DETERMINANTS OF SMALLHOLDER FARMERS' PARTICIPATION IN IMPROVED SHEEP PRODUCTION: THE CASE OF DOYOGENA DISTRICT, KEMBATA TEMBARO ZONE, SOUTHERN ETHIOPIA

MSc. THESIS

BY:

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MSc. Thesis report

Submitted to School of Graduate Studies, College of Agriculture and Veterinary Medicine, Jimma University in Partial Fulfillment of the Requirements for the Degree of Master of Science in Rural Development and Agricultural Extension with specialization of Rural Development

Major Advisor: Daniel Temesgen (PhD)

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I have incorporated the suggestions and modifications given during the internal thesis defense and got the approval of my advisers. Hence, I hereby kindly request the Department to allow me to submit my thesis for external defense.

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We, the thesis advisors have verified that the student has incorporated the suggestion and modification given during the internal thesis defense and the thesis is ready to be submitted. Hence, we recommend the thesis to be submitted.

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Chair person, DGC Signature Date

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Chair person, CGC Signature Date

DEDICATION

I dedicate this piece of work to my lovely wife Ribika Samuel Siboro and my friend Abraham Abide Arficho for their unreserved love, encouragement and partnership during this study.

STATEMENT OF AUTHOR

By my signature below, I declare and confirm that this thesis is my own work and that all sources of materials used for this thesis have been duly acknowledged and I have followed all ethical principles of scholarship in the preparation, data collection, data analysis and completion of this thesis.

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BIOGRAPHICAL SKETCH

The author Mr. Teketel Mathewos was born on April, 1988GC at *Doyogena* district, *Kembata Tembaro* Zone, southern region, Ethiopia from his father Mathewos Dolebo and mother Amarech Kotiso.

He attended his primary education at Minatofa elementary school; and his secondary education Wachemo preparatory and secondary School. Then he joined Hawassa University, college of agriculture in the department of rural development and family sciences in 2005 and obtained B.Sc. degree in rural development and family sciences in July 2008. Soon after his graduation, he was employed as expert in *Doyogena* agricultural development office. Then in October 2016, he joined Jimma University School of Graduate Studies for a Master of Science study in rural development and agricultural extension (Specialization of rural development).

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LIST OF ACRONYMS AND ABBREVIATIONS

ADLI	Agricultural Development-Led Industrialization
CBIBS	Community Based Improved Breed Selection
CC	Contingency Coefficient
CSA	Central Statistics Authority
DA	Development Agents
DDANRO	*Doyogena* District Agriculture and Natural Resources Office
DDARDO	Doyogena District Agricultural and Rural Development Office
DDFEDO	*Doyogena* District Finance and Economy Development Office
DDLFO	*Doyogena* district livestock and fishery office
ETBr	Ethiopian *Birr*
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GOs	Governmental Organizations
Ha	Hectare
HH	Household
ILRI	International Livestock Research Institute
KI	Key Informant
ME	Man equivalent
ML	Maximum Likelihood
MT	Metric Ton
NGO	Non-Governmental Organizations
OMO	Type of Micro Finance

LIST OF ACRONYMS AND ABBREVIATIONS (Cont…)

OLS	Ordinary Least Square
PISP	Participating in Improved Sheep Production
NPISP	Not Participating in Improved Sheep Production
SNNPRS	Southern Nations, Nationalities and Peoples Regional Sate
Sta.dev	Standard deviation
VIF	Variance Inflation Factor

DETERMINANTS OF SMALLHOLDER FARMERS' PARTICIPATION IN IMPROVED SHEEP PRODUCTION: THE CASE OF *DOYOGENA DISTRICT, KEMBATA TEMBARO* ZONE, SOUTHERN ETHIOPIA

