Were Baye Tabia of Raya Azebo District in Southern Tigray* (SSRN Scholarly Paper No. 2437303). https://doi.org/10.2139/ssrn.2437303

Ministry of Youth, Sport and Culture. (2004). *FDRE National Youth Policy*. https://chilot.me/wp-content/uploads/2011/08/fdre-youth-policy.pdf

Minten, B., Randrianarisoa, J.-C., & Barrett, C. B. (2007). Productivity in Malagasy rice systems: Wealth-differentiated constraints and priorities. *Agricultural Economics, 37*, 225–237.

Minten, B., Taffesse, A. S., & Brown, P. (2018). *The economics of teff: Exploring Ethiopia's biggest cash crop*. Intl Food Policy Res Inst.

MoA(a). (2015). *FDRE Ministry of Agriculture. Agricultural Growth Program II (AGP-II) Program Design Document*. https://eeas.europa.eu/archives/delegations/ethiopia/documents/financing_agreement/1._agp_ii_design_doc.docx.

MoA(b). (2015). *FDRE Ministry of Agriculture. Agricultural Growth Program II (AGP-II) Program Implementation Manual*.

MoANR. (2016). *FDRE Agricultural Growth Program II Program Implementation Manual*. Elsevier. http://ethioagp.org/agricultural-growth-program-agp.

MoFED. (2010). *FDRE Ministry of Finance and Economic Development (MoFED). Growth and Transformation Plan (GTP) Volume I. The Federal Democratic Republic of Ethiopia. - Google Search*.

MoFED. (2015). *Growth and Transformation Plan (GTP) Volume II. The Federal Democratic Republic of Ethiopia Ministry of Finance and Economic Development.*

Mohammed. (2020, October 2). *An interview with the Technical Advisor of the AGP II at Ministry of Agriculture* [In Person].

Mohammed, N. (2019). Small-Scale Irrigation Development for Rural Ethiopia. *Journal of Saemaulogy, PARK CHUNG HEE Saemaul Undong Institute*. https://www.academia.edu/41556391/Small_Scale_Irrigation_Development_for_Rural_Ethiopia.

Mojo, D., Fischer, C., & Degefa, T. (2017). The determinants and economic impacts of membership in coffee farmer cooperatives: Recent evidence from rural Ethiopia. *Journal of Rural Studies*, *50*, 84–94.

Moore, K. (2018). *Gender and Youth Livelihoods Programming in Africa*. Mastercard Foundation. https://mastercardfdn.org/gender-and-youth-livelihoods-programming-in-africa-2/.

Mossie, M., Gerezgiher, A., Ayalew, Z., & Nigussie, Z. (2021). Welfare effects of small-scale farmers' participation in apple and mango value chains in Ethiopia. *Agrekon*, *60*(2), 192–208.

Mozumdar, L. (2012). Agricultural productivity and food security in the developing world. *Bangladesh Journal of Agricultural Economics*, *35*(454-2016–36350), 53–69.

Mulugeta, T., & Hundie, B. (2012). *Impacts of adoption of improved wheat technologies on households' food consumption in southeastern Ethiopia*.

Muriithi, B. W., & Matz, J. A. (2015). Welfare effects of vegetable commercialization: Evidence from smallholder producers in Kenya. *Food Policy*, *50*, 80–91.

Musyoka, C. M., Mbwayo, A., Donovan, D., & Mathai, M. (2020). Alcohol and substance use among first-year students at the University of Nairobi, Kenya: Prevalence and patterns. *PLOS ONE*, *15*(8), e0238170. https://doi.org/10.1371/journal.pone.0238170.

Mutyasira, V. (2020). Prospects of sustainable intensification of smallholder farming systems: A farmer typology approach. *African Journal of Science, Technology, Innovation and Development*. https://www.tandfonline.com/doi/abs/10.1080/20421338.2019.1711319

National Meteorological Agency of Ethiopia [NMAE]. (2020). *Meteorological Grid Data*. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=National+Meteorological+Agency+of+Ethiopia.+Meteorological+Grid+Data&btnG=.

Natnael. (2019a). Impact of technology adoption on agricultural productivity and income: A case study of improved teff variety adoption in north eastern Ethiopia. *Agricultural Research & Technology: Open Access Journal*, *20*(4), 556139.

Natnael. (2019b). Impact of technology adoption on agricultural productivity and income: A case study of improved teff variety adoption in north eastern Ethiopia. *Agri Res & Tech: Open Access J*, *20*(4), 556139.

Negussie, F. A. (2020). Impact of row planting teff technology adoption on the income of smallholder farmers: The case of Hidabu Abote District, North Shoa Zone of Oromia Region, Ethiopia. *International Journal of Agricultural Science and Food Technology*, *6*(2), 195–203.

Njuki, H. M., Mwangómbe, C. W., Okoth, O. N., & Mutua, M. W. (2013). *An Investigation into the Factors that Affect Performance of Youth Group Income Generating Projects in Kenya: A case of*. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.736.5062&rep=rep1&type=pdf.

Numan, M., Khan, A. L., Asaf, S., Salehin, M., Beyene, G., Tadele, Z., & Ligaba-Osena, A. (2021). From Traditional Breeding to Genome Editing for Boosting Productivity of the Ancient Grain Tef [Eragrostis tef (Zucc.) Trotter]. *Plants*, *10*(4), 628. https://doi.org/10.3390/plants10040628.

OECD. (2007). *Promoting Pro-Poor Growth: Policy Guidance for Donors*. Organisation for Economic Co-operation and Development.

OECD. (2013). *OECD Guidelines on Measuring Subjective Well-being*. OECD. https://doi.org/10.1787/9789264191655-en.

OECD. (2018). *The Future of Rural Youth in Developing Countries—Tapping the Potential of Local Value Chains.* Organization for Economic Cooperation and Development. https://public.ebookcentral.proquest.com/choice/publicfullrecord.aspx?p=5408729.

Ogada, M. J., Mwabu, G., & Muchai, D. (2014). Farm technology adoption in Kenya: A simultaneous estimation of inorganic fertilizer and improved maize variety adoption decisions. *Agricultural and Food Economics*, *2*(1), 1–18.

Ogunniyi, A., Omonona, B., Abioye, O., & Olagunju, K. (2018). *Impact of irrigation technology use on crop yield, crop income and household food security in Nigeria: A treatment effect approach*.

Ogutu, S. O., Gödecke, T., & Qaim, M. (2020). Agricultural Commercialisation and Nutrition in Smallholder Farm Households. *Journal of Agricultural Economics*, *71*(2), 534–555. https://doi.org/10.1111/1477-9552.12359.

Ojiewo, C. O., Kugbei, S., Bishaw, Z., & Rubyogo, J. C. (2015). Community seed production. *Community Seed Production Addis Ababa (Ethiopia) 9-11 Dec 2013*.

Olaniran, S. O., & Mncube, D. W. (2018). *Barriers to Effective Youth Entrepreneurship and Vocational Education*. *24*(4), 11.

Omofa, F. H. (2020). Role of Agriculture in the Economic Development of a Country. *Политика, Экономика и Инновации*, *3 (32)*, 19.

Omore, A. O. (2012). *More milk by and for the poor: Adapting dairy market Hubs for pro-poor smallholder value chains in Tanzania*. https://cgspace.cgiar.org/handle/10568/16396

O'Neill, A. (2021). *Ethiopia—Share of economic sectors in the gross domestic product 2020*. Statista. https://www.statista.com/statistics/455149/share-of-economic-sectors-in-the-gdp-in-ethiopia/.

Onwuegbuzie, A. J., & Johnson, R. B. (2006). The validity issue in mixed research. *Research in the Schools*, *13*(1), 48–63.

Orr, A., Tiba, Z., Congrave, J., Porázik, P., Dejen, A., & Hassen, S. (2021). Smallholder commercialization and climate change: A simulation game for teff in South Wollo, Ethiopia. *International Journal of Agricultural Sustainability*, *19*(5–6), 595–608.

Osgood, D., Wilson, J., O'malley, P., Bachman, J., & Johnston, L. (1996). Routine Activities and Individual Deviant Behavior. *American Sociological Review*, *61*, 635–655. https://doi.org/10.2307/2096397.

Osmani, M. A. G., Islam, K., Ghosh, B. C., & Hossain, M. E. (2014). Commercialization of smallholder farmers and its welfare outcomes: Evidence from Durgapur Upazila of Rajshahi District, Bangladesh. *Journal of World Economic Research*, *3*(6), 119–126.

Partington, D., & Harris, H. (1999). Team role balance and team performance: An empirical study. *Journal of Management Development*. https://doi.org/10.1108/02621719910293783.

Pattyn, V., Molenveld, A., & Befani, B. (2019). Qualitative Comparative Analysis as an Evaluation Tool: Lessons From an Application in Development Cooperation. *American Journal of Evaluation*, *40*(1), 55–74. https://doi.org/10.1177/1098214017710502.

Pedersen, E. R. (2006). Making Corporate Social Responsibility (CSR) Operable: How Companies Translate Stakeholder Dialogue into Practice. *Business and Society Review*, *111*(2), 137–163. https://doi.org/10.1111/j.1467-8594.2006.00265.x.

Pickton, D., & Wright, S. (1998). What's SWOT in strategic analysis? *Strategic Change*, *7*, 101–109. https://doi.org/10.1002/(SICI)1099-1697(199803/04)7:23.0.CO;2-6.

Pingali, P. L., & Rosegrant, M. W. (1995a). Agricultural commercialization and diversification: Processes and policies. *Food Policy*, *20*(3), 171–185.

Pingali, P. L., & Rosegrant, M. W. (1995b). Agricultural commercialization and diversification: Processes and policies. *Food Policy*, *20*(3), 171–185.

Pokharel, C. (2007). Agricultural diversification in Nepal: Status, constraints and opportunities. *Agricultural Diversification and Smallholders in South Asia. Academic Foundation, New Delhi, India*, 271–296.

Population projection. (2018). *Oromia Region Population*. http://populationof2018.com/oromia-region-population-2018.html.

Posluschny-Treuner, M. (2012). International large-scale land acquisitions in Ethiopia: The key to trigger agricultural modernization, development and poverty reduction. *4th ECPR Graduate Conference, Jacobs University, Bremen*, *4*.

Poulton, C. (2017). *What is Agricultural Commercialisation, Why is it Important, and how do we Measure it?*

Poulton, C., Tyler, G., Hazell, P., Dorward, A., Kydd, J., & Stockbridge, M. (2008). Commercial agriculture in Africa: Lessons from success and failure. *Background Paper for the Competitive Commercial Agriculture on Sub-Saharan Africa (CCAA) Study. World Bank and FAO*.

Praburaj, L., Design, F., & Nadu, T. (2018). Role of agriculture in the economic development of a country. *Shanlax International Journal of Commerce*, *6*(3), 1–5.

Puentes, R. (2015). Why Infrastructure Matters: Rotten Roads, Bum Economy. *Brookings*. https://www.brookings.edu/opinions/why-infrastructure-matters-rotten-roads-bum-economy/.

Rahmato, D. (2011). *Land to investors: Large-scale land transfers in Ethiopia*. African Books Collective.

Ramey, K. (2013). What is technology-meaning of technology and its use. *Canton Fair*.

Ramsbottom, G., Horan, B., Berry, D. P., & Roche, J. R. (2015). Factors associated with the financial performance of spring-calving, pasture-based dairy farms. *Journal of Dairy Science*, *98*(5), 3526–3540. https://doi.org/10.3168/jds.2014-8516.

Rea, L.M. & Parker, R.A. (2005). Designing and Constructing Survey Research. Jossey-Bass, San Francisco, CA.

Regasa, M. G., Negash, R., Bekele, A. E., & Nemera, D. B. (2020). Smallholder market participation and its associated factors: Evidence from Ethiopian vegetable producers. *Cogent Food & Agriculture*, *6*(1), 1783173. https://doi.org/10.1080/23311932.2020.1783173.

