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Determinants of Dairy Cooperative Membership and its Impacts on Dairy Farm income in Bahir Dar Zuria District, North Gojjam Zone, Amhara Region, Ethiopia

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BAHIR DAR UNIVERSITY
COLLEGE OF AGRICULTURE AND ENVIRONMENTAL SCIENCES

GRADUATE PROGRAM IN
AGRICULTURAL ECONOMICS DEPARTMENT

DETERMINANTS OF DAIRY COOPERATIVE MEMBERSHIP AND ITS
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DISTRICT, NORTH GOJJAM ZONE, AMHARA REGION, ETHIOPIA

M.Sc. THESIS
BY:
YESHI HUNEGNAW YISMAW

October 2024
BAHIR DAR, ETHIOPIA



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M.Sc. THESIS

BY:

YESHI HUNEGNAW YISMAW

**THIS THESIS SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL
ECONOMICS IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
AWARD OF DEGREE OF MASTER OF SCIENCE (M.SC.)**

ADVISOR: BERIHUN TEFERA ADUGNA (PhD.)

October 2024

BAHIR DAR, ETHIOPIA

THESIS APPROVAL SHEET

As a member of the Board of Examiners of the Master of Sciences (M.Sc.) thesis open defense Examination, we have read and evaluated this thesis prepared by Mrs. Yeshi Hunegnaw Yismaw entitled “Determinants of Dairy Cooperative Membership of Farm Households and its Impacts on Dairy Farm Income in Bahir Dar Zuria District, North Gojjam Zone, Amhara, Ethiopia”. We hereby certify that the thesis is accepted for fulfilling the requirements for the award of the degree of Master of Sciences (M.Sc.) in the Agricultural Economics Department.

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DECLARATION

This is to certify that this thesis entitled “**Determinants of Dairy Cooperative Membership of Farm Households and its Impacts on Dairy Farm Income in Bahir Dar Zuria District, North Gojjam Zone, Amhara, Ethiopia**,” submitted in partial fulfillment of the requirements for the award of the degree of Master of Science in “**Agricultural Economics**” to the Graduate Program of College of Agriculture and Environmental Sciences, Bahir Dar University by **Yeshi Hunegnaw Yismaw (ID. No. 1401271)** is an authentic work carried out by her under our guidance. The matter embodied in this project work has not been submitted earlier for the award of any degree or diploma to the best of our knowledge and belief.

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ABSTRACT

Dairy cooperatives play a vital role to dairy farmers in overcoming production and marketing risks, enhancing milk output, and improving dairy farm income. However, evaluation of the determinants and impact of dairy cooperative membership on dairy farm income in Ethiopia was limited. Therefore, this study aimed to identify the determinants of dairy cooperative membership and its impact on dairy farm income in Bahirdar Zuria District. Secondary data were collected from the district and kebele level agricultural and cooperative offices, published and unpublished documents related to dairy cooperatives. Primary data were collected from 400 households using a three-stage sampling technique from four sample kebeles. Descriptive statistics and econometric models were used to analyze the data. Double hurdle model was used to analyze determinates of dairy cooperative membership and intensity of participation in milk supply, and endogenous switching regression model was used to analyze its impact on household dairy farm income. The result of the first double hurdle model (probit) revealed that age, number of crossbreed cow ownership, having member neighbors, off-farm activity, frequency of livestock extension contact, and access to dairy production training were positively and significantly associated with dairy cooperative membership decision. Conversely, distance to the district market and distance to the dairy cooperative affected the dairy cooperative membership decision negatively and significantly. The truncated result indicated that age, education status, number of crossbreed cow ownership, off-farm activity, input availability, frequency of livestock extension contact, dairy production training, and having neighbor dairy cooperative members significantly and positively affected dairy cooperative members' intensity of participation in milk supply. Whereas, distance to the district market and distance to the dairy cooperative was affected negatively. The endogenous switching regression model result showed that the dairy farm income of treated (members) households increased by 9,007.85 ETB due to membership. Untreated (Non-members), dairy farm income could be increased by 6,960.95 ETB if they had been members of the dairy cooperative. Members got 24% more dairy income than non-members; which implies dairy cooperative membership has a positive and significant effect on dairy farm income. Therefore, development and extension institutes needs to focus on promoting dairy cooperatives membership. In addition, improving artificial insemination or supply of affordable cross-breed heifers, market or value chain support, and expansion of veterinary service are very important to advance the dairy sector and increase the income of dairy farmers in the study area and other areas with similar contexts. Impact on households' nutritional and welfare is also advisable for future research.

Keywords: dairy cooperative, double hurdle, endogenous switching, dairy farm income, Ethiopia

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ABBREVIATIONS AND ACRONYMS

ANRS	Amhara National Regional State
ATT	Average Treatment Effect on the Treated
ATU	Average Treatment Effect on Untreated
CSA	Central Statics Agency
DA	Development Agent
ETB	Ethiopian Birr
ESR	Endogenous Switching Regression
FCA	Federal Cooperative Agency
FGD	Focus Group Discussion
HE	Heterogeneity Effect
ICA	International Cooperatives Alliance
PSM	Propensity Score Matching
SD	Standard Deviation
TLU	Tropical Livestock Unit

1. INTRODUCTION

1.1. Background of the study

Ethiopia is the second most populous and largest country in Africa. Ethiopia's economy depends mainly on the agricultural sector. It has a large livestock population in Africa (CSA, 2021). Dairy farming is an important sector in Ethiopia and Amhara region to ensure food security and generate household income (Nibret Moges *et al.*, 2019; Naol Dibaba, 2021; Mihret Dessie and Tadele Bayu, 2021). The Amhara region, particularly the West Gojjam zone, is the most potential milk shed area (Bernabas Ayeneshet; Muluyeet *al.*, 2017). But its productivity and commercialization are low (Getabalew *et al.*, 2019; CSA, 2021).

The main reasons for low productivity are shortage of quality and quantity of feed, poor genetic potential, prevalent diseases, poor breeding strategy, poor infrastructure, low institutional support, and poor access to extension and financial services (Alvarez Aranguiz, 2019; Nibret Moges *et al.*, 2019; Medina Yassin *et al.*, 2022). Agricultural cooperatives have emerged as a necessary institutional organization that can help farmers in developing countries to overcome the constraints that impede them from improving sustainable agricultural production and acquiring new marketing opportunities (Martinson Ankrah *et al.*, 2021). In Ethiopia, the number of primary cooperatives has increased from 149 to 99,542 from 1960 to 2021. Members also increased from less than one thousand approximately to nearly 21 million during the same period. In general, cooperative growth is low as compared to the expected achievements (Desalegn Fekadu, 2022).

In Ethiopia, agricultural cooperatives are deemed an important institutional mechanism to overcome market failure, facilitate smallholder farmers' market access, internalize transaction costs, and consequently attain rural poverty reduction (Gashaw Tadesse, 2018; Tibebe Bezabih, 2021). Dairy cooperatives can improve access to market information, reduce costs and price risks of marketing, increase producers' access to technology and extension services, enhance the bargaining power of dairy producers, support livelihood development, and uplift the socio-economic conditions of their members and their local communities (Kindie Getnet, 2012; Beyene Derso and Kavitha Nachimuthu, 2018; Yilkal Andualem, 2021 and Belay Mulat *et al.*, 2021).

But behind those important aspects of cooperative membership in different parts of the country, particularly in the study area, the number of participants is low. To increase the number of members of the dairy cooperative, it was essential to identify the determinants of dairy cooperative membership, the intensity of participation in milk supply, and its impact on dairy farm income. Therefore, the main aim of this study was to identify factors determining dairy cooperative membership, and its impact on household dairy farm income in the study area.

1.2. Statement of the problem

The presence of a large number of cattle populations, favorable agro ecology, and increasing demand for dairy products in Ethiopia are the main signs indicating the importance of dairy production. However, the production and productivity of the dairy sector in general are insufficient, resulting in a short supply of dairy products that is below people's demand (Tilahun *et al.*, 2018, Nibo Beneberu, 2021). Due to inadequate extension service, socio-economic factors, environmental, policy, and marketing linkage problems lower the production and productivity of dairy cattle (Solomon Gizaw *et al.*, 2016; Tadesse Guadu and Mengistie Abebaw, 2019; Yonnas Addis, 2019; Gebregziabher Gebreyohanes, Zelalem Yilma, 2021). Cooperatives can be suitable institutions to increase milk productivity and facilitate the transfer of dairy technologies (Clarietta Chagwiza, 2023).

Dairy cooperatives play a significant role in ensuring a sustainable supply of raw milk to the dairy industry by coordinating the flow of milk from their members and supplying the required dairy farm inputs (Zelege Mekuriaw, 2021). It has been established to address smallholder dairy producers' market constraints through collective action (Daniel Belay, 2018). It is a vital strategy to reduce poverty and increase the incomes of smallholder dairy farmers (Abateneh Molla, 2022). Based on FCA (2016) cited by (Daniel Belay, 2018) there are solely 504 dairy cooperatives involved in milk production and marketing activities in Ethiopia. Based on the Amhara Region Cooperative Agency (2019) annual report cited by (Abateneh Molla *et al.*, 2024), there were 3,145 active agricultural cooperatives and only 126 were dairy cooperatives.

Among all the districts in Amhara region Bahirdar Zuria district has an encouraging number of dairy cooperative societies (District Cooperative Office, 2023). There are some empirical studies conducted on dairy cooperative membership in Ethiopia. Beyene Derso and Kavitha Nachimuthu

(2018) studied factors affecting dairy cooperative membership but not studied on impacts of dairy cooperative membership on dairy farm income and intensity of participation in milk supply.

Abebe Ejigu and Jimi Adesina (2015) and Abateneh Molla (2022) studied the impacts of dairy cooperative membership on household income but did not study specifically the impact on dairy farm income and intensity of dairy cooperative membership participation. In addition, membership in dairy cooperatives is affected by several factors which are different from place to place based on the difference in agro ecology and socio-economic situations. Membership decision difference to wards people's choice. However, literature relating to the intensity of participation in milk supply and its impact on dairy farm income in the district is very limited. Moreover, yet in Bahirdar Zuria district, the impact of dairy cooperative membership on households' dairy farm income and intensity of participation in milk supply is not studied. To fill the above information gap the main aim of this study was to analyze the determinants of dairy cooperative membership and its impacts on dairy farm income in the study area.

1.3. Objectives of the study

The general objective of this study was to identify determinants of dairy cooperative membership and its impact on dairy farm income in the study area.

1. To identify factors determining dairy cooperative membership
2. To identify determinants of dairy cooperative members' intensity of milk supply to cooperatives
3. To analyze impact of dairy cooperative membership on dairy farm income

1.4. Research questions

1. What factors determine dairy cooperatives' membership of dairy farmers?
2. What factors determine the intensity of participation in the milk supply of dairy cooperative members?
3. Does dairy cooperative membership have an impact on dairy farm income?

1.5. Significance of the Study

This study will contribute as an empirical example for other researchers and will help decision-makers identify dairy cooperative membership decision determinants. The study can also provide useful information and evidence to the government, policymakers, researchers, and the public community about the impact of dairy cooperatives. It gives baseline information for future dairy-related studies, guides interventions to create strong dairy cooperatives, and improves dairy production and productivity in the study area.

1.6. Scope and Limitations of the Study

This study is focused on factors affecting dairy farmers' decision of dairy cooperative membership participation, dairy cooperatives intensity, and its impacts on dairy farm income in four purposely selected kebeles of Bahirdar Zuria District. Due to constraints in financial, temporal, and personnel resources, the researcher's capacity to encompass a broader array of kebeles within the district was restricted. Another limitation of this study was: the use of cross-sectional data rather than the possible panel data for some years.

1.7. Organization of the study

The study is organized as follows. Chapter one includes background, statement of the problem, objectives of the study, research questions, significance of the study, scope and limitation of the study. Chapter two deals with the review of related literatures relevant to the study. In chapter three research designs, data type and source, target population, sampling technique, sample size determination, method of data collection, procedure, method of data analysis, description of variable, are discussed. In chapter four, major findings of the study with interpretation of results are presented. Last chapter, summary, concluding remarks along with recommendations are stated.

2. LITERATURE REVIEW

2.1. Concepts and Definitions

Cooperatives: These are an autonomous association of people united voluntarily to meet common economic, social and cultural needs as well as aspirations through jointly owned and democratically controlled enterprise (Kigathi, 2016).

Cooperatives enable people to improve their quality of life and enhance economic opportunities through self-help. It is organized for economic activity, generally operating on principles of equal membership and member democratic control of their livelihood. It has developed as a modern institution aiming to tackle problems created by modern capitalism and its associated dependency on wage work (Rakopoulos, 2020).

A dairy cooperative: is a collection of dairy farmers who work together to bring milk and other dairy products to market. It is a business owned and controlled by dairy farmers who produce and process milk and milk products (Matawork Milkias, 2016). Dairy cooperatives have an integrated multi-tier role including production, processing, and marketing of milk and milk products. This links producers directly with the consumers, thereby eliminating the role of mediators (Sajja and Dave, 2022).

Intensity of dairy cooperative members' participation in milk supply: The proportion of milk sold to dairy cooperatives to total milk sold showed their degree/level of participation in the cooperative society (Laishram Priscilla *et al.*, 2017).

2.2. Cooperatives in Ethiopia

The people of Ethiopia have a very long social history of working together to fulfill their socioeconomic needs (Kidist Aschalew, 2023). Traditional cooperative associations existed in the form of *Iqub* and *Idir*. *Iqub* is an association of people having common objectives of mobilizing resources, especially finance, and distributing them to members on a rotating basis. *Idir* is an association of people that have the objective of providing social and economic insurance for the members in the events of death and accident among others. There is also labor resource mobilization to overcome seasonal labor peaks, known as *Jigie*, *Wonfel* (ICA, 2021).

The government of Ethiopia has identified the cooperatives as a business organization instrumental to socio-economic development and has paved the way for better cooperative development in the country by creating the legal basis and expansion of human resource development at higher institutions (Kidist Aschalew, 2023). Modern types of cooperative development in Ethiopia started in the Era of Emperor Haile Selassie I between 1950 and 1974. The key societies were producers and service cooperatives. Since this time cooperative policy and law have undertaken many reforms and cooperatives have come to play a crucial role in economic and social development (ICA, 2021).