ABSTRACT

The practices of improved sheep production are getting importance but the participation of smallholder farmers in improved sheep production was below expectation and not specific studies to determinants of smallholder farmers' participation in improved sheep production were conducted. This study was conducted to analyze determinants of smallholder farmers' participation in improved sheep production in the study area. For this study multi stages sampling technique were used. Firstly, Doyogena district was selected purposively due to existence experience and its accessibility. Secondly, three kebeles were selected by simple random sampling and thirdly 144 survey respondents were selected by systematic sampling. Both quantitative and qualitative data were collected from primary and secondary sources. The methods of data collection were through survey, focus group discussions and key informants. Quantitative data analyzed by descriptive statistics like mean, frequency, standard deviation, range and inferential statistics of t-test and chi square (χ^2) as well as logit model were employed. Qualitative data which were collected from focus group discussions and key informants were analyzed through narration and used for triangulation of survey data. The result of the study indicated that out of the 144 samples, participants and non-participants were 51and 93 respectively. Determinants of participation which identified in this study area were household labour, age,, frequency of contacts with development agents, membership to cooperatives, land size owned, participation in credit and off-farm income. Participation in improved sheep production made significant impact between participants and non-participants households' income. In general, participation of smallholder farmers in improved sheep production influenced by different determinants. Future effort through effective policy should be intended to accelerate agricultural and rural development through effective utilization of improved sheep potential regarding smallholder farmers in study area particularly and in Ethiopia generally.

Key words: Determinants**,** Improved Sheep production, Logit, Household, Doyogena District, Ethiopia

1. INTRODUCTION

1.1. Back Ground

Ethiopia believed to have the largest livestock population in Africa and accounting for 55% from total agricultural share to national gross domestic product (GDP), 60- 85% of exports, 80% of the total employment as well as the raw material for domestic small- scale industries of this country (CSA, 2015). It is used for food, input for crop production and soil fertility management, raw material for industry, cash income, saving, fuel, social functions and employment (Edea *et al.,* 2017).

Population pressure leads farm sizes to decrease; simultaneously the role of large ruminants reduces and has become substituted by small ruminants due to their less competition for arable land (Varga *et al., 2016*). As compared to large ruminants sheep require small investments, have shorter production cycles, faster growth rates and greater environmental adaptability, and hence have a unique place in smallholder (Desta *et al.,* 2017).

According to Lakew *et al. (*2018), sheep in Ethiopia have a multipurpose role for smallholder farmers as sources of income, meat, skin, manure and long hairy fleece. Thus, increasing the current level of productivity of sheep is essential to meet the demands of the increasing human population.

On the other hand, by improving the productivity of sheep and export earnings can enhance the income of household (Gizaw *et al.,* 2018). The study done by (Gowane *et. al,* 2017) confirmed that sheep are relatively resilient to higher temperatures compared with other livestock and the increased temperatures because of climate change would bring about increasing numbers of sheep.

Sheep production gives security in times of crop failure, they are expected as “near cash” capital stock (Brown *et al.,* 2017). Similarly, (Ahmed, 2016) insists to that sheep enterprise in Ethiopia is source of cash income e and provides social security in the bad crop years. Moreover, in Ethiopia, the sheep provide almost 15% of fresh skins and hide production and 72% of semi processed skins and hides export trade (Tindano *et al.*, 2017). The annual mutton production of the country is estimated at 78,000 Metric Ton (MT) (Gebrehiwot, *et*

al., 2017). Sheep is important to small holder farmers especially for poor and women who are often the most vulnerable members of the society in terms of food security and poverty which contribute to cash income generation (Oladunni and Aduba, 2014).

According to CSA (2017), survey in Ethiopia sheep potential is very high, 30.70 million sheep are estimated to be found in the country, out of which about 5,087,007(17%) found in SNNPR, and from 5,087,007 around 109, 732(2.2%) are found at *Kembata Tembaro* zone and from 109,732 about 32920 (30%) found in *Doyogena* district. This zone is known by mixed farming which has high potential for both crop and livestock production. The district's land' ecology is mostly high land area. In Ethiopia high land areas believed to be potential for sheep production (Dagnew *et al.,* 2017).

The practice of improved sheep production are getting importance but the participation of smallholder farmers in improved sheep production was below expectation in study area and the study did not show why participation is limited and what factors limit participation of the smallholder farmers in improved sheep production (DDLFO, 2018).

Therefore, this study was aimed and conducted to identifying determinants of smallholder farmers' participation in improved sheep production in the study area and the study designed to use binary logistic regression model to analyze determinants of farmers' participation in improved sheep production.

1.2. Statement of the Problem

Ethiopian national sheep production program aimed to improve production per head of sheep instead of keeping very large number of unproductive sheep that contributes to land degradation, feed scarcity and consuming large resources (Tibbo *et al.,* 2016). In spite of, the well adapted and large population of sheep, the current level of productivity and participation in improved sheep production of smallholder farmers is low and the country is not able to achieve the expected amount of benefit from sheep production due to various reasons (Kassa *et al.,* 2011).