Rim, J.-Y., & Nsanganira, T. R. (2019). *Creating jobs for rural youth in agricultural value chains*. CTA. https://cgspace.cgiar.org/bitstream/handle/10568/99347/2063_PDF.pdf

Ritz, C., Baty, F., Streibig, J. C., & Gerhard, D. (2015). Dose-response analysis using R. *PloS One*, *10*(12), e0146021.

Robinson, L., Delgadillo, J., & Kellett, S. (2020). The dose-response effect in routinely delivered psychological therapies: A systematic review. *Psychotherapy Research*, *30*(1), 79–96. https://doi.org/10.1080/10503307.2019.1566676.

Robson, C. (2002). *Real world research: A resource for social scientists and practitioner-researchers*. Wiley-Blackwell.

Rogers, E. M., Singhal, A., & Quinlan, M. M. (2014). Diffusion of innovations. In *An integrated approach to communication theory and research* (pp. 432–448). Routledge.

Root, G. N. (2021). *Team Project: Perceptions That Build Work Relationships | Small Business—Chron.com*. https://smallbusiness.chron.com/team-project-perceptions-build-work-relationships-10848.html.

Rosenbaum, P. R., & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, *70*(1), 41–55.

Rossman, G. B., & Wilson, B. L. (1985). Numbers and words: Combining quantitative and qualitative methods in a single large-scale evaluation study. *Evaluation Review*, *9*(5), 627–643.

Rubin, D. B. (2001). Using propensity scores to help design observational studies: Application to the tobacco litigation. *Health Services and Outcomes Research Methodology*, *2*(3), 169–188.

Rubin, D. B. (2006). *Matched sampling for causal effects*. Cambridge University Press.

Rudemo, M., Ruppert, D., & Streibig, J. C. (1989). Random-Effect Models in Nonlinear Regression with Applications to Bioassay. *Biometrics*, *45*(2), 349. https://doi.org/10.2307/2531482.

Ruder, H. L. (2018). *Impact of khat production on household welfare in Amhara region of Ethiopia* [PhD Thesis].

Rutstein, S. O. (2008). *The DHS wealth index: Approaches for rural and urban areas* (DHS Working Papers No. 60). Article DHS Working Papers No. 60. https://dhsprogram.com/publications/publication-wp60-working-papers.cfm.

Rutstein, S. O., & Johnson, K. (2004). DHS comparative reports 6: The DHS wealth index. *Measure DHS+. Calverton, Maryland, USA: ORC Macro*.

Samuel, G., & Kay, S. (2008). Commercialization of smallholder agriculture in Selected Tef-Growth area of Ethiopia. *Ethiopian Journal of Economics*, *16*(683-2016–46875), 55–86.

Saunders, B., Kitzinger, J., & Kitzinger, C. (2015). Anonymising interview data: Challenges and compromise in practice. *Qualitative Research*, *15*(5), 616–632.

Saunders, Lewis, P., & Thornhill, A. (2003). Research methods forbusiness students. *Essex: Prentice Hall: Financial Times*.

Saunders, W. (2007). *The new architectural pragmatism: A Harvard design magazine reader* (Vol. 5). U of Minnesota Press.

Schmidt, E., & Bekele, F. (2016). *Rural youth and employment in Ethiopia. Strategy support program. EDRI (Ethiopia Development Research Institute) and IFPRI (International Food Policy Research Institute)—Google Search*.

Schmidt, E., & Woldeyes, F. B. (2019). Rural Youth and Employment in Ethiopia. In E. Schmidt & F. B. Woldeyes, *Youth and Jobs in Rural Africa* (pp. 109–136). Oxford University Press. https://doi.org/10.1093/oso/9780198848059.003.0005.

Schneider, K., & Gugerty, M. K. (2011). Agricultural productivity and poverty reduction: Linkages and pathways. *Libraries Test Journal*, *1*(1), 56–74.

Scoones, I. (1998). Sustainable Rural Livelihoods: A Framework for Analysis. IDS Working Paper 62, Institute of Development Studies, Brighton.

Seetanah, B., Sannassee, R., Teeroovengadum, V., Nunkoo, R., Fauzel, Matadeen, J., & Pooloo, A. (2019). *Youth employment and women's economic empowerment in Africa: The role of small and medium enterprises in the tourism sector: Mauritius, Tanzania and Uganda*. http://hdl.handle.net/10625/59121.

Sewnet, A. (2005). *Effects of nitrogen and seed rates on grain yield, yield components and nitrogen uptake of rainfed rice (Oryza sativa L.) in Fogera, South Gondar* [PhD Thesis]. M. Sc. Thesis Presented to the School of Graduate Studies of Haramaya.

Seyfu, K. (1997). Tef. Eragrostis tef (Zucc.) Trotter. *Promoting the Conservation and Use of Underutilized and Neglected Crops*, *12*, 35.

Seyoum. (2020, October 14). *An interview with the district's cooperative establishment and development office* [In Person].

Shadreck, Z., Isaac, J. M., & Bruce, M. (2013). Smallholder agricultural commercialization for income growth and poverty alleviation in southern Africa: A review. *African Journal of Agricultural Research*, *8*(22), 2599–2608.

Shenggen, F., Sivan, Y., & Rajul, P.-L. (2019). *Agriculture for improved nutrition: Seizing the momentum*. Intl Food Policy Res Inst.

Shepherd, J. (2005). Review of Exploring Corporate Strategy [Review of *Review of Exploring Corporate Strategy*, by G. Johnson, K. Scholes, & R. Whittington]. *Academy of Management Learning & Education*, *4*(4), 517–519.

Shete, M., & Rutten, M. (2015). Impacts of large-scale farming on local communities' food security and income levels–Empirical evidence from Oromia Region, Ethiopia. *Land Use Policy*, *47*, 282–292.

Shifera, K., Tolera, A., & Nandeshwar, B. (2020). Effects of Seed Rate and Row Spacing on Yield and Yield Components of Teff (Eragrostis tef [Zucc.] Trotter.) in Kiltu Kara Distirct of Western Ethiopia. *International Journal of Plant & Soil Science*, 8–23. https://doi.org/10.9734/ijpss/2020/v32i1530370.

Shikur, Z. H. (2020). Agricultural policies, agricultural production and rural households' welfare in Ethiopia. *Journal of Economic Structures*, *9*(1), 1–21.

SIDA. (2004). *Improving Income among Rural Poor", position paper—Swedish International Development Co-operation Agency*.

Singh, G., & Belwal, R. (2008). Entrepreneurship and SMEs in Ethiopia: Evaluating the role, prospects and problems faced by women in this emergent sector. *Gender in Management: An International Journal*. https://www.emerald.com/insight/content/doi/10.1108/17542410810858321/full/pdf?title=entrepreneurship-and-smes-in-ethiopia-evaluating-the-role-prospects-and-problems-faced-by-women-in-this-emergent-sector.

Sisay, D. T., Verhees, F. J., & Van Trijp, H. C. (2017). Seed producer cooperatives in the Ethiopian seed sector and their role in seed supply improvement: A review. *Journal of Crop Improvement*, *31*(3), 323–355.

Smith, J. A., & Todd, P. E. (2005). Does matching overcome LaLonde's critique of nonexperimental estimators? *Journal of Econometrics*, *125*(1–2), 305–353.

Snow, L. K. (2001). *Community Transformation: Turning Threats into Opportunities; A Community Building Workbook from the Asset-Based Community Development*. Institute Institute for Policy Research, Northwestern University; Chicago Association of Neighborhood Development Organizations (CANDO), ACTA Publications. https://resources.depaul.edu/abcdinstitute/publications/documents/workbooks/communitytransformation.pdf.

SNV. (2021). *Pulling Ethiopian youth out of unemployment | Netherlands Development Organization (SNV) World*. https://snv.org/update/pulling-ethiopian-youth-out-unemployment.

Sokoni, C. H. (2008). Commercialisation of smallholder production in Tanzania: Implications for sustainable resources management. *The Geographical Journal*, *174*(2), 158–161.

Solomon, C., Setotaw, F., Tebkew, D., Tsion, F., Yazachew, G., Worku, K., Kidist, T., Tadele, Z., & Kebebew, A. (2019). Significance and prospects of an orphan crop tef. *Planta*, *250*(3), 753–767.

Spielman, D. J., Byerlee, D., Alemu, D., & Kelemework, D. (2010). Policies to promote cereal intensification in Ethiopia: The search for appropriate public and private roles. *Food Policy*, *35*(3), 185–194.

Stefan, D., & Pramila, K. (1998). Changes in poverty in rural Ethiopia 1989-1995: measurement, robustness tests and decomposition, No 1998-07, CSAE Working Paper Series, Centre for the Study of African Economies, University of Oxford.

Stefanucci, J. K., & Proffitt, D. R. (2009). The roles of altitude and fear in the perception of height. *Journal of Experimental Psychology: Human Perception and Performance*, *35*(2), 424–438. https://doi.org/10.1037/a0013894.

Stiglitz, J., & Pike, R. M. (2004). Globalization and its Discontents. *Canadian Journal of Sociology*, *29*(2), 321.

Suri, T. (2011). Selection and comparative advantage in technology adoption. *Econometrica*, *79*(1), 159–209.

Swanson, B., Bentz, R., & Sofranko, A. (1997). Improving agricultural extension A reference manual. *Undefined*. https://www.semanticscholar.org/paper/Improving-agricultural-extension-A-reference-manual-SwansonBentz/29a3002197653ce8464cbc92bd4290d070c219d6

Tadele, M., Wudineh, G., Agajie, T., Ali, C., Tesfaye, S., Aden, A.-H., Tolessa, D., & Solomon, A. (2017). Analysis of wheat commercialization in Ethiopia: The case of SARD-SC wheat project innovation platform sites. *African Journal of Agricultural Research*, *12*(10), 841–849.

Taffesse, A. S., Dorosh, P., & Gemessa, S. A. (2012). Crop production in Ethiopia: Regional patterns and trends. *Food and Agriculture in Ethiopia: Progress and Policy Challenges*, 53–83.

Tattao, L. A. (2007). Basic concepts in statistics. *Manila: Rex*, 7.

Tedla, W. T. (2019). *Rural Youth Livelihood Opportunities and Impediments of Livelihood Strategy Choice in North Western Ethiopia*. https://core.ac.uk/download/pdf/270187999.pdf.

Tefera, T., Tesfay, G., Elias, E., Diro, M., & Koomen, I. (2016). Drivers for adoption of agricultural technologies and practices in Ethiopia. *A Study Report From*, *30*.

Teferi, A., Philip, D., & Jaleta, M. (2015). Factors that affect the adoption of improved maize varieties by smallholder farmers in Central Oromia, Ethiopia. *Developing Country Studies*, *5*(15), 50–59.

Teka, A., & Lee, S.-K. (2020). Do Agricultural Package Programs Improve the Welfare of Rural People? Evidence from Smallholder Farmers in Ethiopia. *Agriculture*, *10*(5), Article 5. https://doi.org/10.3390/agriculture10050190.

Tekele, A. A. (2019). *Factors Affecting the Performance of Micro and Small Enterprises in Wolita Sodo Town*. 9.

Tesfahun, A. (2021). *Review on the Determinants of Smallholder farmers' Commercialization in Ethiopia and Limitations in Commercialization Methodology*. 9.

Tesfaye, S., Bedada, B., & Mesay, Y. (2016). Impact of improved wheat technology adoption on productivity and income in Ethiopia. *African Crop Science Journal*, *24*(s1), 127–135.

Tesso, G. (2016). Commercialization of Smallholder Farmers in light of climate change and logistic challenges: Evidence from central Ethiopia. *Global Journal of Economics and Business Administration*, *1*.

Tigabu, D. G., & Gebeyehu, M. F. (2020). *Enhancing Youth Employment Opportunities in Rural Economies in Ethiopia*. FARA Research Report 5(3) PP 39. https://library.faraafrica.org/wp-content/uploads/2020/03/FRR-Vol-5-No-3-2020.pdf

Timmer, P. (2005). Agriculture and pro-poor growth: An Asian perspective. *Available at SSRN 1114155*.