In Ethiopia, cooperatives have inherent advantages in tackling the problems of poverty, food security, and job creation. They also considered the immense potential to deliver goods and services in areas where both the state and the private sector have failed. Serious efforts are being made to strengthen the capital of the cooperative base through increasing members' subscriptions, mobilization of savings, and value addition. The establishment of agricultural cooperatives in Ethiopia is significantly associated with and responsible for overcoming the problems that individual farmer cannot solve solely. Ethiopian Government made efforts for cooperative development that can be taken as opportunities. However, the growth of cooperatives in different parts of the country is not up to the expectation (Abebaw Yenesew and Dejen Debeb, 2019).

2. 3. Types of cooperative

Cooperatives differ in the service offered, the way that the members are organized, the economic activity they enrolled in, and their management style. In Ethiopia multipurpose cooperatives, saving and credit cooperatives, consumer cooperatives, and housing cooperatives are the most important types in terms of the purpose of establishment (Muthyalu Menig, 2019). The number of agricultural cooperatives increased quickly in Ethiopia since the 1990s (Kifle T *et al.*, 2021). Some types of cooperatives are agricultural cooperative societies, housing cooperative societies, industrial and artisan producers' cooperative societies, consumer cooperative societies, savings and credit cooperative societies, fishers cooperative societies, and mining cooperative societies (Dagne Mojo, 2017).

2.4. Roles of dairy cooperatives

Cooperatives can encourage significant changes in the prices of products by operating a variety of mechanisms, such as enhancing market power, achieving higher levels of vertical integration, or playing a role in knowledge dissemination or quality control, resulting in quality improvement. That increase the chance of participation in specialty markets (Clarietta Chagwiza *et al.*, 2016). Dairy marketing cooperatives offer services exclusively to members, and members also have easy access to hybrid dairy cows, feed supply, veterinary services, artificial insemination, and programmed follow-up by livestock extension experts. The services provided by cooperatives contributed to an increase in milk production and to cow productivity being relatively higher for members (Abebe Ejigu and Jimi Adesina, 2015). Organizing farmers through dairy cooperatives can have many advantages over individual farming. Cooperatives facilitate access to market information, reduce costs of marketing, and increase producers' access to technology, extension, and related services, thereby enhancing efficiency in the process of production and marketing of dairy products. It also decreases transaction costs and price risks and enhances the bargaining power of dairy producers (Matawork Milkias, 2016).

2.5. Cooperative Theory

Cooperatives play a vital role in economies and societies worldwide, regardless of their socioeconomic development level. They are seen as a potential solution to the economic challenges faced by marginalized members of society. While cooperatives may not be perceived as a primary source of economic efficiency or a major contributor to material welfare, they emerge from the behavioral assumptions embedded in economic theory (Kalmi, 2007).

The growth and importance of cooperatives in certain sectors of the economy, such as agricultural input supply and the processing-marketing of dairy products, grains, and fresh produce, causes concern that these organizations may be creating some of the problems they originally intended to mitigate. In addition, there is an emergent need to understand the economic nature of the cooperative enterprise to determine its appropriate role in a changing market environment where government policy and budgetary support of agricultural markets for price and income stability is becoming increasingly unpopular. To address these issues appropriately, economists must have at their disposal a sound theory of cooperative enterprise to interpret and predict the behavior of these complex

organizations (Condon *et al.*, 1987). The role of positive transaction costs and variable property rights has given economists new insights into the existence of firms (including cooperatives), and the evolution of alternative forms of business organization (aimed at minimizing both production and exchange costs). The main components of the new institutional economics theory, namely, transaction cost economics, agency theory, and property rights theory.

Transaction cost economics: Coase (1937) first described the concept of transaction costs in his seminal paper on the nature of the firm which described them as simply the cost of using the price mechanism. Transaction costs are the costs of organizing and transacting exchanges including information costs, bargaining, decision, and enforcement costs (Williamson, 1987).

Agency theory: Agency relationships exist whenever an individual or organization (the agent) acts on behalf of another (the principal). Principal-agent problems arise because the objectives of the agent are usually not the same as those of the principal, and thus the agent may not always best represent the interests of the principal (Alchian, 1972). As Chaddad (1999) points out, most applications of agency theory focus on the incentive vs. risk-sharing trade-off of Contracts aimed at aligning the interests of the agent with those of the principal. It is very relevant to the institutional structure of cooperatives because employed agents (managers) may not act in the best interests of cooperative owner-members (principals).

Property rights theory: Demsetz (1967) defines property rights as the capacity to use or to control the use of an asset or resource. He maintains that for any form of human cooperation to be workable, especially a form involving agreement requires clearly defined and enforced property rights. It is based on the assumption that contracts are necessarily incomplete (e.g., due to asymmetric information between trading parties and bounded rationality), and thus do not “fully specify the division of value in an exchange relationship for every contingency (Chaddad, (1999). Hence, ownership (the right of residual control) of the assets involved in a transaction becomes critical in deciding how value is divided when a contingency arises.

2.6. Empirical literature review

2.6. 1. Determinants of farmers' membership and intensity of participation in dairy milk supply

Various scholars studied the determinants of dairy cooperative membership. The most important determinants of dairy cooperative membership are distance to a milk collection center, social participation, herd size, veterinary services, procurement price of milk, social participation score of the dairy farmer, number of milking cows, credit access, and patronage dividend (Beyene Derso and Kavitha Nachimuthu, 2018; Patibandla Lakshmipriya *et al.*, 2019).

According to Geremew Motuma *et al.* (2024) study on dairy product market participation and its impacts on household food security of smallholder farmers in Jimma zone Ethiopia, using binary logit family size, livestock size, off-farm engagement, access to dairy input, ownership of crossbreed cows, and cooperative membership significantly and positively influenced dairy product market participation and proportion of milk supply participation, conversely, age, education level, and market distance had a negative effect.

Ruth D. *et al.* (2015) study result using the binomial logit model shows that age, gender, household size, herd size, distance to the nearest market, access to credit, and quantity of milk sold influenced the decision to join cooperative societies. According to Martinson Ankrah *et al.* (2021) study using the Endogenous switching regression model household heads' decisions to join cooperatives are affected by access to credit, off-farm work, education level, and peer influence.

According to Laishram Priscilla *et al.* (2017) study using the double hurdle model the truncated regression result indicated that age and technical efficiency coefficient were positively related to the proportion of milk sold by the member farmers to dairy cooperatives. And also experience in dairy farming and milk production had a negative influence on the extent of participation.

A study by Zewdu Getachew *et al.* (2023) on the impact of membership to certified coffee marketing cooperatives on the income of smallholder farmers in Jimma zone of Oromia region, Ethiopia, the result of binary probit model shows that the decisions to join certified coffee marketing cooperatives significantly and positively influenced by sex, total livestock holding size, credit access, and walking

distances to development agent's office and coffee marketing center. Total coffee land size, total quantity of coffee produced, and marital status were influenced negatively.

Table 1: Summary of empirical studies on the determinants of cooperatives membership

Authors	Year	Model used	Types of coops	Location	Finding
Zewdu Getachew <i>et al.</i>	2023	Binary probit	Coffee	Jimma zone of Oromia region, Ethiopia	Sex, marital status, total livestock holding, total coffee land size, total quantity of coffee produced, credit access, walking distances to development agent's office & coffee marketing center.
Beyene Derso and Kavitha Nachimuthu	2018	Binary logistic	Dairy	North Gondar zone, Amhara, Ethiopia	Access to transport, access of training, raw milk price, milking cows, access to credit and Patronage dividend
Martinson Ankrah <i>et al.</i>	2021	ESR	Fish	Ghana	Access to credit, off-farm work, education level, and peer influence
Patibandla Lakshmipriya <i>et al.</i>	2019	Binary logistic	Dairy	Andhra Pradesh	Social participation, distances to a milk collection center, veterinary, services, procurement price came,
Ruth D. <i>et al.</i>	2015	Binomia l logit	Dairy	Embu County, Kenya	Age, gender, household size, herd size, distance to the nearest market, access to credit, and milk sold

2.6.2. Impact of dairy cooperatives membership on household income

Megersa Debela *et al.*(2017) studied the impact of cooperatives on income, productivity, marketed surplus, and savings of the households in the Haramaya district, Ethiopia by using PSM. The result shows cooperative membership has a positive impact on income, productivity, market surplus, and savings of the member households.

According to Geremew Motuma *et al.* (2024) study on dairy product market participation and its impacts on household food security of smallholder farmers in Jimma zone Ethiopia, using the Propensity Score Matching (PSM) model The results indicated that dairy product market participation had a positive impact on the household food consumption score and dietary diversity.

According to the study of Zewdu Getachew *et al.* (2023) on the impact of membership to certified coffee marketing cooperatives on the income of smallholder farmers in the Jimma zone of Oromia region, Ethiopia, by applying PSM results shows that membership to certified coffee marketing cooperatives has a positive and significant impact on average annual gross income. The average gross annual income earned by cooperative member farmers was ETB 14639.15, which was 36.5% higher than their counterpart non-cooperative member farmers.

A study by Qingbin Wang and Yang Zou. (2022) on impacts of farmer cooperative membership on household income and inequality: Evidence from a household survey in China using PSM estimation shows that farmer cooperatives can increase farmers' income by increasing agricultural output, raising sales prices, reducing costs, and realizing surplus distribution from the cooperatives.

A study by Abebe Ejigu and Jimi Adesina (2015) on the effects of cooperatives and contracts on rural income and production in the dairy supply chains in Northern Ethiopia using the Propensity score matching approach showed membership in cooperatives resulting in significantly higher milk production, higher milk productivity, and higher farmer income.

According to Patibandla Lakshmipriya *et al.*, (2019) study on the impact of dairy cooperatives on the income of rural households in Andhra Pradesh, using the Heckman two-stage model the result shows the positive impact of dairy cooperatives on the productivity of dairy animals and net income of the member households. This study indicated that dairy cooperatives are the main instrumental tools for enhancing the milk yield and income of dairy farmers in the study area. A study by Khyalia *et al.* (2016) on the impact of dairy cooperative society on the overall status of member dairy farmers in Bareilly (UP), India, By using a t-test indicated that dairy cooperative has a positive impact on dairy farmers in terms of change in overall knowledge and adoption of scientific dairy farming practices, productivity of dairy animals and the income from dairy farming.

Table 2: Summary of empirical studies on the impacts of cooperative membership

Author	Year	Model Used	Types of cooperatives	Location	Important Finding
Zewdu Getachew <i>et al.</i>	2023	PSM	Coffee	Jimma zone, Oromia region, Ethiopia	Membership of coffee marketing cooperatives has a positive and significant impact on average annual gross income.
Megersa Debela <i>et al.</i>	2017	PSM	Agricultural Farmers' Cooperative	Haramaya district, Ethiopia	Cooperative membership has a positive impact on income, productivity, marketed surplus, and savings of the farmer households.
Abebe Ejigu and Jimi Adesina	2015	PSM	Dairy	Northern Ethiopia	Membership in cooperatives significantly increases milk production, higher cow productivity, and leads to higher farmer income.
Qingbin Wang and Yang Zou.	2022	PSM	Farmer	China	Farmer cooperatives can increase farmers' income by increasing agricultural output, raising sales prices, reducing costs, and realizing surplus distribution from the cooperatives.
Patibandla Lakshmipriya <i>et al.</i>	2019	Heckman two stage	Dairy	Andhra Pradesh	A positive impact of dairy cooperatives on the productivity of dairy animals and net income of the member households
Khyalia <i>et al.</i>	2016	By using student-test	Dairy	Bareilly (UP), India	The dairy cooperative has a positive impact on dairy farmers, change in overall knowledge, adoption of scientific dairy farming practices, productivity of dairy animals & income from dairy.

Generally, the above studies are related to this study but not directly conducted on the impact of dairy cooperative membership on dairy farm income and the intensity of dairy product supply. The researchers employed simple comparisons between members' and non-members' income, milk yield, and food security using propensity score matching, multiple regression, descriptive, chi-square test, t-test, and narration. This study used an endogenous switching regression model identified problems and compared the results of impacts of dairy cooperative membership on dairy farm income and forward recommendations based on the results.

2.7. Conceptual Frame Work

Dairy cooperative membership participation can be affected by demographic, socioeconomic, and institutional factors. The following conceptual framework shows factors that may influence dairy cooperative membership and the final impact of dairy cooperative membership on the income of the members. Dairy cooperative membership is expected to improves milk yield and quality of supply, which leads to household dairy farm income improvement.