Sheep primarily kept for cash generation purpose where uncertainty of rainfall is observed and where poor are involved in owning and keeping it for immediate income generation (Lakew *et al.,* 2017). Sheep use as a source of income to have agricultural inputs, reducing risks associated with crop production in mixed farming system, generating employment, means of saving and capital (Gebrehiwot *et al.,* 2017).

A lot of smallholder farmers' sheep production improving programs were employed in southern, nation, nationalities and peoples of Ethiopia. However, the participation of smallholder farmers' in improved sheep production is still under questions and determined by different influencing factors (CSA, 2013).

As studies in *Mareko* district, *Gurage* zone dealt that farmer's decision to participate in improved sheep production determined by the combined effects of a number of factors such as lack of access to improved breeds, age, socio economic (membership of cooperative, land size, farm income, labour) and institutional factors like access to animals' health services, credit utilization distance from kebele center and extension contact (Tesfaye *et al.,* 2017).

Moreover, the study conducted (Lakew *et. al,* 2017) in *Wolayita* zone described that there is less productivity and smallholder farmers' engagement in improved sheep production. This is due to determinants such as membership of cooperatives, land, sex of household head, distance from near market, frequency contact with development agents and environmental factors besides the institutional, environmental and infrastructure challenges.

The District is known in potential of sheep including improved breed production for due to existence of experiences of community based improved breed selection since 2013 and scale upping program, however, the smallholder farmers' participation was 30% out of 10,171 households in the district (DDLFO, 2018). This implies that the smallholder sheep producers in the study area did not get appropriate benefit from this production.

A few studies conducted regarding sheep production in study area but not specific to describe the determinants of smallholder farmers' participation in improved sheep

production in the study area. For example, the study conducted by (Getachew *et. al,* 2015) and (Gizaw *et. al,* 2014) not focused on identifying the determinants of farmers' participation in improved sheep production.

Even though there is a tremendous and continuous effort made by agricultural development workers and researchers, participation in improved sheep production has not reached to the required level. Hence, analyzing the determinants by involving and participating farmers in the study can help to get reliable information that can be useful to facilitate and fasten the production and productivity of improved sheep as well as identifying and intervening negative determinants of participation of smallholder farmers.

Therefore, this study was designed and conducted to fill the existing gaps in technology adoption, by focusing on the determinants of smallholder farmers' participation in improved sheep production through survey, key informant and focus group discussions methods.

1.3. Objectives

1.3.1. General objective

To analyze determinants of smallholder farmers' participation in improved sheep production, in *Doyogena* district, *Kembata Tembaro* Zone, Southern Ethiopia

1.3.2: Specific Objectives

1. To analyze determinants of smallholder farmers' participation in improved sheep production
2. To investigate impact of participation in improved sheep production on smallholder farmers' income

1.4. Research Questions

1. What are determinants of smallholder farmers' participation in improved sheep production?

2. Do participations in improved sheep production have impact on income of smallholder farmers?

1.5. Significance of the Study

The study conducted to analyze determinants of smallholder farmers' participation in improved sheep production, it is crucial to provides research based information that can be used to take effective measures, design and implement appropriate strategies which help to develop income of smallholder farmers. The finding of this study can help as a spring board to examine farmers' participation in improved sheep production in the area with amendment to direct issues.

1.6. The Scope and Limitations of the Study

Due to time and resource constraint, the study was limited only to *Doyogena* district, *Kembata Tembaro zone*. Even if, the determinants which affecting participation are wide, this study emphasized only on thirteen potential determinants influencing participation of smallholder farmers in improved sheep production such as sex of household head, age of household head, education level of house hold head, distance from *kebele* center, access of animals' health services, membership to cooperatives, participation in credit, size of land, farm income, off farm income, household lobour, frequency of contact with development agents, and distance from near market center.

Study specified to only in three *kebeles* by including 144 survey respondents at household level. This study may not be free from these limitations, where as to mitigate these problems as much as possible it was tried to convince farmers individually and collectively about the objectives of the study.

1.7. Organization of the Thesis

The rest of this thesis was organized into five chapters. Chapter two dealt with review of the literature that includes definition of important terms, theoretical, empirical studies on determinants of improved sheep production participation and conceptual framework. In chapter three, brief description of descriptions of the study area and research methodology are presented. Results were discussed in chapter four. Finally, chapter five presents the conclusions and recommendations of the study.