Tiruneh. (2020, October 28). *An interview with DA at Abo-Yayambana kebele* [In Person].

Tjosvold, D. (2006). Defining conflict and making choices about its management: Lighting the dark side of organizational life. *International Journal of Conflict Management*. https://doi.org/10.1108/10444060610736585.

Tshuma, M. C. (2014). Understanding the small-scale agricultural sector as a precondition for promoting rural development in South Africa. *African Journal of Agricultural Research*, *9*(31), 2409–2418.

Tucker, C. J., McHale, S. M., & Crouter, A. C. (2001). Conditions of sibling support in adolescence. *Journal of Family Psychology*, *15*(2), 254–271. https://doi.org/10.1037/0893-3200.15.2.254.

Tufa, A. H., Alene, A. D., Manda, J., Akinwale, M. G., Chikoye, D., Feleke, S., Wossen, T., & Manyong, V. (2019). The productivity and income effects of adoption of improved soybean varieties and agronomic practices in Malawi. *World Development*, *124*, 104631.

Tulema, B., Zapata, F., Aune, J., & Sitaula, B. (2005). N fertilisation, soil type and cultivars effects on N use efficiency in tef [Eragrostis tef (Zucc.) Trotte]. *Nutrient Cycling in Agroecosystems*, *71*(2), 203–211. https://doi.org/10.1007/s10705-004-5083-1.

Twine, E. E., Omore, A., & Githinji, J. (2018). Uncertainty in milk production by smallholders in Tanzania and its implications for investment. *International Food and Agribusiness Management Review*, *21*(1), 53–72. https://doi.org/10.22434/IFAMR2017.0028.

UN. (2022). *170 Actions to Reduce Inequalities*. Sites.Ungeneva.Org. https://sites.ungeneva.org/170actions/sustainable-lifestyle/index.html.

UNNExT. (2011). *Towards a Single Window Trading Environment – Achieving Effective Stakeholder Coordination | ESCAP. Brief No. 7*. https://www.unescap.org/resources/unnext-brief-no-7-towards-single-window-trading-environment-%E2%80%93-achieving-effective.

USAID Fact sheet. (2017). *Developing Ethiopia's Youth, Google Search*. https://www.usaid.gov/sites/default/files/documents/1860/Fact_Sheet_Developing_Ethiopias_Youth_Jul_2017.pdf.

Van der Vliet, L., & Ritz, C. (2013a). Statistics for analyzing ecotoxicity test data. *Encyclopedia of Aquatic Ecotoxicology. New York: Springer*, 1081–1096.

Van der Vliet, L., & Ritz, C. (2013b). Statistics for analyzing ecotoxicity test data. *Encyclopedia of Aquatic Ecotoxicology. New York: Springer*, 1081–1096.

Vandercasteelen, J., Dereje, M., Minten, B., & Taffesse, A. S. (2013). Scaling-up adoption of improved technologies: The impact of the promotion of row planting on farmers' teff yields in Ethiopia. *LICOS-Discussion Paper Series 344/2013*, 1–25.

Vandercasteelen, J., Dereje, M., Minten, B., & Taffesse, A. S. (2016). *Row planting teff in Ethiopia: Impact on farm-level profitability and labor allocation* (Vol. 92). Intl Food Policy Res Inst.

Vijesh, V. K., Maximina A. L., Prasanna , B.M., Kevin, P, Tahirou, A, Abebe M., Marianne B., Olaf E. (2023). Impact of CGIAR maize germplasm in Sub-Saharan Africa, Field Crops Research, Volume 290 https://doi.org/10.1016/j.fcr.2022.108756.

Vogel, L., Rau, W., Baker, P., & Ashby, D. (2013). *Patton, M.(2002). Qualitative research and evaluation methods (3" ed.). Thousand Oaks*.

Volchok, T. (2007). *Stakeholder Analysis for Private Sector Engagement Tool: Private Sector Engagement Toolkit*. Mercy Corps Global Headquarters, Portland. https://www.fsnnetwork.org/sites/default/files/7%20Stakeholder%20Analysis%20Tool.pdf.

Von Braun, J. (1995). Agricultural commercialization: Impacts on income and nutrition and implications for policy. *Food Policy*, *20*(3), 187–202.

Wara Jarso woreda Agriculture and Natural Resource Office. (2019). *Population and Geographical Profile of Wara Jarso woreda*.

Watson, B. (2008). How to Assist the Small-Scale Farmer. *International Assessment of Agriculture Science and Technology For*.

Weldemeskel, T., Ketema, M., Haji, J., & Zemedu, L. (Eds.). (2020). Welfare Impact of Moringa Market Participation in Southern Ethiopia. *Sustainable Agriculture Research*. https://doi.org/10.22004/ag.econ.309786.

Welteji, D. (2018). A critical review of rural development policy of Ethiopia: Access, utilization and coverage. *Agriculture & Food Security*, *7*(1), 1–6.

Wendimu, G. Y. (2021). The challenges and prospects of Ethiopian agriculture. *Cogent Food & Agriculture*, *7*(1), 1923619.

White, S. K. (2019). What is process improvement? A business methodology for efficiency and productivity. *CIO*. https://www.cio.com/article/220557/what-is-process-improvement-a-business-methodology-for-efficiency-and-productivity.html.

Wiebe, K. D. (2003). Linking land quality, agricultural productivity, and food security. *USDA-ERS Agricultural Economic Report*, *823*.

Wiggins, S., Argwings-Kodhek, G., Leavy, J., & Poulton, C. (2011). Small farm commercialisation in Africa: Reviewing the issues. *Future Agricultures Consortium, Research Paper*, *23*.

Wiles, R. & Janine. (2016). A rose by any other name: Participants choosing research pseudonyms. *Qualitative Research in Psychology*, *13*(2), 149–165. https://doi.org/10.1080/14780887.2015.1133746.

Wolde, F., & Geta, E. (2015). Determinants of Growth and Diversification of Micro and Small Enterprises: The Case of Dire Dawa, Ethiopia. *Developing Country Studies*, *5*(1), 61.

Wolde, T. (2021). *Teff in Southern Ethiopia. Effect of Seed Rates and Sowing Methods on Phenology, Growth, Yield and Yield Attributes at Wolaita Sodo*. GRIN Verlag.

Wolfenson, K. D. M. (2013). *Coping with the food and agriculture challenge: Smallholders' agenda*. https://www.semanticscholar.org/paper/Coping-with-the-food-and-agriculture-challenge%3A-Wolfenson/61b749b9c53e7771611b69504bec804c7abb0d2a.

Wondimagegnhu, B. A., Huluka, A. T., & Nischalke, S. M. (2019). Determinants of farm livelihoods of smallholder farmers in Yayu biosphere reserve, SW Ethiopia: A gender disaggregated analysis. *Cogent Economics & Finance*, *7*(1), 1645583. https://doi.org/10.1080/23322039.2019.1645583.

Wordofa, M. G., Hassen, J. Y., Endris, G. S., Aweke, C. S., Moges, D. K., & Rorisa, D. T. (2021). Adoption of improved agricultural technology and its impact on household income: A propensity score matching estimation in eastern Ethiopia. *Agriculture & Food Security*, *10*(1), 1–12.

Worku, S., & Woldetsadik, M. (2013). Livelihood strategies of rural women with emphasis on income diversification and demographic adjustment in Central Ethiopia: The case of Olonkomoi1, Oromia Region. *Ethiopian Journal of the Social Sciences and Humanities*, *9*(1), 111–146.

World Bank. (2015). *International Development Association Project Appraisal Document On A Proposed Credit to the Federal Democratic Republic Of Ethiopia for a Second Agricultural Growth Project. Report No: PAD1052—Google Search.*

World Bank. (2016). *Ethiopia ET: Female Headed Households | Economic Indicators | CEIC*.

World Economic Forum. (2017). *Engaging All Affected Stakeholders Guidance for investors, funders, and organizations*. Action Group 3 of the World Economic Forum's initiative to Accelerate Impact Measurement and Management. https://sptf.info/images/SIWG-WEF-AG3-Engaging-all-affected-stakeholders-December-2017.pdf.

Yamane, T. (1967). *Statistics: An introductory analysis.*

Yechale, M., Alemayehu, A., & Abaynew, J. J. (2021). Sowing methods and seeding rates effects on yield and yield components of Tef (Eragrostis tef [Zucc.] Trotter) at Adet, North West Ethiopia. *Heliyon*, *7*(3), e06519. https://doi.org/10.1016/j.heliyon.2021.e06519.

Yengoh, G. T. (2012). Determinants of yield differences in small-scale food crop farming systems in Cameroon. *Agriculture & Food Security*, *1*(1), 1–17.

Yirgalem, E., Bamlaku, A., & Zewdie, B. (2021). Yield and Cost Effects of Plot-Level Wheat Seed Rates and Seed Recycling Practices in the East Gojam Zone, Amhara Region, Ethiopia: Application of the Dose–Response Model. *Sustainability*, *13*(7), 3793. https://doi.org/10.3390/su13073793.

Zapalska, A., Dabb, H., & Peryy, G. (2003). Environmental Factors Affecting Entrepreneurial Activities: Indigenous Maori Entrepreneurs of New Zealand. *Asia Pacific Business Review*, *10*, 160–177. https://doi.org/10.1080/13602380410001677191.

Zeitzoff, T. (2014). Anger, Exposure to Violence, and Intragroup Conflict: A "Lab in the Field" Experiment in Southern Israel. *Political Psychology*, *35*(3), 309–335. https://doi.org/10.1111/pops.12065.

Zeng, D., Alwang, J., Norton, G. W., Shiferaw, B., Jaleta, M., & Yirga, C. (2017). Agricultural technology adoption and child nutrition enhancement: Improved maize varieties in rural Ethiopia. *Agricultural Economics*, *48*(5), 573–586. https://doi.org/10.1111/agec.12358.

Zerihun. (2020, October 15). *An interview with the district's Livestock and fishery development office* [In Person].

Zerssa, G., Feyssa, D., Kim, D.-G., & Eichler-Löbermann, B. (2021). Challenges of smallholder farming in Ethiopia and opportunities by adopting climate-smart agriculture. *Agriculture*, *11*(3), 192.

Zewdie, B. B. (2015). Analyses of agricultural development led industrialization (ADLI) policy's effectiveness in Ethiopia. *Journal for Studies in Management and Planning*, *1*(11), 201–220.

Appendices

Appendix A: Questionnaire

Ph.D. Dissertation Research Project
on
Impacts of Agricultural Growth Program II Interventions on the Livelihood of Rural Households: Evidence from Central Ethiopia

College of Development Studies
Center for Rural Development Studies
Addis Ababa University

Dear Sir/Madam,

I am a Ph.D. student at Addis Ababa University, College of Development Studies, Center for Rural Development Studies. This interview aims to collect data to examine how the Agricultural Growth Program II (AGP II) activities have impacted the program's smallholder farmers in the *Wara-Jarso woreda*. It is particularly designed to look into the impacts of adopting crop technologies on agricultural productivity, income, commercialization, and welfare. The data you provide for this study will only be used to partially meet the requirements for a Ph.D. in Rural Development Studies from the Addis Ababa University Center for Rural Development. Researchers, policymakers, and other stakeholders who are curious about the significance of crop technology use for smallholders' livelihoods and who want to engage in comparable interventions on smallholders may find the data you provide in this research to be valuable. Otherwise, data has no administrative use and/or should not be used to make decisions that could in any way have an impact on your private life. I kindly request that you keep your responses modest and honest. Please feel free to pause me at any point during your responses to the following questions if you require more clarification.

I appreciate the useful information you will be providing for me in advance!