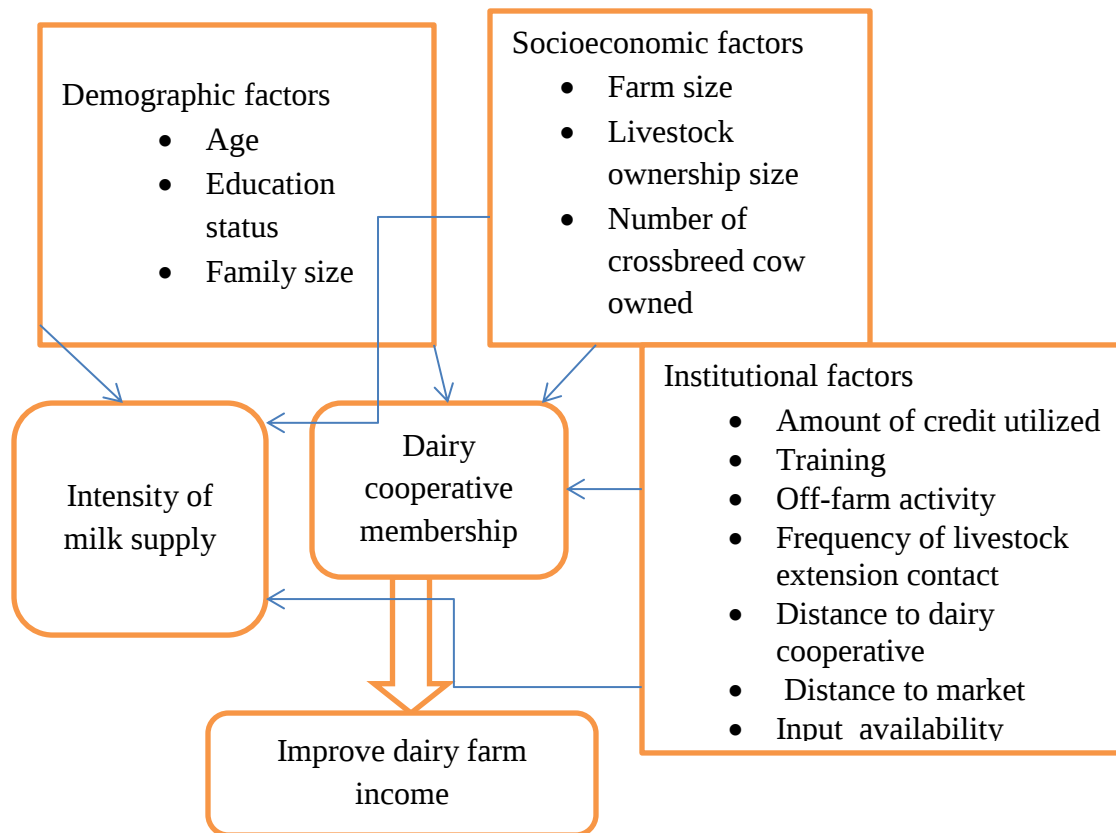


Figure 1 Conceptual framework

Source: own construction based on literature

3. RESEARCH METHODOLOGY

3.1. Description of the study area

Bahir Dar Woreda is one of the districts in the North Gojjam zone of Amhara National Regional State (ANRS), Ethiopia. It is located in northwest Ethiopia, about 565 km and 460 km away from the capital city, Addis Ababa, via Bure and Motta, respectively. Bahir Dar Zuria district is bounded by Lake Tana and North Gondar Zone on the north, Yelemena Densa district in the south, Dera district and the Abay River in the east, and Mecha and Achefer districts in the west. The topography of Bahir Dar Zuria district is estimated at 48% rolling, 32% hilly, 13% mountainous, and 7% valleys. It has one agro-climatic zone, Woyena Dega (midland). Bahir Dar Zuria district approximately covers an area of 1283.6 km and includes 36 kebeles. The altitude ranges from 1,750 to 2,300 m above sea level (m.a.s.l). The population in the study area is dependent on agriculture for their economy (CSA, 2020). Which practices a mixed farming system, that is., crops along with livestock production, to secure their family's food supply and income?

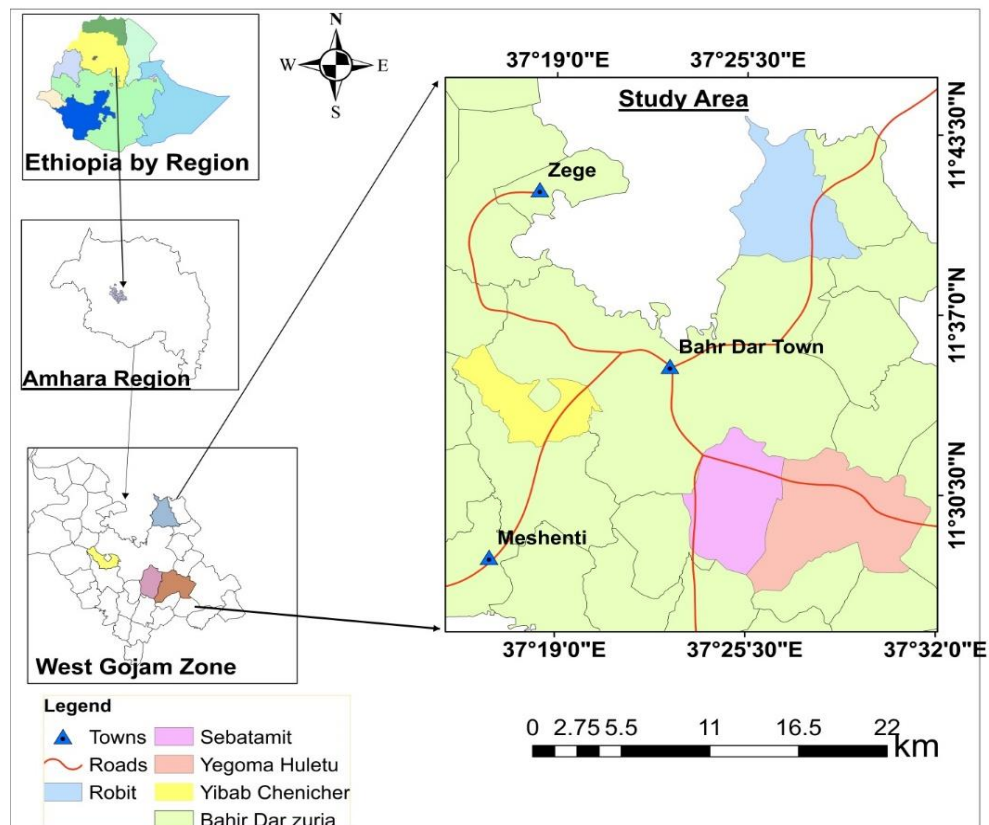


Figure 2: Study Area Map
Source: Own mapping using Arc GIS

3.2. Sampling Technique and Sample Size Determination

Sampling technique: The cross-sectional (survey) research design was applied in this study. Three-stage sampling procedures were employed to select sample farm households. In the district, there are eight dairy production and marketing cooperatives. In the first stage, four dairy production and marketing cooperatives were selected purposively based on their functionality, number of participants, dairy production level, and accessibility. In the **second stage**, dairy farmers were stratified as cooperative member dairy farmers and non-member dairy farmers. The list of dairy cooperative member farmers was taken from the respective dairy cooperatives, and the list of non-member dairy farmers was taken from the Kebeles Agricultural Development office. **Finally**, in the third stage 200 members and 200 non-members of dairy cooperatives, and a total of **400** total sample households were selected randomly and proportionally from each kebele.

Sampling unit: For this study, different data were collected from the household level by using a survey questionnaire. Thus, the sampling unit was households for analysis purposes.

Sampling frame: The sampling frame for this study was the list of dairy farm households in the sample kebeles. These households include both participants and non-participants in dairy cooperatives.

Sample size determination: According to the data from Bahir Dar Zuria district Agricultural Office (2023) the total number of households in the district was 47,104. The sample size was calculated by using the formula for limited population size, heterogeneity, and finiteness Kothari, (2004):

$$n = \frac{Z^2 pqN}{e^2(N-1) + Z^2 pq} = \text{-----} \text{ equation 1}$$

Where **n**= desired sample size

N= the total number of households in the district= 47,104

Z= confidence interval (95%) which is 1.96

e= acceptable error of margin =0.05

p= proportion of the sampled population (member) =0.5

q= estimation of the proportion of population to be sampled (nonmember) =0.5

$$n = \frac{1.96^2 * 0.5 * 0.5 * 47104}{0.05^2 (47104 - 1) + 1.96^2 * 0.5 * 0.5} = \mathbf{381}$$

An additional 5% sample respondents were used to reduce error and to cater for non-response and incomplete questionnaires, data was collected from 400 respondents, consisting of 200 members and 200 non-members. The sample size for each kebele was determined based on their proportion to the total share of households residing in each kebele within each stratum.

Table 3 Distribution of sample respondents among four Kebeles

Kebeles	Dairy farmers			Percentage share			Sample Households		
	Members	Non-Members	Total	Members	Non-Members	Total	Members	Non-Members	Total
- Robit	249	1611	1860	27	44	40.7	54	88	142
- Yegoma Huletu	302	1359	1661	32.5	37.5	36.4	65	75	140
- Sebatamit	338	467	805	36.5	13	17.6	73	26	99
- Yibab	35	208	243	4	5.5	5.3	8	11	19
Total	924	3645	4569	100	100	100	200	200	400

3.3. Sources, types, and methods of data collection

Both quantitative and qualitative data were collected from primary and secondary data sources. Primary data were collected through a household survey, focus group discussions, and key informant interviews. Secondary data were collected from district-level agriculture, livestock, and dairy cooperative offices, regional and national level reports, journal articles, records of published and unpublished documents of the Bahir Dar Zuria Agriculture Office related to dairy cooperatives, and other sources.

The household survey was conducted using structured questionnaires administered through face-to-face interviews with the household head. The household-level survey was used to collect information related to the demographic, socio-economic, and institutional characteristics of the households. Information on the importance of cooperatives, the role of cooperatives in improving milk supply and income, and dairy cooperative membership determinants were collected through a survey.

Key informant interview (KI) was conducted with those people who further enrich the area and can give clear information on major issues of the study. Key informants were kebele administrators, development agents, district NGO focal persons, model farmers, the head of the district livestock resource promotion agency, and the head of the district agriculture office. Key informants were

interviewed on the overall information on the existing trend of dairy cooperative membership participation, development, and its contribution to dairy farmers' milk yield and income. The socioeconomic status of the communities, livelihood activities of the communities, and the current difference between members and non-members were interviewed.

Focus group discussions were used to verify the information given by individual farmers during the survey. During FGDs, there were development agents (DA) or experts, youths, women groups, and innovative or model dairy farmers. FGD was composed of 5 individuals on average for each separate group. The participants expressed their feelings, perceptions, and experiences about cooperatives and their membership.

3.4. Method of data analysis

To analyze quantitative data both descriptive and econometric models were employed.

3.4.1. Descriptive and inferential statistics

Descriptive analysis was used to summarize some important characteristics of the sample households including measures of central tendency like mean, percentage, and frequency, and measures of dispersion like variance and standard deviation. A parametric (t-test) was used to compare the mean difference for continuous variables and a non-parametric (chi-square test) was used to check the association between dummy variables between cooperative members and non-members.

3.4.2. Econometric analysis

An econometric model was used to measure dairy farmers' decisions to participate in dairy cooperatives and their impact on dairy farm income. Double Hurdle and Endogenous Switching Regression Models were used to examine how dairy cooperative membership affected dairy farm income in the study area.

The logit, probit, and Tobit models have been frequently used to examine the participation decisions of farmers. Logit and probit are regression models for binary outcomes that allow one to avoid the problems associated with the linear probability model, such as the non-constant error variance and the unrealistic assumption of linearity in the parameters. However, understanding both the factors

affecting the probability of participation as well as the intensity of members' participation in milk supply was intended in the study.

The drawback of the Tobit model can be overcome with the double-hurdle model. This is a two-step process, that is membership decision with the probability of membership and the intensity of members supply are being determined by separate processes. The double hurdle model considers the possibility of zero realizations (outcomes) in the second hurdle arising from the individual's deliberate choices or random circumstances. The model is designed to examine the instances of an event that may or may not occur, and if it occurs, takes on continuous positive values. In this study, there are two levels of decisions. The first is the decision to be a member or not followed by the second, the decision on how much milk to sell to dairy cooperatives.

Double-hurdle model: involves a two-step estimation procedure. This study used this model due to the proportion of milk supplied by dairy cooperative members is different from farmer to farmer and the decision stage also from membership participation and proportion of milk supplied is different. Assumes households make two decisions regarding to dairy cooperatives, determined by different explanatory variables. In the first stage, probit regression was used to identify factors affecting membership decisions. A probit model is a discrete choice model that is characterized by the dependent variable taking only two values (0 and 1), which correspond to each of the two possible alternatives (Ravallion, 2001). The first hurdle is the dairy cooperative membership equation estimated by using a probit model as described in the equation:

$$D_i = \beta_1 x_i + \varepsilon_i \sim N(0,1) \text{ ----- Eq. 2}$$

$$D_i = 1 \quad \text{if } D^* > 0$$

$$D_i = 0 \quad \text{if } D^* \leq 0$$

where, D_i^* is a latent variable that takes the value 1 if the dairy farmer participates in a dairy cooperative and zero otherwise, x_i is a vector of explanatory variables and β_1 is a vector of parameter, ε_i is an error term is normally distributed with mean zero (0), and standard deviation of 1

The second Hurdle (truncated regression model): was used to examine the extent of participation by members in the dairy cooperative. The model is of the form:

$$Y_i = \beta_i X_i + u_i \text{----- Eq. 3}$$

$$Y_i^* = 0, \text{ if } Y_i = 0$$

$$Y_i^* = Y_i \text{ if } Y > 0 \text{ and } D_i=1, 0 \text{ otherwise}$$

where, Y_i^* and Y_i are latent and the observed levels of participation in dairy cooperatives respectively, x_i is a vector of variables influencing how much milk member households sell to dairy cooperatives and β_i is a vector of parameters to be estimated. If both decisions are made by the individual farmer independently, the error terms are assumed.

Impact Analysis Model

There are several econometric models used for impact analysis. Some of the methods are propensity score matching, endogenous switching regression, difference-in-difference, and the instrumental variable method.

Instrumental variable (IV) is one of the econometric methods that can be used to compare program participants and non-participants by correcting selection bias. However, it is difficult to get a strong instrument (Imbens, 2014; Becker, 2016).

Difference-in-Differences (DID) is one of the most frequently used methods in impact evaluation studies. Based on a combination of before-after and treatment-control group comparisons (Magalhães, 2019). However, constructing panel data sets can be expensive and time-consuming. Since this study uses cross-sectional data, it doesn't allow DID analysis.

Propensity score matching (PSM), a method proposed by Rosenbaum and Rubin, has been widely employed to examine the impact of a program or project (Rosenbaum & Rubin, 2006). It tries to create an observational similarity with an experiment in which everyone has the same probability of participation (Ravallion, 2005). PSM is a popular approach for research studies when randomization is infeasible. It can only be obtained from the observed covariates (Bai Haiyan, 2011).

The Endogenous Switching Regression (ESR) model considers both observable and unobservable characteristics and heterogeneity. Although PSM can effectively reduce the selection bias caused by observable variables, it is unreliable for unobservable variables. ESR, therefore, can be used to

address these PSM method weaknesses (Zhineng Hu *et al.*, 2021). The ESR model is better suited to account for the selection bias in the estimation of the impact of participation in dairy cooperatives on dairy farm income than the above impact analysis models. An endogenous Switching Regression (ESR) model was used to analyze the impacts of dairy cooperative membership on households' dairy farm income.

The Endogenous Switching Regression Model consists of two stages. Firstly, the probit model identified, the factors that determine household involvement decisions in a dairy cooperative. This leads to two possible states; a decision to be a member of a dairy cooperative ($DC_i=1$) and not to be a member of a dairy cooperative ($DC_i=0$). The selection equation association with a dairy cooperative can be specified

$$DC_i^* = \beta x_i + v_i \text{ where } DC_i = \begin{cases} 1 & \text{if } DC_i^* > 0 \\ 0 & \text{otherwise} \end{cases} \text{----- Eq. 4}$$

where DC_i^* reflects whether the household dairy cooperative member; otherwise, 0; x_i represents the vector of exogenous variables influencing dairy farm households' dairy cooperative membership decisions; β is a vector of coefficients; and v_i represents the disturbance terms with a zero mean and constant variance.

Second stage, the outcome variables were estimated separately for each group (as a dairy cooperative member and a non-member), the dairy farm household that faces a decision on whether or not. The following specification was giving the outcome regression equations for the two regimes:

$$\text{Regime 1: } Y_{1i} = \beta_1 x_{1i} + \varepsilon_{1i} \text{ if } DC_i = 1 \text{----- Eq. 5}$$

$$\text{Regime 2: } Y_{0i} = \beta_0 x_{0i} + \varepsilon_{0i} \text{ if } DC_i = 0 \text{----- Eq. 6}$$

where Y_i represents the outcome variable of household dairy income of cooperative members and nonmembers of each regime (1=member and 0=non-member),

x_i a vector of explanatory variables that affect outcome variables

β_i a vector of parameters to be estimated

$$\text{cov}(\varepsilon_1, \varepsilon_0, v) = \begin{pmatrix} \sigma_{\varepsilon_1}^2 & \sigma_v & \sigma_{\varepsilon_1} \\ \sigma_v & \sigma_{\varepsilon_0}^2 & \sigma_{\varepsilon_0} \\ \sigma_{\varepsilon_1} & \sigma_{\varepsilon_0} & \sigma_v^2 \end{pmatrix} \text{----- Eq. 7}$$

where σ_1^2 , σ_0^2 , and σ_v^2 are the variances of the outcome functions of regimes 1, 2, and the selection equation respectively. σ_{ε_1} , σ_{ε_0} and σ_v indicates the covariance of ε_{1i} , ε_{0i} and v_i . The variance of the selection equation (σ_i^2) is assumed to be equal to 1 since the coefficients (β) are estimable only up to a scalar factor.

Maddala (1983) confirms that the covariance of the error terms (ε_{1i} and ε_{0i}) is not defined since outcome variables (Y_{1i} and Y_{0i}) are not captured at the same time. The expected values of the error terms of the second stages are non-zero because the error terms of the first and the second stages are associated with each other. The expected value of the error terms of the equation above can be expressed as follows:

$$E(\varepsilon_{1i}|DC = 1) = \sigma_{1v} \frac{\phi(\beta x_i)}{\Phi(\beta x_i)} = \sigma_{1v} \lambda_{1i} \quad \text{----- Eq. 8}$$

$$E(\varepsilon_{0i}|DC = 0) = \sigma_{0v} \frac{\phi(\beta x_i)}{1 - \Phi(\beta x_i)} = \sigma_{0v} \lambda_{0i} \quad \text{----- Eq. 9}$$

Where; $\phi(\cdot)$ is the standard normal probability density function, $\Phi(\cdot)$ is the standard normal cumulative density function

Based on the above situation, the average treatment effect on the treated (ATT) is obtained by comparing real and counterfactual scenarios of expected values of the member's outcome. Similarly, the average treatment effect on the untreated (ATU) can also be calculated by comparing the expected values of non-member outcomes in truth and not.

According to Lokshin (2004), Mehariw Worku (2020), Sisay Getaneh (2021), and Abateneh Molla (2022), the endogenous switching regression model used to estimate the average treatment effect on the treated (ATT) and the average treatment effects of untreated. Specifically, the expected value of outcomes of members and non-members for observed and unobserved counterfactuals can be computed as:

Members of the dairy cooperative (truth)

$$E[Y_{1i}/DC_i = 1, X] = \beta X_{1i} + \delta_{\varepsilon 1} \lambda_{1i} \quad \text{----- Eq. 10a}$$

Non-member without dairy cooperative (truth)

$$E[Y_{0i}/DC_i = 0, X] = \beta X_{0i} + \delta_{\varepsilon 0} \lambda_{0i} \quad \text{----- Eq. 10b}$$

If dairy cooperative members had not a member in a dairy cooperative (counterfactual)

$$E[Y_{0i}/DC_i = 1, X] = \beta X_{0i} + \delta_{\varepsilon 0} \lambda_{0i} \text{ ----- Eq. 10c}$$

If non-members had decided to be dairy cooperative members (counterfactual)

$$E[Y_{1i}/DC_i = 0, X] = \beta X_{1i} + \delta_{\varepsilon 1} \lambda_{1i} \text{ ----- Eq. 10d}$$

The average treatment effect on the treated (members) (ATT) can be calculated as the difference between (10a) and (10c), and the average treatment effect of untreated (non-members) (ATU) as the difference between (10d) and (10b).

$$ATT = E[Y_{1i}/DC_i = 1, X] - E[Y_{0i}/DC_i = 1, X] = \beta X_{1i} + \delta_{\varepsilon 1} \lambda_{1i} - \beta X_{0i} + \delta_{\varepsilon 0} \lambda_{0i} \text{ -- Eq. 11}$$

And, the ATU for the dairy farm households that are not dairy cooperative members is calculated as the difference between (10d) and (10b):

$$ATU = E[Y_{1i}/DC_i = 0, X] - E[Y_{0i}/DC_i = 0, X] = \beta X_{1i} + \delta_{\varepsilon 1} \lambda_{1i} - \beta X_{0i} + \delta_{\varepsilon 0} \lambda_{0i} \text{ --- Eq. 12}$$

Moreover, this study used conditional expected outcomes in Eq. (10a) to (10d); by computed heterogeneity effects (HE), because members may have had higher dairy farm income than non-members even if they did not member in dairy cooperative, due to unobserved factors. Hence, HE is described as the difference between Eq. (10a) and (10d) for members, whereas for non-members as the difference between Eq. (10c) to (10b). Lastly, to examine whether the impact of membership in dairy cooperatives is higher or lower for households that member had they not member, or for households that not member had they member requires calculations of transitional heterogeneity effects (TH). This is calculated from the differences between HE1 and HE2 or ATT and ATU.

Table 4: Conditional expectations, treatment, and heterogeneity effects

Category	Decision stage		Treatment effect (ATE)
	To be member	Not to be a member	
Members	$E[Y_{1i}/DC_i = 1, X]$ (10a)	$E[Y_{0i}/DC_i = 1, X]$ (10c)	TT
Non-members	$E[Y_{1i}/DC_i = 0, X]$ (10d)	$E[Y_{0i}/DC_i = 0, X]$ (10b)	TU
Heterogeneity effects	HE1 (10a-10d)	HE2 (10c-10b)	TH

Source: Adapted from Sisay Getaneh (2021) and Abateneh Molla (2022).

3.5. Variable Definition and Working Hypotheses

3.5.1. Dependent variable

Household membership in dairy cooperatives: It is a dichotomous variable and takes a value of 1 if a household is a member of the dairy cooperatives; and 0 for non-members.

Intensity of supply of milk to dairy cooperative: It is a continuous dependent variable. The proportion of milk sold to dairy cooperatives by members to total milk sold showed their degree/level of participation in the dairy cooperative.

3.5.2. Outcome variable

Dairy income: income generated from the sale of dairy and dairy products. It is net cash income from the sale of dairy and dairy products. It is expected that dairy cooperative membership improves household income and the variable was measured in Ethiopian Birr (ETB).

3.5.3. Independent variables

The independent variables used in this study are:

Age of the household head: is a continuous variable and measured by the number of years. Age was expected to positively influence dairy cooperative membership. The probability of participation in dairy cooperatives increases with an increase in age (Mohammed Kedir, 2020).

Household size in man equivalent: is a continuous variable measured in man equivalent that is, the availability of active labour force in the household. Since production is the function of labor, availability of labour was assumed to have a positive relation with the volume of supply. According to Ashenafi Duguma(2016), dairy production and marketing of its products are labor-intensive. So, a household with more family members was a member of a dairy cooperative than a household with fewer family members.

Educational status of the household head: It is the maximum qualification possessed by the farmers at the time of study. It was expected that educated households would be able to understand the benefits of membership to cooperatives and they may join it. It is treated as a categorical variable to see its influence on dairy cooperative membership. It is measured as zero (0) for illiterate farmers

and 1 for literate farmers. In a study conducted by Feleke Shitu (2022), education positively affected agricultural cooperative acquisition and income.

Livestock holding (TLU): It is a continuous variable measured in Tropical Livestock Unit (TLU). It was expected to affect cooperative membership positively. The study conducted by Mohammed Kedir(2020) revealed that farmers' livestock ownership has increased the probability of dairy cooperative membership.

Crossbreed cow ownership: Farmers who have more crossbreed cows are expected to produce more dairy products; therefore, this may encourage membership in dairy cooperatives to find out the market for their products. As a result, it was expected to affect membership positively. According to Habiyaremye Naphtal *et al.*, (2023), farmers who own crossbreeds or pure-breed lactating cows are more likely to join cooperatives compared to those keeping local breed cows affecting membership positively.

Farm size/Land holding size: is a continuous variable measured in hectares. The size of land holding can have either a positive or negative relation. It may have a significant positive effect on the probability of membership. Farmers that have larger farm sizes are not only wealthier but also have a higher capacity to expand agricultural production which in turn forces the farmer to join cooperatives to sell the product and to access farm input easily. On the other hand, landholding size significantly and negatively affects the probability of dairy cooperative membership. It means that smallholders can be attracted to smaller farm sizes demanding dairy farming practices. (Abateneh Molla (2022), stated as cooperatives membership improves milk productivity.

Distance from the respondent's home to the district market: it is a continuous variable representing the time required to reach the nearest market (Measured in minutes). Farm households located far from the market centers have a higher rate of cooperative participation, confirming the notion that proximity to the market gives farmers additional possibilities for selling their produce through alternate channels (Mandi Kalyan *et al.*, 2022).

Distance to the dairy cooperative: is the time required to reach the dairy cooperative. It is crucial in deciding to make transactions with the cooperative. The closer the cooperative office is to the

household, the lesser the time and labor spend to make transactions and communicate officers. According to Musa Hasen and Hiwot Mekonne (2017), distance to the cooperative office has an inverse relationship with the probability of cooperative membership.

Frequency of livestock extension contact: Households' frequency of contact with livestock extension workers influences dairy cooperative membership positively and is measured by the number of contacts in a year. Dairy farmers who get continuous contact with extension agents on the use and benefits of cooperatives are more likely to join dairy cooperatives than those who haven't gotten advice (Mohammed Kedir, 2020).

Training on dairy production: this variable is a dummy variable taking 1 if the household takes dairy production/cooperative training and 0 otherwise. According to (Beyene Derso and Kavitha Nachimuthu /92018), access to training is positively and significantly associated with the member's participation in the society.

Amount of credit utilized: this is a continuous variable. Was expected amount of credit has a positive and significant effect on dairy cooperative membership participation because dairy farmers used more amount of credit the probability of joining in dairy cooperative increased by using this birr purchase inputs required for dairy production porpoise. The amount of credit utilized positively influences households' membership in a dairy cooperative (Beyene Derso and Kavitha Nachimuthu, 2018).

Off-farm activity participation: It is a dummy variable with a value of 1 if the household participated in an off-farm activity and 0 otherwise. A farmer who has off-farm employment may have a positive effect on cooperative membership decisions. According to Bizualem Assefa and Saron (2018), off-farm activity participation influences cooperative membership positively.

Dairy production input availability: is a dummy variable with a value of 1 if the dairy farm households get dairy production input and 0 otherwise. This indicates that the accessibility of dairy production inputs like, crossbreed cows, fodder, hay, veterinary service etc. When dairy farmers get

those production inputs the probability of becoming a member is high. According to Geremew Motuma *et al.* (2024), dairy input availability affects dairy cooperative membership positively.

Table 5: Summary of variables, description, expected sign and their measurement

Variables	Description	Type	Measurement units	Expected sign
Dependent variables				
- Dairy Cooperative membership	Dependent variable	Dummy	1 for a member 0 otherwise	
- Intensity of participation in milk supply	Dependent variable	Continuous	Proportion of milk sold to cooperative to total milk sold	
- Dairy income	Outcome variable	Continuous	Total annual household's dairy net income in (ETB)	
Independent variables				
- Age	Age of the household head	Continuous	Years	(+)
- Education	Education status of the household head	Categorical	Illiterate Literate	(+)
- Farm size/land holding	Total farmland size owned by the household	Continuous	Hectare /Timad	(+/-)
- Livestock holding	Livestock ownership of the household	Continuous	Tropical livestock unit(TLU)	(+/-)
- Family size	Total household size	Continuous	Man equivalent	(+)
- Amount of credit utilized.	Amount of credit utilized by the household	Continuous	ETB	(+/-)
- Extension contact	Farmer's frequency of contact with livestock extension workers	Continuous	Number of contacts per year	(+)
- Training	Household head access to dairy production training	Dummy	1 =yes, 0 =no	(+)
- Number of improved cow	The number of improved cows owned by the household	Continuous	Number	(+)
- Whether	Whether the household has neighbor cooperative member farmer or not	Dummy	1=yes, 0= no	(+)
- Distance to the dairy cooperative	Time needed to reach the cooperative	Continuous	Minute	(-)
- Distance to market	Time needed to reach the district market	Continuous	Minute	(+/-)
- Off-farm Activity	Household's participation in off-farm activity	Dummy	1=yes, 0= no	(+)
- Input availability	Access to dairy production input	Dummy	1=yes, 0= no	(+)

by the household

The availability of Neighbor dairy cooperative members: is a dummy variable. Dairy farm households' decision to dairy cooperative membership is positively influenced by their neighbor's membership. As a result of information exchange between dairy farmers regarding all aspects of dairy cooperatives. According to Abateneh Molla's (2022) studies dairy cooperative membership is positively influenced by neighbor's membership.