Part I. General Information

1.1. Household ID (001-400?): _____
1.2. District name: _____
1.3. Name of the *kebele*: _____ Village (Got):_____
1.4. *Kebele*'s agro-ecological zone_____
1.5. Date of interview (dd/mm/yy): _____
1.6. Time of interview: Beginning: _____ Ending: _____
1.7. Name of the enumerator: _____
    1.7.1. Sex_____
    1.7.2. Educational level_____
    1.3.3. Signature_____

1.8. Name of the supervisor: _____ Signature: _____

Part II. Characteristics of the household head and household members

2.1. Demographic characteristics of the household head:

Name of the household head	Age in year	**Sex** **[Code a]**	**Marital status** **[Code b]**	**Educational Status** **[Code c]**	If literate, highest grade completed) [Age 5 years and more] **Enumerator:** ***Write the highest educational level the respondent achieves, like grade…, diploma, TVET, degree, etc.***	Health status **[Code e]**	Farm experience [_____ years]

[Code a]	**[Code b]**			**[Code c]**	**[Code e]**	
1 = [Male]	1 = [Married, single spouse]	3 = [Single]	5 = [Widowed]	0 = [Illiterate]	1 = [Healthy]	3=[Unhealthy]
2 = [Female]	2 = [Married, more than one spouse]	4 = [Divorced]	6 = [Not together for any reason]	1 = [Literate]	2= [Moderately healthy]	4=[Disable]

2.2. Family size of the household by age group and sex [including the head]

Age Category	Family number by gender category	
	Male	**Female**
Below 10		
10 < X < 14		
15 < X < 64		
X > 65		
Disabled/permanently sick		
Total		

Part III. Farmer's resource ownership, technology characteristics, production costs and income of the household

3.1. Farm resource ownership:

Land ownership **[Code f]**	If yes, Sources of land **[Code g]**	Amount of land		Land use **[Code h]**	Land size for different use		House type **[Code i]**	House use **[Code j]**	Number of houses	Livestock owned **[Code k]**	Number of livestock	**The household has:**			
												Functional radio		Functional mobile phone	
												[Code f]	If yes, the program listened: **[Code l]**	**[Code f]**	If yes, the conversation made: **[Code l]**
		Unit	Amount		Unit	Amount									
Total															

[Code f]	[Code g]	[Code h]	[Code i]	[Code j]	[Code k]		[Code l]
0 = [No]	1 = [Allocated/owned from government]	1 = [Cultivated/crop land]	1 = [Thatched roof]	1 = [For human/residential]	1 = [Calves]	7 = [Goats]	1= [Agricultural]
1 = [Yes]	2 = [Inherited/parents' gift]	2 = [Grazing land]	2 = [Corrugated iron roof]	2 = [For animals]	2 = [Bulls]	8 = [Horses]	2 = [Non-agricultural]
	3 = [Rented-in]	3 = [Forest land]		3 = [For both]	3 = [Oxen]	9 = [Donkeys]	3 = [Both]
	4 = [Shared land]	4 = [Homestead land]		4 = [Store]	4 = [Heifer]	10 = [Young bulls]	
	5 = [Mortgaged/pledged]	5 = [Fallow land]		5 = [Multipurpose]	5 = [Cows]	11 = [Mule]	
	6 = [Purchased]	6 = [Others, specify]		6 = [Others]	6 = [Sheep]	12 = [Chicken/poultry]	

3.2. Technology use characteristics of farmers in the 2011/12 E.C production season:

Crops	Technologies and practices introduced by AGP II and adopted and used by the household		Used in the 2011/12 E.C cropping season [Code f]	Crops	Technologies and practices introduced by AGP II and adopted and used by the household		Used in the 2011/12 E.C cropping season [Code f]
Tef	Row planting			Maize	Row planting		
	Clustering				Clustering		
	Improved *tef* seed of *Korra* [type of tef seed introduced by AGP II]				BH540 [type of maize seed introduced by AGP II]		
	Soil fertility reclamation	Lime application			Soil fertility reclamation	Lime application	
		Salinity treatment				Salinity treatment	
		Erosion protection				Erosion protection	
		Others				Others	
	Chemical fertilizer (DAP, Urea)				Chemical fertilizer (DAP, Urea)		
	Organic fertilizer (Compost, manure, *etc.*)				Organic fertilizer (Compost, manure, *etc.*)		
	Improved *tef* seed other than *Korra*				Improved maize seed other than BH540		
	Herbicide				Herbicide		
	Insecticide				Insecticide		
	Others, specify				Others, specify		
Wheat	Row planting						
	Clustering						

	Danda'a [type of wheat seed introduced by AGP II]			
	Soil fertility reclamation	Lime application		
		Salinity treatment		
		Erosion protection		
		Others		
	Chemical fertilizer (DAP, Urea)			
	Organic fertilizer (Compost, manure, *etc.*)			
	Improved wheat seed other than Danda'a			
	Herbicide			
	Insecticide			
	Others, specify			

3.3. Questions for USERS and NON-USERS:

	For USERS		**For NON-USERS**	
S.Nº	**QUESTION:** Why do you use the subsequent technologies in *tef*, wheat and maize production? **Crop technologies and practices**	**Codes on why they make use of technologies and practices in *tef* wheat and maize production** **[Code m]**	**QUESTION:** Why not use the subsequent technologies in *tef*, wheat and maize production or in any other? **Crop technologies and practices**	**Codes on why don't they make use of technologies and practices in *tef* wheat and maize production** **[Code n]**
1	Row planting		Row planting	
2	Clustering		Clustering	
3	*Korra* [type of *tef* seed introduced by AGP II]		*Korra* [type of *tef* seed introduced by AGP II]	
4	Danda'a [type of wheat seed introduced by AGP II]		Danda'a [type of wheat seed introduced by AGP II]	
5	BH540 [type of maize seed introduced by AGP II]		BH540 [type of maize seed introduced by AGP II]	
6	Soil fertility reclamation		Soil fertility reclamation	

[Code m]		[Code n]	
1 = [The method/practice enhances yield extent (better yield advantage)]	5 = [Better marketing demand]	1 = [Not knowing the method]	7 = [Incompatible/unsuitable seed]
2 = [It reduces production costs]	6 = [Prices are affordable]	2 = [I know the method, but it does not help (it is not useful)]	8 = [My own saved seed is better]
3 = [Food quality (bread and Enjera taste, cooking time, *etc*.)]	7 = [Better germination rate]	3 = [I used to do it, but doing so costs me much]	9 = [Expensiveness/high cost]
4 = [Drought resistance)]	8 = [Others, please mention as many reasons as you can]	4 = [Lack of access (Unavailability)]	10 = [Less usefulness]
		5 = [Unreliable/untimely/late supply]	11 = [Others, please specify]
		6 = [Lack of capital to purchase]	

3.4. Production costs incurred for tef, wheat and maize production in the 2011/12 E.C cropping season

3.4.1. Production costs of inputs [inputs used and machinery rent] in the 2011/12 E.C cropping season:

			Tef				**Wheat**				**Maize**			
	Inputs used		Unit	Unit price	Quantity	Total cost	Unit	Unit price	Quantity	Total cost	Unit	Unit price	Quantity	Total cost
Technologies and practices adopted and used by the household	Improved seed		Kg				Kg				Kg			
	DAP		Kg				Kg				Kg			
	Urea		Kg				Kg				Kg			
	NPS		Kg				Kg				Kg			
	Soil fertility reclamation	Lime application	Kg				Kg				Kg			
		Salinity treatment	Kg				Kg				Kg			
		Erosion protection	Man/day				Man/day				Man/day			
		Others												
	Compost		Kg				Kg				Kg			
	Herbicide		Lit				lit				Lit			
	Pesticide		Lit				lit				Lit			
	Land rent		Ha				ha				Ha			
	Others													
					Total				**Total**				**Total**	

3.4.2. Labor and machinery use related information

Please indicate the average amount of labor used and costs pertinent to labor and machinery used for various tef, wheat and maize production operations in the last production season (in the 2011/12 E.C cropping season):

S.Nº	**Production activities/operations**	**Crop types**														
		Tef					**Wheat**					**Maize**				
		Number of labor employed			**Costs Paid for hired labor (ETB)**	**Costs incurred if machinery were rented**	**Number of labor employed**			**Costs Paid for hired labor (ETB)**	**Costs incurred if machinery were rented**	**Number of labor employed**			**Costs Paid for hired labor (ETB)**	**Costs incurred if machinery were rented**
		Family **[Code f]**	Hired **[Code f]**	Debbo and other arrangements **[Code f]**			Family **[Code f]**	Hired **[Code f]**	Debbo and other arrangements **[Code f]**			Family **[Code f]**	Hired **[Code f]**	Debbo and other arrangements **[Code f]**		
1	Land preparation (including seed cover, trampling and levelling)															
2	Planting															
3	Fertilizer application															
4	Weeding															
5	Harvesting															
6	Threshing															
7	Transporting to storage															
8	Agro-chemical application															
9	Irrigation and related activities															
10	Packaging															
11	Other activities															
	Total															

3.4.2.1. Family labor use information

	Crop types											
Family labor	*Tef*				*Wheat*				*Maize*			
	Age category (years)	**Number**		**Number of days**	**Age category (years)**	**Number**		**Number of days**	**Age category (years)**	**Number**		**Number of days**
		Male	**Female**			**Male**	**Female**			**Male**	**Female**	
	<10				<10				<10			
	10-13				10-13				10-13			
	14-16				14-16				14-16			
	17-50				17-50				17-50			
	>50				>50				>50			

3.4.2.1(a)

Crop types	**Which labor problem (both human labor and machinery-related problems) significantly affects the production of […] crop?** **[Code o]** **Note: Allow for multiple answers!**
Tef	
Wheat	
Maize	

[Code o]		
1 = [High wage rate]	3 = [Lack of skill]	5 = [Lack of farm implements]
2 = [Lack of labor during peak production seasons]	4 = [High machinery cost]	6 = [others, specify]:_____

3.4. Characteristics of cultivated plots, crops grown, AGP II inputs use, yields obtained, price and marketing-related information in the last production season [2011/12 E.C]

NB: Units of measurement must be changed to kilogram or quintal by the enumerator while responding. Filling any other unit of measure will invalidate the response.

Plot **[Code p]**	Plot size		Soil type **[Code q]**	Slope **[Code r]**	Fertility status **[Code s]**	Crops grown **[Code t]**	The total yield obtained/plot [Amount produced]		The amount used for different purposes					
									Consumption		Amount sold[Commercial]		Other	
	(*Timad/ Gezim*)	Hectare					Unit of measurement	Quantity	Unit of measurement	Quantity	Unit of measurement	Quantity	Unit of measurement	Quantity
Total						**Total**								

[Code p]	**[Code q]**	**[Code r]**	**[Code s]**	**[Code t]**
1 = [Plot 1] 4 = [Plot 4] 5 = [Plot 5]	1 = [Red] 3 = [Brown] 5 = [Other]	1 = [Gentle slope/flat] 3 = [Steeps lope]	1 = [Good] 3 = [Poor]	1 = [*Tef*] 3 = [Maize]
2 = [Plot 2] 3 = [Plot 3] 6 = [Plot 6]	2 = [Black] 4 = [Grey]	2 = [Medium slope]	2 = [Medium]	2 = [Wheat]

Part V: Access to institutional services

4.1. Access to extension, credit and irrigation services, cooperative and/or association membership, the distance of the AGP II's office (FTC) and market

Access to Extension **[Code f]**	If yes, frequency of extension contact per month	Access to credit **[Code f]**	**If yes, sources of the credit [Code u]**	If yes, amount received (Birr)	**Purpose of credit received** **[Code v]**	Did you use irrigation water to produce crops? **[Code f]**	If yes, What proportion of your___crop land was irrigated (%)?			Membership in cooperatives and/or associations or any other organization Or involvement in any civic engagement? **[Code f]**	**If yes, to which** **[Code w]** **NB: Multiple answers are allowed**	If yes, rate its importance in the production of … **[Code x]**			Distance the household travels from home to where AGP II focal people reside at the local level [mainly the FTC] **[in km]**	What is the distance to the nearest market (in km)? (Average distance from home to the main market area. Enumerator: Note that the market is for the mentioned crops		
							Tef crop	Wheat crop	Maize crop			*Tef* crop	Wheat crop	Maize crop		*Tef* production	Wheat production	Maize production

[Code u]	**[Code v]**	**[Code w]**		**[Code x]**
1 = [Banks]	1 = [Seed purchasing]	1 = [Agricultural cooperative]	10 = [AGP task force]	1 = [Very low]
2 = [Oromia credit and saving institution]	2 = [Fertilizer purchasing]	2 = [Village saving and loan society]	11 = [Farmers Research Group]	2 = [Low]
3 = [Other microfinance]	3 = [Agro-chemicals (pesticide, herbicide insecticide *etc.*)]	3 = [RUSSACO]	12 = [Community-based forage-producing group]	3 = [Moderate]
4 = [Informal money lenders]	4 = [Livestock purchasing]	4 = [Iddir]	13 = [Any kind of Common Interest Group]	4 = [High]
5 = [Friends]	5 = [Land rent]	5 = [Equub]	14 = [Others, specify_____]	5 = [Very high]
6 = [Relatives]	6 = [To purchase household consumption goods]	6 = [*Kebele* council]		
7 = [Others, specify_____]	7 = [Medical expenses (livestock and human)]	7 = [Youths' association]		
	8 = [Other expenditure]	8 = [Women's association]		
		9 = [Water use committee]		
		10 = [Government official]		
		11 = [Local representative]		
		12= [Religious organization membership]		

4.2. Did you participate in awareness creation programs about agricultural technologies (training, field days, demonstration, *etc*.)?