4. RESULT AND DISCUSSION

This chapter deals with the results from descriptive and Econometric models. The first subsection is about the demographic, socio-economic, and institutional characteristics of the sample households. This is followed by the determinants of dairy cooperative membership, milk supply intensity, and the impact of dairy cooperative membership on dairy farm income.

4.1. Sample households Characteristics

Descriptive statistics like minimum, maximum, frequency, percentage, mean, and standard deviation are executed to describe the main variables of the models. In addition, inferential statistics like chi-square and t-tests are also used to check the association between categorical variables and dairy cooperative memberships.

Age of the household head: the mean age of the sample households was found to be 46.25 with a standard deviation of 10.78 with a minimum and maximum of 24 and 70 years respectively. The result also indicated that the mean age of members was 48.26 with a standard deviation of 9.91 while the age of non-members was 44.23 with a standard deviation of 11.26. The independent t-test result implied that there was a significant mean difference between members and non-members of dairy cooperatives members in terms of age at $p < 0.01$ significance level.

Household size (in man equivalent): The average household size of the whole sampled households was 3.55, with a minimum and maximum of 0.5 and 8.5, respectively. The average household size of members and non-members was 3.83 and 3.27, respectively. The independent t-test result implied that there was no statistically significant difference between members and non-members in terms of household size.

Landholding size/Farm size: The mean farm size of total respondents was 1.27. The average farm size of members and non-members was 1.40 and 1.14 hectares, respectively. The independent t-test result implied that there was no significant mean difference between the members and non-members about farm size.

Livestock holding size: The mean livestock holding size in Tropical Livestock Unit for sample households was 7.99, with a value of 8.35 for member households and 7.62 for non-member

households in the study area. The mean difference between members and non-member households in terms of livestock ownership size was positive and statistically significant at a 5% significant level. This indicates that members of the dairy cooperatives were in a better position in terms of livestock holding than non-members including dairy cows.

Number of crossbreed cows owned: The average number of crossbreed cows owned was 1.80 for members of the dairy cooperative and 0.94 for non-members. The overall average number of crossbreed cows owned by sample respondents in the study area was 1.37. The result indicates that members of the cooperatives owned more crossbreed cows than non-members. Cow ownership means difference test between members and non-members was statistically significant at a 1% significance level.

Distance from respondent's home to the district market: the survey result indicated that the average distance of respondents' homes from the district market took 133.83 minutes for members and 150.95 minutes for non-members. The overall mean of sample respondents showed the walking distance from respondents' homes to the nearest district market was found 142.39 minutes. There was no significant mean difference between members and non-members of dairy cooperatives in terms of distance from home to the district market.

Distance to a dairy cooperative: The average distance from respondents' homes to the milk cooperative was found 17.55 walking minutes. The result also indicated that the average distance of the respondents' home from the dairy cooperative took 15.91 minutes for members and 19.20 minutes for non-members. There was statistically significant mean difference between members and non-members in terms of distance from home to the dairy cooperative at a 1% significance level.

Amount of credit utilized: The average amount of credit utilized was 4,773.5 ETB for members of the dairy cooperative and 1,771.5 ETB for non-members. The overall average amount of credit used by sample respondents in the study area was 3,272.5 ETB. There was no statistically significant mean difference between members and non-members in terms of the amount of credit utilization.

Frequency of livestock extension contact: The average number of extension contacts by the household for the entire sample is 1.35 per year. The mean values of extension contact for members

and non-members were 1.99 and 0.71 days per year respectively. The t-test result shows that there was a statistically significant mean livestock extension contact difference between the two groups at a 1% significant level.

Table 6: Descriptive statistics of continuous variables for dairy cooperative membership

Variables	Member (200)		Non –member (200)		Total sample (400)				t- test value
	Mean	SD	Mean	SD	Min	Max	Mean	SD	
- Age	48.26	9.91	44.23	11.26	24	70	46.25	10.78	-3.8***
- Family size	3.83	1.57	3.27	1.6	0.5	8.5	3.55	1.61	-3.5
- Farm size	1.40	0.58	1.14	0.40	0.16	3.5	1.27	0.59	-4.35
- Livestock holding	8.35	3.14	7.62	2.93	2.25	22.77	7.99	3.05	-2.45**
- Number of crossbreed cows	1.80	1.03	0.94	1.07	0	10	1.37	1.13	-8.2***
- Distance to district mkt	133.83	43.45	150.95	44.17	40	300	142.39	44.59	3.9
- Distance to the dairy cooperative	15.91	8.88	19.195	12.92	2	60	17.55	11.19	2.95***
- Amount of credit utilized	4774	1770	1772	7621	0	230000	3273	13608	-2.2
- Livestock extension contact	1.99	1.91	0.71	1.198	0	12	1.35	1.72	-8.05***

Note: And** significant at (p<0.01) and (p<0.05) respectively.

Source: own survey result, 2024

Education status: The survey results showed that out of the total respondents 251(62.75%) and 149(37.25%) household heads were illiterate and literate, respectively. From the total 251 respondents, 109(54.50%) were illiterate members and 142(71.00%) were non-members of dairy cooperatives. Also, 91(45.50%) and 58(29.00%) respondents were members and non-members of dairy cooperatives, respectively. The Chi-square test showed that there was a significant association between members and non-members in terms of education status at a 1% significance level.

Off-farm activity: Farmers participate in different off-farm activities. In this study from a total of 400 sample households, 181(45.25%) households engaged in off-farm activities while the other 219(54.75%) households were not engaged in off-farm activities. From the total of 181 off-farm activity participant households, 118(59.00%) households were found to be dairy cooperative members and 63(31.50%) households were non-members of dairy cooperatives. Out of 219 off-farm

activity non-participant households, 82(41%) were dairy cooperative members and the rest 137(68.50%) were non-members of dairy cooperatives. The chi-square test result revealed that there was no statistically significant association between off-farm activity and dairy cooperative membership.

Input availability: out of the total sample households 297(74.25%) obtained dairy production inputs while the remaining 103(25.75%) did not obtain dairy production inputs. The chi-square test result revealed a statistically significant association between input availability and dairy cooperative membership at a 1% significance level. In this study dairy cooperative input availability means easy accessibility of inputs near the dairy farmer's home and at available prices at the required time.

Table 7: Descriptive statistics of dummy variables for dairy cooperative membership of sample households

Variables	Category	Member (200)		Non-member (200)		Total sample (400)		Chi-square Value
		Freq	%	Freq	%	Freq	%	
- Education	Illiterate	109	54.50	142	71.00	251	62.75	11.65***
	Literate	91	45.50	58	29.00	149	37.25	
- Off-farm activity	No	82	41.00	137	68.50	219	54.75	30.53
	Yes	118	59.00	63	31.50	181	45.25	
- Input availability	No	28	14.00	75	37.50	103	25.75	28.88***
	Yes	172	86.00	125	62.50	297	74.25	
- Dairy production training	No	74	37.00	151	75.50	225	56.25	60.23***
	Yes	126	63.00	49	24.50	175	43.75	
- Neighbor membership	No	60	30.00	131	65.50	191	47.75	50.51***
	Yes	140	70.00	69	34.50	209	52.25	

Source: own survey result, 2024

Note: *** Significant at 1% ($P < 0.01$) significant level.

Dairy production training: The survey results show that of the total respondents, 175(43.75%) attended a training program on dairy production training and 225(56.25%) didn't attend a training program. Of the total 175 respondents, 126(63%) and 49(24.50%) respondents were members and non-members of dairy cooperatives who attended dairy production training. In addition to this, out of 225 respondents, 74(37%) were members and 151(75.50%) were non-members of dairy cooperatives who had not attended training, respectively. The Chi-square test result showed that there was a

significant association between members & non-members in terms of attending training at a 1% significance level.

Having neighbor dairy cooperative members: out of the total sample households 209 (52.25%) had neighbor dairy cooperative member farmers while the remaining 191 (47.75%) did not have dairy cooperative member farmers. The chi-square test result revealed a statistically significant difference between neighbor membership and dairy cooperative membership at a 1% significance level.

4.2. Main reasons to become a dairy cooperative member

The main reasons for dairy farmers to become dairy cooperative member were cooperatives practice to receive milk during the fasting period (90.5%), transportation service (86.5%), delivery of dairy production inputs (78%), credit provision by the cooperative (69.5%), dividend from the cooperatives' profit 64.5%), training and extension services (62.5%), reduction of marketing risk (57%), various government support (35.5%), and better price of dairy products.

Based on the focus group discussion result dairy cooperative membership is extremely influenced by milk selling price, cross-breed cow ownership, and input availability. The practice of receiving butter and cheese, lack of coordination and management of cooperatives, entrance fees, and lack of awareness were critical factors for dairy farmers to become members of dairy cooperatives.

Table 8: Main reasons for dairy cooperative membership

Major reasons for members to join dairy cooperatives	Frequency	Percentage
- Receive milk during the fasting period	181	90.5%
- Provision of transportation service	173	86.5%
- Delivery of dairy production inputs	156	78%
- Credit provision by the cooperatives	139	69.5%
- Dividends from the cooperatives' profit	129	64.5%
- Training and extension services of cooperatives	125	62.5%
- Reduced marketing risk	114	57%
- Other government support	71	35.5%
- Better price of dairy products	3	1.5%

Total members	200
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4.3. Main reasons for not participating in dairy cooperative member

The main reasons that hindered dairy farmers from joining the dairy cooperative were the lower price of milk (75%), denial of receiving butter and cheese (63.5%), lack of awareness about cooperatives (49%), higher initial capital requirement (43.5%), lack of coordination and management of cooperatives (18.5%), and distance from dairy cooperatives (5.5%).

Table 9: the main reasons for not joining in dairy cooperative

Non-members reason for not joining dairy cooperative	Frequency	Percentage
- The lower price of milk	150	75%
- Denial of receiving butter and cheese	127	63.5%
- Lack of awareness	98	49%
- Higher initial capital requirement	87	43.5%
- Lack of coordination and management of cooperatives	37	18.5%
- Longer distance from dairy cooperatives	11	5.5%
Total non-members	200	

The descriptive result showed that the total milk produced on average per year was 6164.738 liters per year for dairy cooperative members and 3463.613 for non-members. Thus, the dairy cooperative members produce better milk per year. The t-test result revealed significant differences among dairy cooperative members and non-members in terms of milk output at $p < 0.01$ significance level.

Table 10: Total milk produced per year by dairy farm households

Variable	Total sample (N=400)		Member (N=200)		Non-member (N=200)		T- value
	Mean	SD	Mean	SD	Mean	SD	
Total milk produced per year (Liter/year)	4814.18	2751.4	6164.74	2990.55	3463.61	1602.71	-11.25***

Source: Own survey result, 2024

Note: *** Means significant at 1% ($p < 0.01$), probability levels

The descriptive result showed that the total cost incurred for dairy production on average per year was 48666 ETB for dairy cooperative members and 31240 for non-members. Thus, dairy cooperative members incurred more cost of production. The t-test result revealed significant differences among dairy cooperative members and non-members in terms of the cost of dairy production at $p < 0.01$ significance level.

Table 11: Total annual cost incurred for dairy production per year

Variable	Total sample (N=400)		Member (N=200)		Non-member (N=200)		T- value
	Mean	SD	Mean	SD	Mean	SD	
Total cost incurred for dairy production per year (ETB)	39953	53248	48666	61429	31240	41939	-3.3***

Source: Own survey result, 2024

Note: *** Means significant at 1% ($p < 0.01$), probability levels

The descriptive result showed that net dairy farm income on average per year was 171,972 ETB for dairy cooperative members and 108,656 ETB for non-members. Thus, the dairy cooperative members produced better milk per cow and generated more net dairy income. The t-test result revealed significant differences among dairy cooperative members and non-members in terms of net dairy farm income at $p < 0.01$ significance level.

Table 12: Net dairy farm income generated by sample farm households

Variable	Total sample (N=400)		Member (N=200)		Non-member (N=200)		T- value
	Mean	SD	Mean	SD	Mean	SD	
Net dairy farm income	139,139.50	71,434.95	171333	75,461.00	106857	49,419.64	-10.10***

Source: Own survey result, 2024

Note: *** Means significant at 1% ($p < 0.01$), probability levels

4.4. Econometric Model Results

Before proceeding to run the econometric model, the data were tested for the presence of perfect multicollinearity and Heteroscedasticity problems. The existence of multicollinearity among the

continuous explanatory variables was checked using VIF. Likewise, to test the multicollinearity problem of dummy variables, a contingency coefficient was used. The results indicated that there was no serious problem of multi-collinearity since the result of VIF is less than 5 for all variables, as shown in Appendix 3.

Heteroscedasticity: One of the assumptions in regression analysis is that the errors (u_i) exhibit homoscedasticity, meaning they have a constant variance σ^2 . If the errors do not have a constant variance, there is heteroscedasticity. However, the estimated parameters of a regression in which heteroscedasticity is present are consistent, though they are inefficient. The presence of heteroscedasticity has been checked using the Breusch-Pagan test. The Breusch-Pagan test result indicates that the alternative hypothesis (variance is not constant) is rejected, that is, there is no heteroscedasticity problem in the data set.

4.4.1. Factors Affecting Dairy Cooperative Membership

The first stage double hurdle model result has been estimated by maximum likelihood. The model fits the data reasonably well and better LR $\chi^2(14) = 228.94$ with Prob > $\chi^2 = 0.0000$. This showed that the explanatory variables included in the models are meaningful and relevant. The parameter estimates of the first stage double hurdle model (probit model) provide only the direction of the effect of the independent variables on the dependent variable estimates but do not represent the actual magnitude of change or probabilities. Thus, the marginal effect from the probit, which measures the probability of being dairy cooperative membership to a unit change in an independent variable, was computed.

Out of a total of fourteen explanatory variables, eight variables significantly determined the probability of dairy cooperative membership decision. Based on the model result, age, number of crossbreed cows' ownership, neighbor dairy cooperative members, off-farm activity participation, frequency of livestock extension contact and access to dairy production training were positively and significantly determine dairy cooperative membership decision. Conversely, distance to the district market and distance to dairy cooperative, were negatively and significantly determine dairy cooperative membership decision.

Age of household head: The age of the household head influenced decisions by the smallholder dairy farmers to join dairy cooperatives positively at $p < 0.01$ level of significance. This indicates that any increase in age will lead to a corresponding increase in the probability of membership in dairy cooperatives. A one-year increase in the age of the households, *ceteris paribus*, increases the probability of joining a dairy cooperative by about 0.7%. It was thus implied that people in the older age group are more likely to be dairy cooperative members. This might be because as farmers stayed longer, more understood the importance and use of dairy cooperatives to actively engage in the commitments and activities shared in the cooperatives. The result of this study is similar to Bizualem Assefa and Saron Mebratu (2018) study on factors influencing farmers' membership preferences in agricultural cooperatives in Ethiopia.

Number of cross-breed cows: the model result indicated that the number of cross-breed cows ownership influences dairy cooperative membership positively and significantly at $p < 0.01$ significant level. Farm households with at least one crossbreed cow were more likely to join dairy cooperatives. The marginal effect indicated that as crossbreed cow ownership of the household increased by 1 the probability of dairy cooperative membership increased by 8.4%, keeping other variables constant. This result is similar to the findings of Bayan Baban (2018) study on the impacts of dairy cooperatives in smallholder dairy production systems : a case study in Assam and Abateneh Molla (2022) studies on determinants of dairy cooperative membership and its impact on household income: The case of Machakel Worda, Amhara Region, Ethiopia.

Participation in off-farm activity: off-farm activity positively and significantly affected the decision to become a dairy cooperative member at $p < 0.01$ significant level. Thus, sample households participating in off-farm activities are more likely to become members. Off-farm activity participation provides households with additional sources of income, which advances their ability and interest in cooperative participation for marketing their dairy products. Having extra income from off-farm activity provides financial freedom to dairy farmers as a result dairy farmers may invest in the purchase of dairy production inputs. The model result showed Involvement in off-farm activities increases the probability of becoming members of the dairy cooperatives by 18%. The finding is in line with Geremew Motuma *et al.* (2024) study on dairy product market participation and its impacts on household food security of smallholder farmers in Jimma zone Ethiopia, and Eshetu Tefera and Assefa Gebre (2015) Study on the performance and determinants of household's

participation in dairy marketing cooperatives: The Case of Lemu-Arya and Bekoji Dairy Marketing Cooperatives, Arsi Zone, Oromiya Region, Ethiopia.

Distance to the district market: The model result showed that distance to the district market negatively and significantly affected the decision to participate in dairy cooperatives. As the distance to the market increases, the probability of being a dairy cooperative member decreases. One-minute increases in market distance decrease the likelihood of household participation in dairy cooperatives by 0.1%. This shows that farm households located nearer to the market have more probability of being cooperative members, contradicting the understanding that nearness to the market provides better options for farmers to sell their milk products to alternative channels. Distance to the district market increased dairy cooperative membership participation by 0.1%. This result is similar to the findings of Bayan Baban (2018) study on the impacts of dairy cooperatives in smallholder dairy production systems: a case study in Assam and Laishram Priscilla *et al.* (2017) study on the participation behavior of dairy farmers in dairy cooperative societies in Manipur.

Distance to dairy cooperative: The model result indicated that distance to the dairy cooperative office has an inverse relationship with the probability of dairy cooperative membership decision. Distance to the dairy cooperative office decreases the probability of dairy farmers joining the dairy cooperative by 0.4%. This implies when the dairy cooperative office is close to the household head, the cost of time, money, and labor that the farmer spends to communicate with cooperative officers will be reduced. Those farmers who are closer to the dairy cooperative office have more knowledge about dairy cooperatives and their benefits. This result is similar to the findings of Musa Hasen and Hiwot Mekonnen (2017) study on the impact of agricultural cooperatives membership on the well-being of smallholder farmers: empirical evidence from eastern Ethiopia and Bhattacharjee Shraddhanjali and Nath Dharmendra (2023) study on impact and determinants of membership in dairy cooperative society: The case of smallholder dairy farmers in Barpeta District of Assam.

Frequency of livestock extension contact: this is the frequency of contact made to visit smallholder dairy farmers per year in the study area. Some dairy farmers visit extension agents more frequently, while others visit them rarely. The frequency of livestock extension contact significantly and positively affects dairy cooperative membership at $p < 0.01$ significant level. Dairy farmers who have received extension advice on the use and benefits of working with dairy cooperatives from

development agents are more likely to join dairy cooperatives than those who have not received advice. The contacts between development agents and dairy farmers may improve dairy farmer's knowledge and awareness in selecting the best milk-marketing outlet and joining the dairy cooperatives. The marginal effect result showed that the frequency of livestock extension contact increased the probability of joining the dairy cooperatives by 5%. These findings are in line with Mohammed Kedir (2020) study on the determinants of participation in dairy marketing cooperatives and its contribution to household income in Welmera District of Oromia Special Zone, Oromia Region, Ethiopia and Eshetu Tefera and Assefa Gebre (2015) study on the performance and determinants of household's participation in dairy marketing cooperatives: The Case of Lemu-Arya and Bekoji Dairy Marketing Cooperatives, Arsi Zone, Oromiya Region, Ethiopia.

Dairy production training: Training of household heads on dairy production has a positive relationship with dairy cooperative membership decisions. The model result revealed that training access influenced dairy cooperative membership positively and significantly at $p < 0.01$ significant level. This indicates that the provision of training attracts more farmers to the cooperative. The marginal effect showed that being a participant in training increased the probability of dairy cooperative membership by 13.4%, keeping other variables constant. This might be because training helps farmers to modernize the dairy production system which in turn increases their milk production. Training raises farmers' understanding of the importance of dairy cooperatives. The finding is in line with the results of Bizualem Assefa and Saron Mebratu (2018) study on factors influencing farmers' membership preferences in agricultural cooperatives in Ethiopia and Abateneh Molla (2022) studies on determinants of dairy cooperative membership and its impact on household income: The case of Machakel Worda, Amhara Region, Ethiopia.

Availability Neighbor membership: The presences of neighbor dairy cooperative members were expected to influence the dairy cooperative membership decisions of farmers positively. The presence of neighbor dairy cooperative members increased the probability of dairy cooperative membership by 18%, keeping other variables constant. This could happen because the existence of nearby dairy cooperative members motivates the membership decision of farmers through information exchange related to the practice and importance of dairy cooperative membership. Neighbor farmer participation creates dairy farmers' awareness about social interaction and involvement like the Neighbors; hence, it is possible to join the dairy cooperatives to increase the

associated benefits. The result is similar to the findings of Abateneh Molla (2022) study on determinants of dairy cooperative membership and its impact on household income: The case of Machakel Worda, Amhara Region, Ethiopia, and Shadrack Kipkogei Ruth Karoney *et al.* (2024) study on the impact of cooperative membership on tea marketing strategies and farmers' income in Kericho, Kenya.

Table 13: Determinants of dairy cooperative membership decision: probit model result (first hurdle model result)

Explanatory variables	Coefficient	Std. err	dy/dx	P>z
- Age of the household head	0.030***	0.011	0.007	0.008
- Household size	0.006	0.067	0.001	0.928
- Education	0.250	0.183	0.057	0.172
- Farm size /land holding size	0.249	0.151	0.057	0.179
- Livestock holding	-0.014	0.029	-0.003	0.637
- Number of improved cow	0.369***	0.075	0.084	0.000
- Off-farm activity	0.809***	0.174	0.184	0.000
- Input availability	0.283	0.192	0.064	0.140
- Distance to district market	-0.007***	0.002	-0.001	0.002
- Distance to dairy cooperative	-0.017**	0.007	-0.004	0.020
- Amount of credit utilized	0.000	0.000	0.000	0.415
- Frequency of livestock extension contact	0.196***	0.055	0.05	0.000
- Dairy production training	0.587***	0.179	0.134	0.001
- Neighbor membership	0.770***	0.165	0.18	0.000
- cons	-2.720***	0.640		0.000

Source: Own estimation survey result, 2024

Note: *** and ** at 1% ($p < 0.01$), and 5% ($p < 0.05$) significance probability level respectively, Std. err = standard error, and dy/dx = marginal effect.

4.4.2. Factors determining dairy cooperatives members' intensity of dairy products supply

To identify the determinants of dairy cooperative members' intensity of milk supplied to the cooperatives, second-stage hurdle regression was used. The second hurdle model (truncated) result

indicated that age, education status, number of crossbreed cows ownership, off-farm activity, input availability, frequency of livestock extension contact, dairy production training, and having neighbor members were positively and statistically significant factors determining dairy cooperative members intensity of dairy products supply. Distance to the district market and distance to dairy cooperative determine dairy cooperative members' intensity of dairy product supply negatively.

Age of the household head: The truncated model result shows that the age of the household head was found to have a positive and significant effect on dairy cooperative members' intensity of supply at $p < 0.01$ level of significance. An increase in the age of smallholders by one year increases dairy cooperative members' intensity of supply of dairy products by 0.006 keeping other variables constant. This finding is in line with Laishram Priscilla *et al.* (2017) study on the participation behavior of dairy farmers in dairy cooperative societies in Manipur, which indicated that older dairy farmers sell more of the milk produced to the cooperatives.

Education status of the household head: The education status of the household head has a positive significant effect on dairy cooperative members' intensity of dairy products supply at $p < 0.05$ significant level. Better-educated dairy farmers sell more milk to dairy cooperatives may be they expect to sell larger quantities and shares more through the dairy cooperative. Education status increases the intensity of dairy cooperative members' supply of dairy products by 0.09. This result was consistent with Elisabeth Fischer and Matin Qaim (2014) and Chikuta Trevor *et al.* (2024) study on smallholder farmers and collective action: What determines the intensity of participation? This suggests that better-educated farmers sell significantly more products through the group.

Number of crossbreed cow ownership: The model result shows that the number of improved cow ownership was found to have a positive and significant effect on the intensity of dairy cooperative membership at $p < 0.01$ significant level. The number of improved cow ownership increased by 1, and it increased dairy cooperative membership intensity by 0.11, keeping other variables constant. Dairy farmers who have cross-breed cows produce a large volume of milk and supply it to different channels which is a dairy cooperative. As compared to other member dairy farmers those dairy farmers sell more quantity of milk to the dairy cooperatives because these dairy farmers with higher milk production and insufficient markets tend to sell more amount of milk to the cooperative. The findings in line with Geremew Motuma *et al.* (2024) study on dairy product market participation and its impacts on household food security of smallholder farmers in Jimma zone Ethiopia, suggested

that crossbreed cow ownership affected milk supply positively. The finding is contrary to Laishram Priscilla *et al.* (2017) study on the participation behavior of dairy farmers in dairy cooperative societies in Manipur. This showed that number of improved cow ownership affected dairy cooperative member's participation intensity negatively.

Participation in off-farm activity: The truncated model result showed that off-farm activity participation has a positive and statistically significant effect on dairy cooperative members' intensity of participation at $p < 0.01$ significant level. Dairy farmers participated in off-farm activities dairy cooperative members' participation intensity increased by 0.14. Dairy farmers who participated in off-farm activity provided more extra income for buying dairy production inputs and high-milking dairy cows. As a result, milk production and the milk supply to dairy cooperatives have also increased. This result is in line with the findings of Eshetu Tefera and Assefa Gebre (2015) Study on the performance and determinants of household participation in dairy marketing cooperatives: The Case of Lemu-Arya and Bekoji Dairy Marketing Cooperatives, Arsi Zone, Oromiya Region, Ethiopia.

Expectation of dairy production input availability: availability of dairy production inputs is found to be significantly affecting the intensity of dairy cooperative members intensity of participation at $P < 0.1$ other factors are kept unchanged, expectation of dairy production inputs increases the intensity of dairy cooperative members dairy products supply intensity by 0.07. This implied that helping dairy farmers to access services for instance improved breeds, veterinary services, concentrated feed, and fodder seeds can inspire them to sell large quantities of milk to cooperatives as a result dairy cooperatives' intensity increased. The result is in line with Geremew Motuma *et al.* (2024): Study on dairy product market participation and its impacts on household food security of smallholder farmers in the Jimma Zone of Ethiopia; and Eshetu Tefera and Assefa Gebre (2015): Study on performance and determinants of household's participation in dairy marketing cooperatives: The Case of Lemu-Arya and Bekoji dairy Marketing Cooperatives, Arsi Zone, Oromiya Region, Ethiopia.

Frequency of livestock extension contact: The model results show that frequency of extension contact was found to have a positive and significant effect on the intensity of dairy cooperative members' participation in dairy product sales at $p < 0.01$ significance level. As dairy farmers frequently contact with extension agents, it increases dairy cooperative member's intensity of participation by 0.07. The contact between dairy farmers and livestock extension agents increased the

know-how on the benefits of supplying milk to the dairy cooperative because dairy cooperatives receive milk at any time like during the fasting- period. These findings are in line with Meier zu Selhausen (2016) study What determines women's participation in collective action? Evidence from a Western Ugandan coffee cooperative.

Dairy production training: The model result revealed that training access influenced dairy cooperative members' intensity of participation positively and significantly at $p < 0.01$ significant level. This showed that being participant in training increased the intensity of dairy cooperative membership by 0.14 keeping other variables constant. This might be because training help farmers to modernizing dairy production system which in turn increases their milk production and supply large volume of milk to the dairy cooperatives. The result in line with Qingbin Wang and Yang Zou. (2022) Study on impacts of farmer cooperative membership on household income and inequality: Evidence from a household survey in China.

Availability of neighbor membership: Neighbor participation is positively and significantly affected dairy cooperative members intensity of participation at $p < 0.01$ significant level. The presence of neighbor members in the dairy cooperatives increases the ratio of supply of milk to cooperatives from the total milk sold increased by 0.10. This result is in line with Samuel Ahado *et al.* (2024) study on supported cooperative groups and the economic performance of small farmers: evidence from Georgia.