0 = [No]
1 = [Yes]

4.2.1. If yes, on average, how often did you participate in these awareness-creation programs?_____/year

4.3. What was the focus of awareness creation programs from the following list of activities? (Multiple answers are possible)

1 = [Chemical fertilizer] 3 = [Credit access] 5 = [High yielding crop variety] 7 = [Improved livestock breeds]
2 = [Pesticides] 4 = [Water conservation practices] 6 = [Beehives] 9 = [Never participated]
8 = [Other, specify:_____]

Part VI: Commercialization-related information

5.1. Purpose of producing *tef*, maize and wheat crops: Can you share with us your primary intent of producing major cereals in the 2011/12 E.C. cropping season?

Crops	Purpose of producing major cereals (AGP II crops)	If your production is market-oriented and/or not largely market-oriented, why?
Tef		
Wheat		
Maize		

[Code y]			[Code z]		
1 = [Only for household consumption]	3 = [For market only]	5 = [Equally for both]	1 = [Production is too small]	3 = [Absence of demand for the product]	5 = [Poor market infrastructure (lack of support like finance, information, *etc.* from the government)]
2 = [Largely for household consumption]	4 = [Largely for market]	6 = [If any other, specify]	2 = [Market price is not attractive to sell]	4 = [High family consumption demand]	6 = [High transaction cost]
					7 = [If any other, specify_____]

5.2. AGP II crops use [utilization and commercialization] in the 2011/12 E.C cropping season:

Crops	How much was your production harvested during the 2011/12 E.C. cropping season? [in Kg]	How much was consumed at home? [in Kg]	How much was saved as seed? [in Kg]	How much was sold? [in Kg]	What was the most important reason for selling … crop? **[Code 1]**	Are you satisfied with the market? **[Code 2]**	For gifts and exchange? [in Kg]	How much of it did you use to repay your debt? [in Kg]	In the last cropping season, did you store … crop for later sell, waiting for the price to increase? **[Code f]**	If yes, how much of this produce did you store? [in Kg]
Tef										
Wheat										
Maize										

[Code 1]		**[Code 2]**	
1 = [Because I have surplus (more than home consumption) yield]	4 = [To buy other or less cheap crops for home consumption]	1 = [Highly satisfied]	4 = [Dissatisfied]
2 = [To cover expenses]	5 = [Because I mainly produce for marketing]	2 = [Satisfied]	5 = [Highly dissatisfied]
3 = [To pay for credit]	6 = [If other, specify_____]	3 = [More or less satisfied]	

5.3. Main crops marketing-related information

Tef				**Wheat**				**Maize**			
View on current market price **[Code 3]**	Who decides the market price for *tef*? **[Code 4]**	Is there enough demand for *tef*? **[Code f]**	If no, mention as many reasons as you can for the absence of demand for *tef*	View on current market price **[Code 3]**	Who decides the market price for wheat? **[Code 4]**	Is there enough demand for wheat? **[Code f]**	If no, mention as many reason as you can for the absence of demand for wheat	View on current market price **[Code 3]**	Who decides the market price for maize? **[Code 4]**	Is there enough demand for maize? **[Code f]**	If no, mention as many reason as you can for the absence of demand for maize

[Code 3]			**[Code 4]**		
1 = [Very low]	3 = [Fair]	5 = [Very high]	1 = [The buyer]	3 =[Both of them]	5 = [Other, specify]
2 = [Low]	4 = [High]		2 = [Farmer/seller]	4 = [The government]	

5.4. Please tell us the sources and amount of average annual income you obtain from different sources.

S.Nº	Average annual household gross income obtained from different sources in the 2011/2012 cropping season	Average income (Birr/year)
1	Farm activities like food crop sales other than *tef*, wheat and maize, livestock and livestock products sale, forest and forest products sale (fuel, wood, charcoal, *etc*.)	
1.1.	*Tef* sale	
1.2.	Wheat sale	
1.3.	Maize sale	
2	Off-farm activities like agricultural wage employment (daily labor sold for agricultural activities), agriculture-related self-employment, *etc.*	
3	Non-farm activities like non-agricultural wage employment, petty trade on non-agriculture activities, artisan work, guard, and other income such as capital earnings and pensions	
4	Remittance (from son/daughter, relatives, friends or others)	
5	Formal credit	
6	Informal credit	
7	Aid/donation	
8	Others	

Part VII: Welfare-related information

6.1. Household's expenditure on food items

S.Nº	Types of household expenditure on food items	Food consumption spending in the last day (24 hours)? [ETB]	Food consumption spending in the last seven days? [ETB]
1	Cereals [*tef*, wheat, maize, barley, sorghum, lentils, *etc.*]		
2	Vegetables		
3	Animal and animal products [milk, meat, butter, cheese, *etc.*]		
4	Expenditure on other food items		
	Total		

6.1.1. Please tell me your household's primary and secondary sources of food consumption in the 2011/12 E.C. cropping season.

Sources of food [Code 5]		**If it is own production, to what extent do the subsequent crops produced with the help of AGP II-introduced crop technologies and practices contribute directly or indirectly?** [Code 5]		
Primary source		*Tef*	Wheat	Maize
Secondary source				

[Code 5]				[Code 6]	
1 = [Own-production]	3 = [Gifts/transfers from family or relatives]	5 = [PSNP direct support]	7 = [To some extent]	1 = [Highly]	3 = [To some extent]
2 = [Purchase]	4 = [PSNP through work]	6 = [Food aid]	8 = [If other, specify_____]	2 = [Moderately]	4 = [Nothing at all]

6.2. Expenditures on non-food items and household assets

S.N^{o}	Types of household expenditure on non-food items	Non-food consumption spending in the last year? [ETB]	S.N^{o}	Types of household's expenditure on non-land assets: consumer durables and production equipment	Household's expenditure on non-land assets in the last year? [ETB]
1	Expenditure on safe and potable water		1	Expenditure on consumer durables	
2	Expenditure on cooking fuel and electricity		2	Expenditure on production equipment/farm implements (including chemical sprayer and water pump, if there are any)	
3	Expenditure on health (human and animal)		3	Expenditure on other non-land assets	
4	Expenditure on schooling				
5	Expenditure on other non-food items				
	Total			**Total**	

6.3. General expenditures: recurrent and infrequent expense

S. N^{o}	Types of household's general expenditures	Household's expenditure on non-land assets in the last six months? [ETB]	Household's expenditure on non-land assets in the last year? [ETB]
1	Recurrent expenses, including household members' personal care items, costs related to social and religious activities such as funerals and weddings, mobile cards, household help/remitted out, tobacco/alcoholic drinks, house rent, *etc.*		

Appendix B: Interview guide for the program beneficiary farmers

Dear Sir/Madam,

I am a Ph.D. student at Addis Ababa University, College of Development Studies, Center for Rural Development Studies. This interview aims to collect data to examine how the Agricultural Growth Program II (AGP II) activities have impacted the program's smallholder farmers in the *Wara-Jarso woreda*. It is particularly designed to look into the Impacts of Agricultural Growth Program II Interventions on the Livelihood of Rural Households: Evidence from Central Ethiopia. The data you provide for this study will only be used to partially meet the requirements for a Ph.D. in Rural Development Studies from the Addis Ababa University Center for Rural Development. Researchers, policymakers, and other stakeholders who are curious about the significance of crop technology use for smallholders' livelihoods and who want to engage in comparable interventions on smallholders may find the data you provide in this research to be valuable. Otherwise, data has no administrative use and/or should not be used to make decisions that could in any way have an impact on your private life. I kindly request that you keep your responses modest and honest. Please feel free to pause me at any point during your responses to the following questions if you require more clarification.

I appreciate the useful information you will be providing for me in advance!

Questions

1. Who are the targets (beneficiaries) of AGP II? Are you from the target group of the program?
2. How the program reaches you?
3. Did the program offer you a crop technology demonstration, especially for *tef*, wheat and maize crops?
4. What are the AGP II-based processes of crop technology demonstrations both in Farmers' Training Centers (FTCs) and farmers' plots?
   4.1. How effective are they?
5. Please provide your perception of crop technologies introduced by the AGP II?
   Probe: *Whether it increases/enhances production and productivity or otherwise*
   Whether it improves food security and income or otherwise
   Whether it helps to reduce pest and disease outbreaks or otherwise
   Whether it increases crop diversity or otherwise
6. What looks the SWOT of the crop technologies? (Strengths, Weaknesses, Opportunities and Threats)?
7. What is your market orientation, especially in producing *tef*, wheat and maize crops?
8. What are the specific interventions of the program being implemented to enhance the mentioned crops' commercialization?
9. Who are the major market actors in the commercialization of these crops?

10. What market infrastructures were established by AGP II to support the commercialization of these crops?
11. What are the major challenges farmers faces in the commercialization of these crops?
12. Please tell us the effect of the utilization of these crop technologies on your consumption expenditure?
13. Does the program's implementation of crop technologies have a differential welfare effect on male and female-headed household beneficiaries? If yes, how?
14. Would you please tell me your perception of AGP II-introduced crop technologies' contribution to your welfare status?

Appendix C: Interview guide for the office-based KIIs

AGP II coordinator at the woreda level, DAs, relevant subject matter specialists (SMSs) or the pertinent officers are all considered in the question guide for KIIs.

Dear Sir/Madam,

I am a Ph.D. student at Addis Ababa University, College of Development Studies, Center for Rural Development Studies. This interview aims to collect data to examine how the Agricultural Growth Program II (AGP II) activities have impacted the program's smallholder farmers in the *Wara-Jarso woreda*. It is particularly designed to look into the Impacts of Agricultural Growth Program II Interventions on the Livelihood of Rural Households: Evidence from Central Ethiopia. The data you provide for this study will only be used to partially meet the requirements for a Ph.D. in Rural Development Studies from the Addis Ababa University Center for Rural Development. Researchers, policymakers, and other stakeholders who are curious about the significance of crop technology use for smallholders' livelihoods and who want to engage in comparable interventions on smallholders may find the data you provide in this research to be valuable. Otherwise, data has no administrative use and/or should not be used to make decisions that could in any way have an impact on your private life. I kindly request that you keep your responses modest and honest. Please feel free to pause me at any point during your responses to the following questions if you require more clarification.

I appreciate the useful information you will be providing for me in advance!

Questions

1. Who are the target beneficiaries of AGP II in general and crop technology utilization in particular? [Target group identification]
2. How are these target farmers reached?
3. Have you encountered any problems (challenges) related to the intended target group identification?
    - 3.1. For the whole package of the program?
    - 3.2. For crop technologies utilization and the practice aspect? (technologies and practices for *Tef*, Wheat and Maize crops independently)

4. What are the AGP II-based processes of crop technology demonstrations?
    - 4.1. In Farmers' Training Centers (FTCs)?
    - 4.2. At farmers' plot?
        - 4.2.1. How effective are they?
        - 4.2.2. Which one is more effective? Why?
5. What are the smallholder farmers' perceptions towards crop technologies introduced by the program?

    Probe: Increases production and productivity (yield gains)

Improves food security and income
Helps to reduce pest and disease outbreak
Increase crop diversity

6. What looks the SWOT of the crop technologies?
    - 6.1. What do you think are the major strengths of crops [*Tef*, Wheat and Maize] technologies utilization in your locality?
    - 6.2. What do you think are the major weaknesses of crops [*Tef*, Wheat and Maize] technologies utilization in your locality?
    - 6.3. What opportunities do you think that utilization of AGP II introduced crop technologies render for you and your locality's people?
    - 6.4. What threats are encountering the operations of crops [*Tef*, Wheat and Maize] technologies utilization in your locality?
7. What intervention strategies could be designed to enhance the implementation of the crop [*Tef*, Wheat and Maize] technologies utilization in your locality? [suggestions for future improvement]
8. What are the smallholder farmers' perceptions of AGP II's contribution to crop productivity?
    - Probe: It increases production and productivity (yield gains)
    - It enhances their condition of food security and income
9. What are the specific interventions of the AGP II being implemented to enhance crop [*Tef*, Wheat and Maize] commercialization?
    - 9.1. Are they beneficial (important)? If yes, to what extent, particularly with regard to the mentioned crops?
10. Who are the major actors identified in crop [*Tef*, Wheat and Maize] commercialization?
    - 10.1. How has AGP II worked with these actors?
    - 10.2. What benefits it renders for crops [*Tef*, Wheat and Maize] producer smallholder farmers?
11. What market infrastructures were established by the program to support crop [*Tef*, Wheat and Maize] commercialization?
    - 11.1. In what ways do they support the processes of commercialization?
12. What are farmers' major challenges in crop [*Tef*, Wheat and Maize] commercialization?
13. What do you think is the effect of crop technology utilization on smallholder farmers' consumption expenditure?
14. What do you think is the differential welfare effect of the program on male and female-headed household beneficiaries?
15. What looks like the implementation of CIGs? Is it going in line with the program implementation manual? Or what?
16. Probes: its strengths, weaknesses and suggestion for future improvement
17. Please tell us new things that happened because of AGP II interventions/implementation in general.

Appendix D: Observation checklist

1. Crop (*Tef*, Wheat and Maize) technologies demonstrated both in FTCs and farmers' plots [if there are any]
2. Activities conducted or being under implementation by CIGs
3. And other observable activities conducted by the program [in relation to the study under consideration]

Appendix E: Checklist for Focus Group Discussions

Dear Sir/Madam,

I am a Ph.D. student at Addis Ababa University, College of Development Studies, Center for Rural Development Studies. The main objective of this discussion is to investigate the effects of AGP II introduced Common Interest Group (CIG) initiative on rural women and youth livelihood in your locality. The data you provide for this study is only used to partially meet the requirements for a Ph.D. in Rural Development Studies from the Addis Ababa University Center for Rural Development. Researchers, policymakers, and other stakeholders who are curious about the significance of the CIGs and who want to engage in comparable interventions for smallholders may find the data you provide in this research to be valuable. Otherwise, data has no administrative use and/or should not be utilized to make decisions that could in any way have an impact on your private life. I kindly request that you keep your responses modest and honest. Please feel free to pause me at any point during your responses to the following questions if you require more clarification.

I appreciate the useful information you will be providing for me in advance!

Questions for discussion

1. Please tell us when are your Common Interest Groups (CIGs) established?
2. What activities are you conducting (or engaged in) via CIGs?
3. Why you joined your respective CIGs?
4. Are CIGs helpful in improving farmers' income and productivity? [Yes or no…explain how]
5. Did you manage to generate additional income from being members of CIGs [Yes or no…explain how]
6. What is your perception of the performance of CIGs in your locality in which you have been a member for the last three (?) years?
   Probe: Highly productive
   Productive
   Somewhat productive
   Not productive with adequate explanations
7. How do you perceive the general performance of CIGs?
   Probe: Highly productive
   Productive
   Not bad (fair)
   Poor
   Extremely poor with adequate explanations
8. Is there a visible performance-related difference between women's CIGs and other CIGs?
9. If yes, which one is more productive?

Probe: Women CIGs
Youth CIGs
Mixed CIGs [explain how]

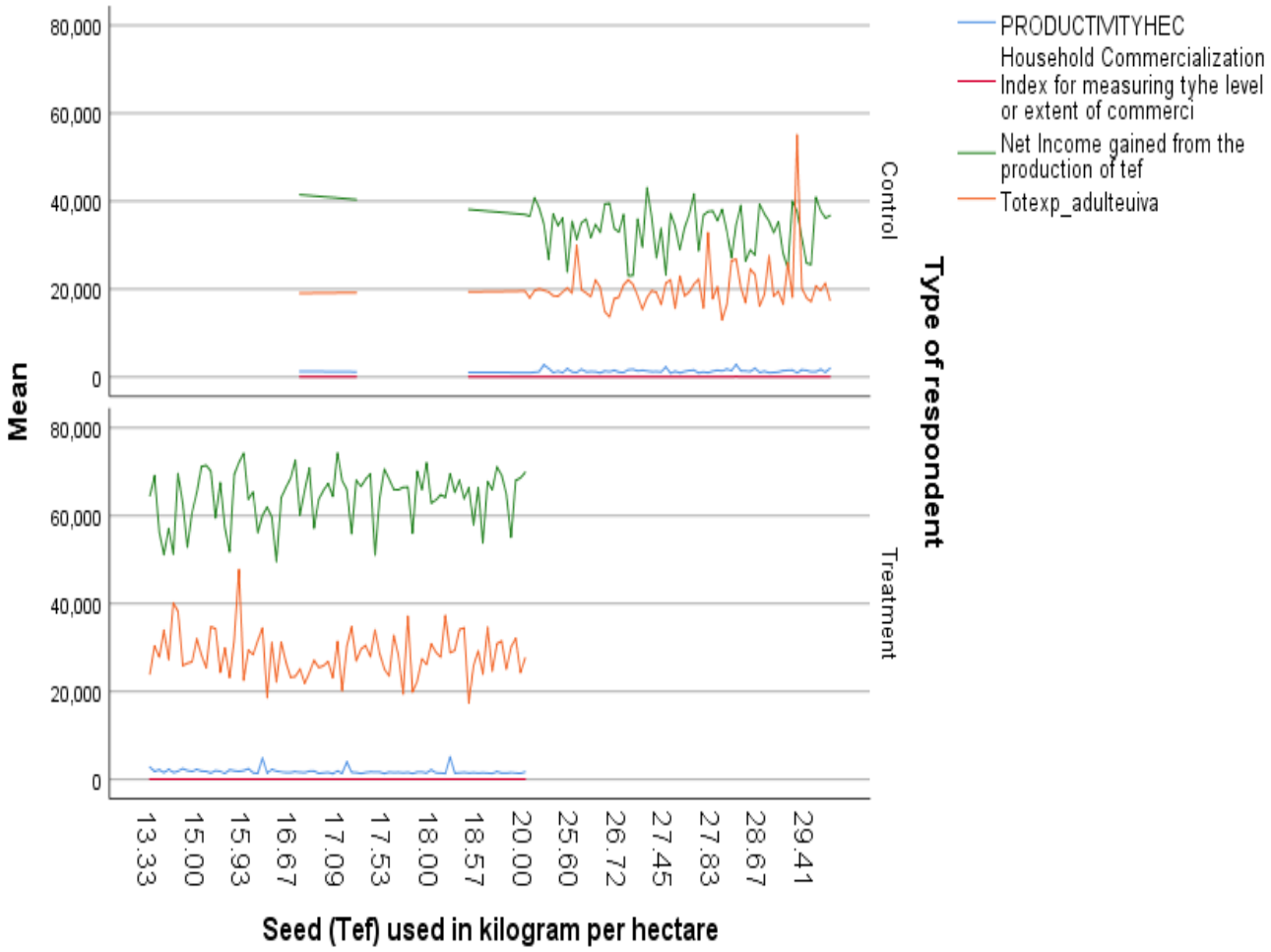
10. Why do you think they performed better?
    Probe: Commonness in interest among members
    Commitment and seriousness of members
    Smaller membership
    Profitability of the line of business (activities) of the group
11. How much have you contributed during establishing your CIG (Birr)?
12. Is the individual members' contribution fair or expensive? [Explain]
13. Have you received market linkage support for selling your crops or livestock? (Yes or No) [Explain]
14. If yes, to which institution was your group linked?
    Probe: Cooperatives
    Unions
    Private buyers/sellers, including factories
    Government enterprises
15. If yes to [any institution], what benefits you got at being in such a cooperative?
    Probe: Easy market access
    Better price
    Easier input access
    Not benefited
16. What are the major strengths of CIG in which you are a member and the CIG scheme in general?
17. What do you think are the major weaknesses of CIG in which you are member and CIGs in general?
18. What opportunities do you think CIGs render for you and your locality's people?
19. What threats are you encountering in the operations of CIGs in your locality?
20. What intervention strategies could be designed to enhance the operation of CIGs in your locality? [suggestions for future improvement]

Appendix F: Nutrition (calorie) based Equivalence Scales

Years of age	Men	Women
0-1	0.33	0.33
1-2	0.46	0.46
2-3	0.54	0.54
3-5	0.62	0.62
5-7	0.74	0.70
7-10	0.84	0.72
10-12	0.88	0.78
12-14	0.96	0.84
14-16	1.06	0.86
16-18	1.14	0.86
18-30	1.04	0.80
30-60	1.00	0.82
60 plus	0.84	0.74