Table 14: Determinants of dairy cooperative member's intensity of participation in milk supply

Variables	Coef.	Sta. Err.	$P > z $
- Age of household head	0.006***	0.002	0.01
- Family size	-0.003	0.015	0.824
- Education status of household head	0.09**	0.039	0.024
- Farm size	0.02	0.034	0.661
- Livestock holding	0.01	0.006	0.293
- Number of crossbreed cows	0.11***	0.017	0.000
- Off-farm activity	0.14***	0.039	0.000
- Input availability	0.07*	0.04	0.067
- Distance to district market	-0.001***	0.000	0.001
- Distance to dairy cooperative	-0.004***	0.001	0.004
- Amount of credit utilized	0.000	0.000	0.817
- Frequency of livestock extension contact	0.07***	0.012	0.000

- Dairy production training	0.14***	0.041	0.001
- Neighbor membership	0.10***	0.036	0.007
- Constant	-0.33***	0.125	0.008
Wald chi2(14)	278.96		
Prob > chi2	0.000		

Source: Owen survey result, 2024

Note: ***, **, and * at 1% ($P < 0.01$), 5% ($P < 0.05$), and 10% ($P < 0.1$) significance probability Errel respectively, and Std. Err = Standard Error.

Distance to district market: Distance to the district market significantly and negatively influences dairy cooperative members' intensity of participation in dairy products supply at $p < 0.01$ significant level. A one minute increase in distance to district market intensity of participation decreased by 0.001. This implies that dairy farmers close to the district market, supply more milk to dairy cooperatives. The finding is similar to Chikuta Trevor *et al.*(2024) study on factors influencing smallholder bean producers' participation in collective marketing in the Kawambwa, Luwingu, and Senga Hill Districts of Zambia.

Distance to dairy cooperative: Distance to dairy cooperative significantly and negatively influences dairy cooperative members' intensity of participation at $p < 0.01$ significant level. A one hour increase in the distance between the household's residence and the dairy cooperative office decreased dairy cooperative members' intensity of participation by 0.24. The finding is in line with Eshetu Tefera and Assefa Gebre (2015) study on performance and determinants of household participation in dairy marketing cooperatives: The Case of Lemu-Arya and Bekoji dairy Marketing Cooperatives, Arsi Zone, Oromiya Region, Ethiopia

4.4.3. Impact of dairy cooperative membership on households' income from dairy

One of the main objectives of this study was to evaluate the impact of dairy cooperative membership on dairy farm income. The endogenous switching regression (ESR) model was employed to analyze it. From the results, as expected, the model diagnosis is satisfactory; the likelihood ratio test indicates statistical significance at less than 5% significance level for outcome variables. This indicates the overall fitness of the endogenous switching regression model. This implies that there is an endogeneity problem; hence, the use of the endogenous switching regression model is reasonable.

From the variables, the presence of neighbor dairy cooperative member farmers (neighbors membership), used in the membership equation is excluded from the outcomes equation. The

variable affects the probability of dairy cooperative membership decision but doesn't directly affect the dairy income of households. It is believed that the presence of dairy cooperative member farmers in nearby areas facilitates information and knowledge sharing between dairy farmers about the importance and contribution of dairy cooperatives. And also motivates the neighbor farmers to be members of dairy cooperatives.

In the first stage, the ESR model result shows the selection equation of dairy cooperative membership. The result indicated that among 14 variables, eight of them (i.e., age of household head, number of improved cow ownership, off-farm activity, distance to district market, distance to dairy cooperative, frequency of livestock extension contacts, dairy production training, and neighbor's membership) are significantly associated with dairy cooperative membership.

The second-stage estimates (that is outcome equation of household dairy farm income) of the ESR model results show factors influencing household dairy farm income for both members and non-members. The finding shows that the education status of the household head and distance to the dairy cooperative was statistically significant and hurt dairy farm income to non-member households. The result contradicts with the findings of Abateneh Molla (2022) studies on determinants of dairy cooperative membership and its impact on household income: The case of Machakel Worda, Amhara Region, Ethiopia. The educational level of the household head had a statistically significant and positive impact on the income of the non-member households.

Farm size/land holding size has a positive effect on household dairy income for non-member dairy farmers. This indicates that farmers who have more land can increase dairy production and productivity and produce more milk output. This indicates dairy farmers can easily get dairy production inputs, especially dairy cow feed either in the form of crop residuals or allocate land for pasture to the dairy cow. This leads to increased household dairy income and improves their livelihoods. The result is in line with the findings of Abateneh Molla (2022) studies on determinants of dairy cooperative membership and its impact on household income: The case of Machakel Worda, Amhara Region, Bahir Dar Ethiopia. The expectation of input availability has a positive effect on household dairy farm income for both members and non-member dairy farmers.

Livestock holding and several cross-breed cow ownership have a positive and significant impact on improving household dairy farm incomes for members. This indicates that households with a large

number of livestock in the tropical livestock unit enable the farm households to have a better chance to earn more income from the sale of the livestock specifically dairy cows. Ownership of more high-yielding cross-breed dairy cows helps farmers produce and supply more amount of milk to the market and earn more dairy farm income. The result is in line with the findings of Abateneh Molla (2022).

Endogenous switching regression model estimation result for the outcome variable for both members had they member (ATT), non-member had they member (ATU), and transitional heterogeneity treatment effect. The average treatment effect on dairy farm income for the treated/members of dairy cooperatives had increased by 9007.85 ETB because of dairy cooperative membership. This indicated that if dairy cooperative members had not be members, the income generated from dairy products would have decreased by 9007.85 ETB. For non-members, the average treatment effect of dairy farm income was 6960.95 ETB. The results showed that if non-members had been members, dairy farm income could have increased by 6960.95ETB.

Table 15: Maximum likelihood estimation of the switching regression model

Variables	Selection Equation		Member (income)		Nonmember (income)	
	Coef.	Sta. Err	Coef.	Sta. Err	Coef.	Sta. Err
- Age	0.030***	0.012	-508.199	647.9	-283.851	458.445
- Family size	0.01	0.066	-2555.2	3035.7	332.795	2510.159
- Education	0.254	0.171	12836	9947	-13704.22*	7280.33
- Farm size	0.214	0.16	-3895.6	7917.9	11314.7*	6677.575
- Livestock holding in TLU	-0.012	0.029	5494***	1375.9	1947.92	1408.91
- Number of cross-breed cow ownership	0.354***	0.115	27866***	4696.4	7659	7884
- Off-farm activity	0.808***	0.177	-11728	10095.3	6835	7348
- Expectations on input availability	0.309	0.203	23709.2**	10827.7	18068.5***	7028.1
- Distance to district market	- 0.007***	0.002	14.97	101.6	-76.488	79.734
- Distance to dairy cooperative	-0.019***	0.007	387	484.8	-530.591**	242
- Amount of credit utilized	0.0005	0.0002	0.088	0.152	-0.464	0.295
- Frequency of livestock extension contact	0.195***	0.05	4952	3016.7	-3474	3183
- Dairy production training	0.593***	0.178	1138.6	11117.5	-6214	7652
- Neighbor membership	0.756***	0.155				

- Cons	-2.63	0.582	76203**	40728	94688.2***	22599
Number of observations =	400		Wald chi2(13) =	53.38		
Log likelihood =	-5058.4222		Prob > chi2 =	0.0000		
LR test of Indep. eqns.:	chi2(2) =	6.87	Prob > chi2 =	0.0322		

Source: Own household survey result, 2024

Note: ***, **, * are significant at 1% ($p < 0.01$), 5% ($P < 0.05$), and 10% ($p < 0.1$) significant level respectively; Std. Err. = Standard Error.

The transitional heterogeneity effect (TH) is positive. This indicated that the impact of dairy cooperative membership on dairy farm income was significantly greater for member dairy farmers as compared to counterfactuals in the study area. Members got a 29% advantage over non-members of dairy income (net cash income). This average income gain due to membership indicates that participating in dairy cooperative membership has a strong positive and significant effect on the dairy farm income of households. This finding is in line with previous studies that argue the existence of direct income and employment impact of cooperative membership (Clarietta Chagwiza, Roldan Muradian, 2016; Musa Hasen and Hiwot Mekonnen, 2017). It is also in line with Kassa Tarekegn *et al.* (2021) and Zewdu Getachew, Fekadu Beyene (2023). Thus, cooperative membership has a strong positive and significant effect on income.

Table 16: Average treatment effects: Endogenous switching regression model result

Outcome variable	Membership status	Decision stage		Treatment effect
		Members	nonmembers	
Dairy farm income	Member	171333 (yc11)	162325 (yc10)	ATT=9007.85***
	Nonmember	113818 (yc01)	106857 (yc00)	ATU=6960.95***
Heterogeneity effect		HE1=57515	HE2=55468	TH=2047

Source: Own household survey result, 2024

5. SUMMARY CONCLUSION AND RECOMMENDATION

5.1. Summary and conclusion

This study analyzes the determinants of dairy cooperative membership and its impacts on dairy farm income in the Bahirdar Zuria district of North Gojjam in the Amhara region. Specifically, determinants of dairy cooperative membership decisions, intensity of participation in dairy milk supply, and impact on dairy farm income were analyzed. The double hurdle model was used to analyze the determinants of dairy cooperative membership decisions and the intensity of participation. The endogenous switching regression model was employed to analyze the impacts of dairy cooperative membership on dairy farm income. The quantitative analysis is based on the primary data collected from 400 dairy producer households.

Half of them were members and half of them were non-members. This was supplemented by information from focus group discussions with dairy producer farmers, board members of the dairy cooperatives, and key informants. Secondary data were collected from district-level agriculture, livestock, and dairy cooperative offices, regional and national level reports, journal articles, records of published and unpublished documents of the Bahir Dar Zuria Agriculture Office related to dairy cooperatives, and other sources.

Descriptive statistics results showed that there was a significant association and mean difference between dairy cooperative member households and non-members. Household dairy farm income was the outcome variable in this study. The study result showed that cooperative members' dairy income was significantly higher than non-members.

The first hurdle regression (probit model) result showed that eight variables determined the probability of dairy cooperative membership decision. These variables were the age of the household head, number of crossbreed cows' ownership, presence of neighbor dairy cooperative members, off-farm activity participation, frequency of livestock extension contact, dairy production training, distance to the district market, and distance to the dairy cooperative. The second hurdle regression (truncated model) result showed that age, education status, number of crossbreed cow ownership, off-farm activity, input availability, frequency of livestock extension

contact, dairy production training, and neighbor membership were positively and statistically significant factors determining the intensity of participation in dairy milk supply. On the other side, the distance between the district market and the dairy cooperative are exhibit a negative relationship.

The endogenous switching regression model estimation result showed that the dairy farm income of members increased by 9,007.85 ETB in the study area as a result of dairy cooperative membership. If non-members had been members, dairy farm income could have increased by 6,960.95 ETB (43.6%). The dairy farm income of members was higher than the non-members by 29%. The high cost of cross-breed cows, low price of milk, dairy cow disease, feed shortage, and lack of veterinary service, are the main constraints of dairy cooperatives identified. Based on this finding, with all these challenges, it is possible to conclude that dairy cooperative membership contributes to improved dairy farm income in the study area.

5.2. Recommendations

The study's findings showed that participation in dairy cooperative membership improves dairy farm income. The following development, policy, and further research recommendations are derived mainly from the relationship between cooperative membership and the intensity of milk supply based on determinant factors.

This study result showed that the number of crossbreed cows owned positively and significantly affected dairy cooperative membership and the intensity of milk supply. Therefore, governmental and non-governmental bodies need to support crossbreed cows access at affordable prices. Aged dairy farmers were more likely to join the dairy cooperative than younger farmers. So, the government and the dairy cooperatives should focus on informing the benefits of dairy cooperatives and increase the interest of younger dairy farmers. Livestock extension contact and dairy production training affect dairy cooperative membership and the intensity of supply positively. So, it is better to widen the extension service and training on dairy management and cooperatives' importance by the respective concerned bodies.

Expectations on dairy production input availability affected dairy cooperative members' intensity of participation in milk supply positively. Lack of production input is a major challenge that hinders the

amount of milk sold by member dairy farmers to the cooperative. Strengthening input supply is required. Woreda livestock office needs to strengthen breeding-related services, veterinary services, and fodder seedlings for dairy farmers to improve the performance of dairy cows in producing high-quality milk.

Based on ESR results dairy cooperative membership has a positive impact on dairy farm income. Both ATT and ATU findings indicated that participating in dairy cooperatives has a significant positive impact on dairy income as compared to their counterfactual. Therefore, the concerned body needs to focus on motivating members to continue and bring non-members to become members. In addition, improving artificial insemination or supply of affordable cross-breed heifers, market or value chain support, and expansion of veterinary service are very important for the advancement of the dairy sector and to increase the income of dairy farmers in the study area and other areas with similar contexts.

This study dealt with the impacts of dairy cooperative membership on a household's dairy farm income. For future research, it will be better to study the impact of dairy cooperative membership on dairy farm households' welfare and the impact on farm households' nutrition security.