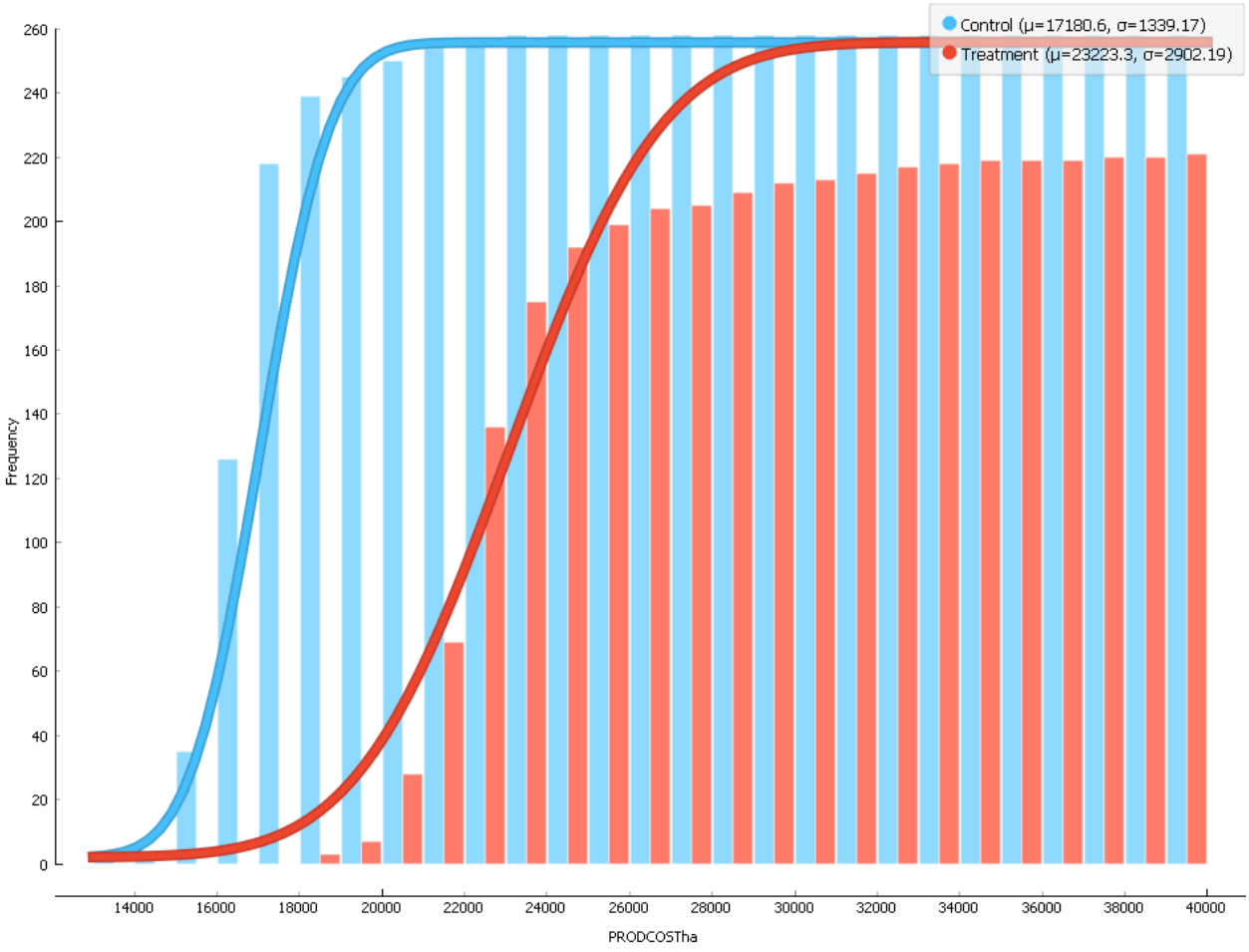
Source: Adopted from Stefan and Pramila (1998), as calculated from World Health Organization data

Appendix G : A visual representation of the relationship between users' productivity, income, commercialization, and welfare and their use of *Korra tef*



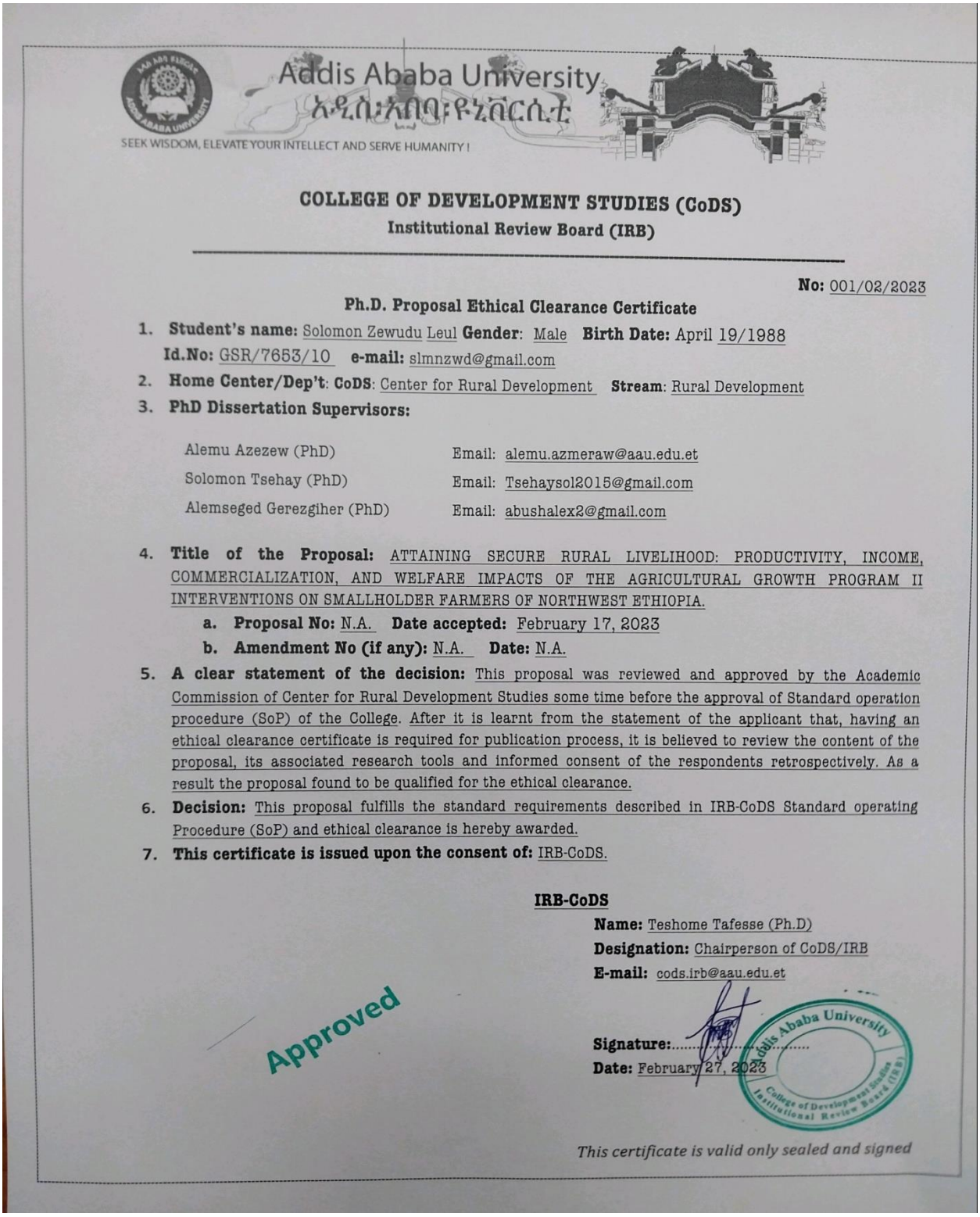
Source: SPSS output

Appendix H: Production costs of *tef* for the users and non-users (ETB/ha)



Source: own survey data (2020) extracted by Orange Data Mining Software

Appendix I: Ph.D. Proposal Ethical Clearance Certificate



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COLLEGE OF DEVELOPMENT STUDIES (CoDS)
Institutional Review Board (IRB)

No: 001/02/2023

Ph.D. Proposal Ethical Clearance Certificate

1. **Student's name:** Solomon Zewudu Leul **Gender**: Male **Birth Date:** April 19/1988
   Id.No: GSR/7653/10 **e-mail:** slmnzwd@gmail.com
2. **Home Center/Dep't**: **CoDS**: Center for Rural Development **Stream**: Rural Development
3. **PhD Dissertation Supervisors:**

Alemu Azezew (PhD)	Email: alemu.azmeraw@aau.edu.et
Solomon Tsehay (PhD)	Email: Tsehaysol2015@gmail.com
Alemseged Gerezgiher (PhD)	Email: abushalex2@gmail.com

4. **Title of the Proposal:** ATTAINING SECURE RURAL LIVELIHOOD: PRODUCTIVITY, INCOME, COMMERCIALIZATION, AND WELFARE IMPACTS OF THE AGRICULTURAL GROWTH PROGRAM II INTERVENTIONS ON SMALLHOLDER FARMERS OF NORTHWEST ETHIOPIA.
   a. **Proposal No:** N.A. **Date accepted:** February 17, 2023
   b. **Amendment No (if any):** N.A. **Date:** N.A.
5. **A clear statement of the decision:** This proposal was reviewed and approved by the Academic Commission of Center for Rural Development Studies some time before the approval of Standard operation procedure (SoP) of the College. After it is learnt from the statement of the applicant that, having an ethical clearance certificate is required for publication process, it is believed to review the content of the proposal, its associated research tools and informed consent of the respondents retrospectively. As a result the proposal found to be qualified for the ethical clearance.
6. **Decision:** This proposal fulfills the standard requirements described in IRB-CoDS Standard operating Procedure (SoP) and ethical clearance is hereby awarded.
7. **This certificate is issued upon the consent of:** IRB-CoDS.

IRB-CoDS
Name: Teshome Tafesse (Ph.D)
Designation: Chairperson of CoDS/IRB
E-mail: cods.irb@aau.edu.et

Approved

Signature:.....
Date: February 27, 2023

Addis Ababa University
College of Development Studies
Institutional Review Board (IRB)

This certificate is valid only sealed and signed

Source: AAU, CDS, Institutional Review Board

Appendix J: Confirmation letter from the treatment *woreda*

Date: 21/10/2020

From,
Mr. Bikila Tolossa Regassa
Wara Jarso wereda's AGP II coordinator
Wara Jarso wereda
Kare-Goha

To,
Mr. Solomon Zewdu Leul
PhD candidate at Addis Ababa University
Addis Ababa

Dear Mr. Solomon

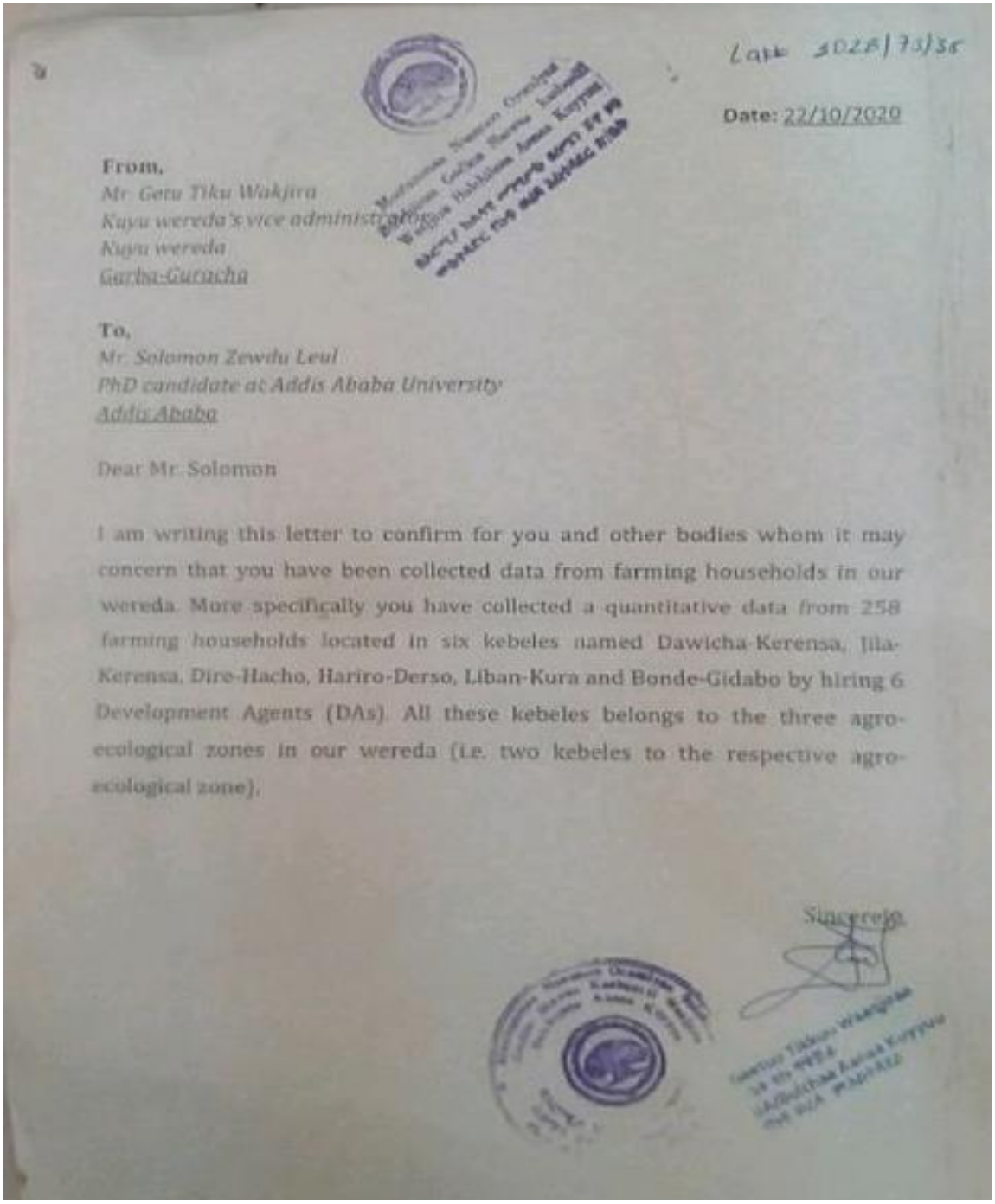
I am writing this letter to confirm for you and other bodies whom it may concern that you have been collected data on the implementation of our program (i.e. AGP II). More specifically you have collected the data from the below-mentioned bodies found in our wereda.

- Quantitative data from 221 AGP II beneficiary households from six kebeles named Lencho-Borsu, Wale-Chilalo, Abo-Yayambana, Dhaye-Tuti, Jemjem-Mela and Faji-Ejersa by hiring 11 Development Agents (DAs)
- Qualitative data from:
  - DAs; one from each of the three agro-ecological zones
  - Nine AGP II beneficiary farmers; three from each of the three agro-ecological zones by classifying crop technology adopter farmers as good performers, medium performers and low performers
  - The wereda's AGP II coordinator
  - Representative of the wereda's women, children and youth affair office
  - Representative of the wereda's livestock and fishery development office
  - Representative of the wereda's cooperative establishment and development office
- Qualitative data from five CIGs located in [illegible] Kebeles namely Lencho-Borsu, Wale-Chilalo, Abo-Yayambana and Dha[illegible] considering them as Focus Group Discussions (FGDs)].

Sincerely,

Source: *Wara-Jarso woreda* AGP II Coordination Office

Appendix K: Confirmation letter from the control *woreda*



Date: 22/10/2020

From,
Mr. Getu Tiku Wakjira
Kuyu wereda's vice administrator
Kuyu wereda
Garba-Guracha

To,
Mr. Solomon Zewdu Leul
PhD candidate at Addis Ababa University
Addis Ababa

Dear Mr. Solomon

I am writing this letter to confirm for you and other bodies whom it may concern that you have been collected data from farming households in our wereda. More specifically you have collected a quantitative data from 258 farming households located in six kebeles named Dawicha-Kerensa, Jila-Kerensa, Dire-Hacho, Hariro-Derso, Liban-Kura and Bonde-Gidabo by hiring 6 Development Agents (DAs). All these kebeles belongs to the three agro-ecological zones in our wereda (i.e. two kebeles to the respective agro-ecological zone).

Sincerely,

Source: *Kuyu woreda*, vice-administration and Agriculture and Natural Resource Office

Appendix L: Collection of photos from fieldwork

Photo 1: HH survey enumerators gather after training at Wara-Jarso woreda

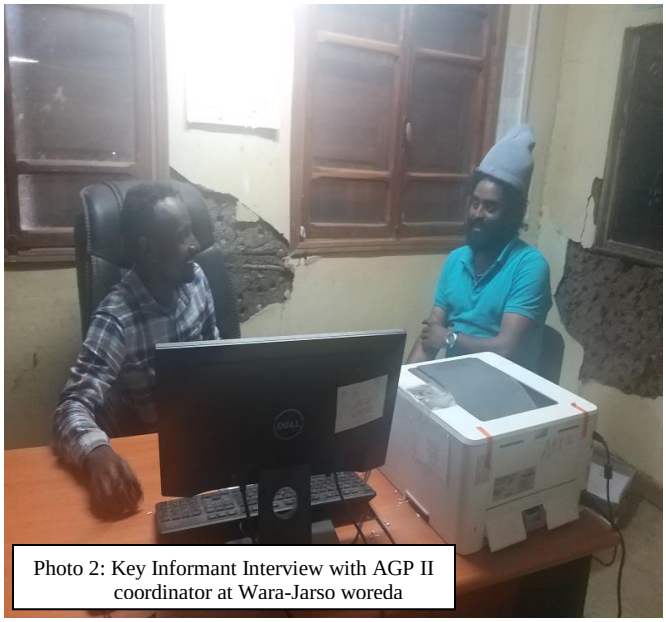


Photo 2: Key Informant Interview with AGP II coordinator at Wara-Jarso woreda

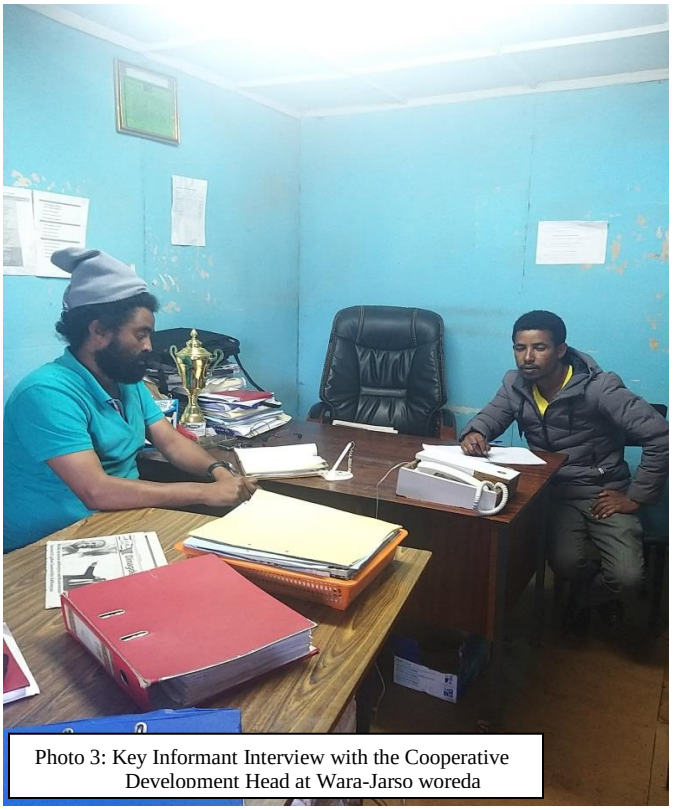


Photo 3: Key Informant Interview with the Cooperative Development Head at Wara-Jarso woreda

Photo 4: FGD with farmers engaged in dairy farm at Lencho Borsu kebele, Wara-Jarso woreda

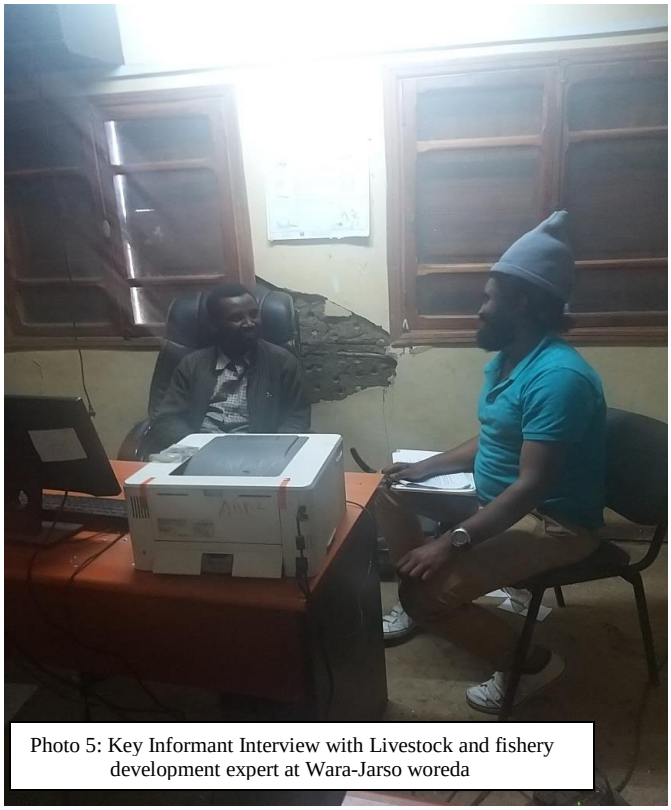


Photo 5: Key Informant Interview with Livestock and fishery development expert at Wara-Jarso woreda

Photo 6: Dairy farm at Lencho-Borsu kebele, Wara-Jarso woreda

Photo 7: Collecting survey questionnaires from enumerators at Kuyu woreda, control group

Photo 8: Student researcher visiting Korra tef farm at Wale-Chilalokebele. Wara-Jarso woreda

Appendix M: Turnitin Originality Report

Document Viewer

Turnitin Originality Report

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Appendix N: Statuses of the Articles

Location of article in the dissertation	Title of the article	Name of the Journal	Publisher	Status and Date
Chapter 2	The Impacts of *Korra tef* (*Eragrostis tef*) Adoption on Farm Households Productivity and Income in Central Ethiopia: A Propensity Score Matching Analysis	African Crop Science Journal	AJOL	Under review after first revision
Chapter 3	Productivity Effects of Plot-Level *Korra Tef* Seed Rate in Central Ethiopia: Application of the Dose-Response Model	Ethiopian Journal of Development Research (EJDR)	CoDS, AAU	Under review
Chapter 4	The Impact of *Korra tef* (*Eragrostis tef*) Adoption on Commercialization Status of Farm Households in Central Ethiopia: A Propensity Score Matching Analysis	Cogent Economics &Finance	Taylor and Francis	Published on August 17, 2023 DOI: 10.1080/23322039.2023.2242652
Chapter 5	Adoption of *Korra tef* (*Eragrostis tef*) and its Impact on Farm Households Welfare: a Propensity Score Matching Estimation in Central Ethiopia	Cogent Food & Agriculture	Taylor and Francis	Published on August 23, 2023 DOI: 10.1080/23311932.2023.2247683
Chapter 6	Effects of Common Interest Groups on rural women and youth livelihood: A qualitative study from Central Ethiopia	PLOS ONE	PLOS	Accepted on March 20, 2023

NB: *The notification sent for the acceoted article is attached in the next page.*

Gmail Solomon Zewdu <slmnzwd@gmail.com>

Notification of Formal Acceptance for PONE-D-22-20401R1 - [EMID:181b4fd86bcc86eb]

3 messages

PLOS ONE <em@editorialmanager.com> Mon, Mar 20, 2023 at 7:13 PM
Reply-To: PLOS ONE <plosone@plos.org>
To: Solomon Zewdu Leul <slmnzwd@gmail.com>

CC: alemu.azmerawb@gmail.com, tsehaysol2015@gmail.com, abushalex2@gmail.com

PONE-D-22-20401R1
Effects of Common Interest Groups on rural women and youth livelihood: A qualitative study from Northwestern Ethiopia

Dear Dr. Leul:

I'm pleased to inform you that your manuscript has been deemed suitable for publication in PLOS ONE. Congratulations! Your manuscript is now with our production department.

If your institution or institutions have a press office, please let them know about your upcoming paper now to help maximize its impact. If they'll be preparing press materials, please inform our press team within the next 48 hours. Your manuscript will remain under strict press embargo until 2 pm Eastern Time on the date of publication. For more information please contact onepress@plos.org.

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Solomon Zewdu <slmnzwd@gmail.com> Thu, Jun 1, 2023 at 8:30 AM
To: PLOS ONE <plosone@plos.org>

Dear PLOS ONE Editorial Office Staff,

I hope this email finds you well. I'm writing about our accepted manuscript titled "Effects of Common Interest Groups on rural women and youth livelihood: A qualitative study from Northwestern Ethiopia" (PONE-D-22-20401), which is currently in the process of production.

If it is not yet produced, we would like to change the general name of the study area (i.e. Northwestern Ethiopia) located in the title and under the study's objective to 'Central Ethiopia'. Even though the area is around Northwestern Ethiopia, we came to learn that naming it Central Ethiopia would better indicate the location of the study under consideration. Thank you for your time and attention. I look forward to hearing from you!

Thank you once again for your understanding!