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APPENDIXS

Appendix 1: Conversion factor of man equivalent

Age group (years)	Man equivalent	
	Male	Female
<10	0	0
10-13	0.2	0.2
14-16	0.5	0.4
17-50	1	0.8
>50	0.7	0.5

Source: (Storck *et al.*, 1991)

Appendix 2: Conversion factors used to estimate tropical livestock unit equivalents

Animal category	TLU
Calf	0.25
Donkey (young)	0.35
Heifer and bull	0.75
Sheep and Goat (adult)	0.13
Cow and Oxen	1.00
Sheep and Goat young	0.06
Horse/mule	1.10
Chicken	0.013
Donkey (adult)	0.7

Source: Storck *et al.* (1991)

Appendix 3: Test of multicollinearity and heteroscedasticity problems

Test of multi-collinearity (estat vi)

VIF	1/VIF
2.410	0.415
1.940	0.515
1.380	0.724
1.370	0.732
1.330	0.754
1.260	0.795
1.250	0.803
1.240	0.808
1.240	0.809
1.240	0.810
1.170	0.856
1.130	0.883
1.130	0.886
1.060	0.940
Mean of VIF	1.370

Test of heteroskedasticity (estat hettest)

Breusch –Pagan/cook-Weisberg test for heteroscedasticity
Variable: Fitted values of cooperative membership
H0: Constant variance
chi2(1) = 0.43
Prob > chi2 = 0.5123

Appendix 4: ESR estimation of impacts of dairy cooperative membership

Endogenous switching regression model

Number of obs = 400

Wald chi2 (13) = 53.38

Log likelihood = -5058.4222

Prob > chi2 = 0.0000

Variables	Coefficient	Std. errs.	Z	P>z
net income				
Age	-283.851	458.445	-0.620	0.536
Family size in man equivalent	332.795	2510.159	0.130	0.895
Education	-1.37e+04	7280.329	-1.880	0.060
Farmsizeinhectar	11314.670	6677.575	1.690	0.090
Livestock holding in TLU	1947.918	1408.908	1.380	0.167
Number of improved cow	7659.306	7884.243	0.970	0.331
Off-farm activity	6835.127	7347.808	0.930	0.352
Input availability	18068.460	7028.088	2.570	0.010
distance to the district market	-76.488	79.734	-0.960	0.337
distance to dairy cooperative	-530.591	241.784	2.190	0.028
Amount of credit utilization	-0.464	0.295	-1.570	0.116
Frequency of livestock extension contact	-3473.592	3182.851	-1.090	0.275
Dairy production training	-6213.643	7651.632	-0.810	0.417
Cons	94688.180	22599.050	4.190	0.000
Net income1				
Age	-508.199	647.922	-0.780	0.433
Family size in man equivalent	-2555.194	3035.664	-0.840	0.400
Education	12835.970	9946.531	1.290	0.197
Farmsizeinhectar	-3895.638	7917.890	-0.490	0.623
Livestock holding in TLU	5494.211	1375.922	3.990	0.000
Number of improved cow	27865.830	4696.339	5.930	0.000
Off-farm activity	-1.17e+04	10095.260	-1.160	0.245
Input availability	23709.190	10827.660	2.190	0.029
distance to the district market	14.967	101.590	0.150	0.883
distance to dairy cooperative	386.921	484.768	0.800	0.425

Variables	Coefficient	Std. errs.	Z	P>z
Amount of credit utilized	0.088	0.152	0.580	0.564
Frequency of livestock extension contact	4952.027	3016.663	1.640	0.101
Dairy production training	1138.614	11117.490	0.100	0.918
Cons	76202.710	40728.060	1.870	0.061
select				
age	0.030	0.012	2.590	0.010
Family size in man equivalent	0.010	0.066	0.150	0.882
Education	0.254	0.171	1.480	0.138
Farm size in hectares	0.214	0.160	1.340	0.179
Livestock holding in TLU	-0.012	0.029	-0.430	0.671
Number of improved cow	0.354	0.115	3.090	0.002
Off-farm activity	0.808	0.177	4.560	0.000
Input availability	0.309	0.203	1.530	0.127
Distance to district market	-0.007	0.002	-3.460	0.001
Distance to dairy cooperative	-0.019	0.007	-2.600	0.009
Amount of credit utilized	0.000	0.000	1.000	0.319
Frequency of livestock extension contact	0.195	0.050	3.870	0.000
Dairy production training	0.593	0.178	3.330	0.001
Neighbor membership	0.756	0.155	4.880	0.000
Cons	-2.630	0.582	-4.520	0.000
/lns0	10.701	0.004	2542.810	0.000
/lns1	10.983	0.010	1077.990	0.000
/r0	0.045	0.151	0.290	0.768
/r1	-0.494	0.191	-2.590	0.010
sigma0	44414.540	186.917		
sigma1	58878.810	599.892		
rho0	0.045	0.151		
rho1	-0.457	0.151		
LR test of Indep. eqns.: chi2 (2) = 6.87 ** Prob > chi2 = 0.0322				

Appendix 5: Questionnaires used for the survey

Dear respondents

This survey is part of a research entitled on “**Impacts of dairy cooperative membership on dairy farm income in Bahir Dar Zuria District, West Gojjam Zone, Amhara, Ethiopia.**” An MSc student, Ms. Yeshe Hunegnaw, is conducting the work under the supervision of Dr. Berihun Tefera (PhD) from Bahir Dar University, College of Agriculture and Environmental Science. Your household has been selected randomly. So this survey questionnaire is designed to collect information on the **impacts of dairy cooperative membership on dairy farm income**. All the information you will provide will be for academic purposes and be treated confidentially. Therefore you’re kindly requested to respond trustfully and faithfully to the following question.

Respondent name _____ Dairy Cooperative membership (✓) Yes ___ No ___

Phone number _____

Name of kebele _____ Village _____

Name of data collector _____ signature _____

Name of supervisor _____ signature _____

1. Household demography

1.1. Sex of the household head

1) Male headed

2) Female headed

1.2. Age of the household head _____ years

1.3. Marital status

1) Single

3) Divorced

2) Married

4) Widowed

1.4. Family size (number of persons in the household).

Age (year)	Male	Female	Total
<10			
10-13			
14-16			
17-50			
>50			
Total			

1.5. Education level of the household head

1) Illiterate

3. Grade 1-8

Grade 12 & above

2) Read & write only

4. Grade 8-12

2. Resource ownership and source of income of the household

2.1. Landholding in Timad

Land use of the household in the last cropping season (2015/16)	Size (in Timad)
Crop land	
Forage land	
Grazing land	
Homestead area	
Fallow land	
Total land holding	

2.2. Livestock ownership in the last 12 months

Livestock	Do you own? 1=Yes, 0=No	Local (Number/household)	Improved (Number/household)	Total
Oxen				
Cow				
Bulls				
Heifer				
Calves				
Sheep				
Goat				
Donkey				
Horses				
Mules				
Chicken				
Beehive				
Others				

2.3. Are you participating in off farm activities and how much birr you get in the past 12 months?

Off farm activities	Yes (✓)	Income in the past 12 months (Birr)
Daily Labor		
Carpentry		
Pottery		
Petty trade		
Weaving		
Additional monthly employee for	Government	
	Private	
Others (specify) _____		

3. Dairy production experience, income and expenditure

3.1. How long have you been engaged in dairying in years? _____ Years

3.2. How many months you get milk from last year? _____ months.

3.3. Dairy production in the past 12 months

Description		Local	Improved	Total
Number of cows (#)				
Milking cows (#)				
Lactating days/year				
Average milk yield in	Lit/day			
	Lit/month			
	Lit/year			
Average milk processed in	Lit/month			
	Lit/year			

3.4. Dairy consumption, marketing and income in the past 12 months

Description		Milk	Butter	Cheese	Yoghurt	Dairy cow
▪ Average amount consumed		___ lit/month ___ lit/year	___ Kg/month ___ Kg/year	___ Kg/month ___ Kg/year	___ Kg/month ___ Kg/year	
▪ Selling practice (✓ if yes)						
▪ Estimated sold quantity from total production (in percentage)		___ lit/month ___ lit/year	___ Kg/month ___ Kg/year	___ Kg/month ___ Kg/year	___ Kg/month ___ Kg/year	___ number
▪ Estimated sold quantity to cooperatives from total selling amount (In percentage)		___ lit/month ___ lit/year	___ Kg/month ___ Kg/year	___ Kg/month ___ Kg/year	___ Kg/month ___ Kg/year	
▪ Average amount sold		___ lit/month ___ lit/year	___ Kg/month ___ kg/year	___ Kg/month ___ kg/year	___ Kg/month ___ kg/year	___ No/year
▪ Average price		___ Birr/lit	___ Birr/Kg	___ Birr/Kg	___ Birr/Kg	___ Birr/No.
▪ Total income in the past 12 months (Birr) from	coop.					
	others					
▪ Market outlet*						
▪ Customer **						

*1. Farm gate 2. Village market 3. Bahir Dar 4. Addis Ababa

** 1. Cooperatives 2. Local collectors 3. Enterprise (hotels, cafeteria) etc. 4. Consumer Households
5. Others (Specify)

3.5. How many birr you spend for dairy production purpose in the past 12 months?

Items	Unit	Price/unit	Total	Money spend in ETB
Buying cows				
Feed				
Hay				
AI services				
Veterinary services				
Labour				
Transport to market				
Other specify				
Total cost incurred				

3.6. Are you gained any income from patronage dividend? 0) No 1) Yes

3.7. If your response is yes, how many birr you gain? _____ Birr.

3.8. What reasons for supplying milk regularly to your choice?

- 1) To get high price 2) Can get immediate cash 3) to provide transportation service
4) Close to production site 5) If others, specify _____

4. Institutional factors

4.1. Are the following input/services easily available?

Input /services	Availability		Source of dairy farm inputs*
	Yes	No	
Improved breeds			
Concentrate feed			
fodder seeds			
Veterinary service			

* 1-Dairy Cooperative 2-Other cooperatives 3-NGOs 4-Agr. Devt office 5-Research institutions 6 - Private groups 7. Government Veterinary service 8. Others (specify)

4.2. If you are purchased from the dairy cooperative, what is your reason?

- 1) Facilitate credit service and training 2) Relatively lower price
3) No other institutions in the area 4) other specify _____

4.3. Did you participate in some social position (Mahbre, and Idir etc.)? 0) No 1) Yes

4.4. If yes, what type of organization was you participated?

- 1) Idir 2) Mahbre 3) Iqub 4) other, specify _____

4.5. What is the average distance of the following (the nearest) from home by walking in minutes?

Market/Institute	Average distance in minutes
1. Village market	
2. District market	
3. Milk collection center (cooperative)	
4. Livestock extension office	

4.6. Have you ever participated in any training related to dairy production? 0) No 1) Yes

4.7. If your answer is yes, who provide the training?

- 1) Dairy Cooperatives 2) NGOs 3) Government livestock office
4) Government research service 5) other specify _____

4.8. Have you ever participated in any training related to dairy cooperatives? 0) No 1) Yes

4.9. Did you utilize/get credit for dairy production purpose last year? 0) No 1) Yes

4.10. If yes how much is it? _____ Birr

4.11. Where did you get the credit?

- 1) Dairy cooperative 3) Close friends/relatives
2) Amhara credit and saving institutions 4) Banks 5) others (specify) _____

4.12. If no (didn't get the credit), what is your reason?

- 1) High interest rate of loan 2) unavailability of credit providers 3) I didn't need
4) Fright of unexpected loss during cow disease 4) other specify _____

4.13. Do you have access to livestock/dairy production extension services? 0) No 1) Yes

4.14. If yes, how many times you are visited in a year? _____ times

5. Dairy production and Cooperative Membership

5.1. Are you member of dairy cooperative? If not proceed to question 5.5. 1) Yes 0) No

5.2. Is there any dairy cooperative member farmer in your neighbor? 0) no 1) yes

5.3. If yes, how many years you are a member? _____ years

5.4. If yes (member), why do you become member of the cooperative?

- 1) Better price for dairy product 2) To get dairy production inputs
3) To reduce marketing risk 4) To get dividend from the cooperative
5) To get training and extension services from the cooperative 6) To provide transportation service
7) To get credit from the cooperative 8) Because they receive milk during the fast- period
9) To get government support

others specify_____

5.5. If yes (member), what are the benefits you got from being a member of dairy cooperative?

- | | | |
|--|---|-------------------------|
| 1) Veterinary service | 2) Patronage dividend | 3) Increased milk price |
| 4) Improved feeds | 5) Definite market and payment for milk | |
| 6) Training on dairy production/management | 7) other specify_____ | |

5.6. If not a member, what are the problems hinder you?

- | | |
|--|--|
| 1) Distance from dairy cooperatives | 2) Initial capital requirement |
| 3) Lack of awareness | 4) Lack of coordination and management of cooperatives |
| 5) They didn't receive butter and cheese | 6) low price of milk 7) Other specify_____ |

5.7. Which of the following are constraints in your dairy farming activity?

- | | |
|---|-----------------------|
| 1) Low feed availability | 2) high cost of feed |
| 3) Shortage of supply of improved dairy animals | 4) Shortage of land |
| 5) Shortage of labor | 6) lack of capital |
| 7) animal diseases | |
| 8) Lack of veterinary service | 9) other specify_____ |

5.8. Which constraints that negatively hinder cooperative participation?

- | | |
|--|---|
| 1) Poor management | 2) lack of adequate milk collection centers |
| 3) Low milk production of local breed cows | |
| 4) Very high cost of improved dairy animal | 5) other specify_____ |

Thank you very much for taking your time!

Checklists for Key informant interview and Focus Group Discussion

Please note that your insightful answers are crucial in order to understand the overall assessment of Cooperative membership and its impact on smallholder's dairy farm income.

KII for agricultural office

- ✓ Is there available extension and training service regarding to dairy production in your district that is provided by your office workers?
- ✓ What is your responsibility to motivate dairy farmers to increase dairy production?

KII for cooperative leaders

- ✓ Establishment of the dairy Cooperative in year
- ✓ What are the activities done by dairy Cooperative
- ✓ Number of members per dairy Cooperatives
- ✓ What is the eligibility criterion for an individual to join dairy Cooperative?
- ✓ What are the major input / service supply and producer related services that delivered by the dairy cooperative.
- ✓ Is that any input cost difference between member and non-member?
- ✓ Do the members of your Cooperative satisfied with the services provided by the Cooperative? If not. Why?
- ✓ What is the main problem your Cooperative face?
- ✓ What is the main cause of the problems?

KII for experienced dairy farmers

- ✓ As a member of the dairy Cooperative, what are the new services that you get from your Cooperative as compared to before joining it?
- ✓ What is the change in your and your family's life after you a member?
- ✓ Do you get advisory services from extension agents on dairy cooperative?
- ✓ Is that the services provided by cooperative fulfill the members wish?

Questions for FGD

- ✓ What is your overall opinion for the role of dairy cooperative on dairy production?
- ✓ What are the factors influence dairy production and productivity in your area?
- ✓ Which you prefer dairy cooperative member or non-member? Why?
- ✓ Is there any dairy benefit difference b/n member and non-member in yield, price, market access, information, training, etc?
- ✓ What do you evaluate the achievements of dairy cooperative membership increasing yield as well as household dairy income?
- ✓ What do you advise others to be a member in dairy cooperative?
- ✓ What are the major challenges farmers not to a member for dairy cooperative?
- ✓ What do you think the solution for these challenges?
- ✓ What type of challenges do you face while dairy cooperative member?
- ✓ What do you think the solutions will be?