2. LITERATURE REVIEW

2.1. Concepts and Definitions

Domestic "small ruminants" are sheep and goats which are relatively easy to own by resources poor farmers. It is feasible because of the high reproductive rate, lower generation interval and risk inherent in agricultural production. Sheep production is typically small-holder farmers' activity attracting minimum investment for housing, feeding and health care (Gebremedhin *et al.*, 2015).

There is no internationally agreed upon definition of the term “smallholder livestock producers" is often used interchangeably with subsistence and family farming or with resource poor, low income, low external input, low output or low-technology usage (FAO, 2009a).

Adoption of improved sheep can be used interchangeably with term of participation in improved sheep production which defined by Miller (2018) is the decision-making process for new technology practice in which an individual passes from first hearing about an innovation to final adoption. Adoption is either at farm level (individual) or at aggregate level. Adoption of improved sheep at the individual's level is defined as the degree of use of improved sheep in the long-run equilibrium when the farmers have full information about the improved sheep production and its potential uses whereas, aggregate adoption (participation) in improved sheep is measured by the aggregate level of use of improved sheep within given area or within a given population.

2.2. Theoretical Review

2.2.1. Sheep production habit in Ethiopia

The nation’s Agricultural Development-Led Industrialization (ADLI) strategy aimed at to achieve sustainable food security and poverty alleviation, creating an enabling policy and institutional environment and accelerating the generation and adoption of productivity-

enhancing technologies and linking to the market are the primary focuses regardless of livestock production (Sudhir and Talukdar, 2015)

Higher numbers of sheep are found in the highland areas of the country (CSA, 2011). The production systems in most highland areas are characterized by erratic and unevenly distributed rainfall, recurrent drought, and scarcity in livestock feeds and feed that is poor in quality (Bogale *et al.*, 2008).

2.2.2. Intensification of sheep production systems

The income growth and population dynamics, urbanization and changing patterns of consumption have led to a dramatic increase in the consumption of animal products in the developing world (Seré *et al.,* 2008). The increased demand for animal products is the driving force for changes in livestock production systems including sheep (Tarawali *et al.,* 2011).

In harsh production environments where crops will not flourish, livestock keeping is often the main or only livelihood option available (FAO, 2010). Although, in the Ethiopian highlands the role of sheep in supporting the livelihood of smallholder farmer has increased due to recurrent crop failure, they are still managed under the traditional extensive systems with no or minimal inputs and improved technologies (Yeheyis *et al.*, 2004), which results in characteristically low productivity. The potential of sheep in those areas as an important source of cash income is not utilized adequately due to the shortage of feed, which results in a prolonged period to reach marketable weight and poor body condition at marketing age (Ayele *et al*, 2006).

Smallholders typically rely on wandering traders or weekly markets to sell their stock and may often have poor bargaining power, leading to low price (McDermott *et al.,* 2010), thus improving sheep marketing system is essential (Gizaw *et al.,* 2010a). Indigenous sheep genetic resources have evolved largely through natural selection and developed specific adaptations to the existing harsh environment, which make them suitable for use in the traditional, low-input production system (Gizaw *et al.*, 2008a).

Feed shortage is one of the limiting factors for increasing production and productivity of small ruminant in most of the agro-ecological zones in Ethiopia (Mekoya, 2008). The sheep in the smallholder area depend on natural pasture and fibrous crop residues for their survival, growth and reproduction. The available natural pasturelands are overloaded with livestock beyond optimum carrying capacity resulting in overgrazing (Dejene, 2003).

2.2.3. Role of sheep production

In many developing countries, livestock are important asset of the poor, providing livelihoods under conditions where other enterprises fail (Rekik *et al.*, 2017). The poor usually keep more than one species, preferring to diversify and take advantages of the different types of roles each species can play for the household (Fitzpatrick, 2017). Sheep are widely distributed and adapted to a wide range of environmental diversity (Banik *et al.*, 2015). They have short generation cycles and high reproductive rates, which lead to high production efficiency (Martinez *et al.*, 2015). According to Mueller *et al.* (2015), sheep (similar to other classes of livestock) have diverse roles in the livelihood strategies for smallholder producers. On the other hand, sheep are being used as coping strategies to resources challenge situations for agricultural production.

2.2.4. Sheep production system

The performance of the livestock sector in Africa has been poor due to failure to design projects and technologies widely applicable to the problems commonly tackled (Amare *et al.*, 2018). This basically determined from failure to understand the situation of the smallholder farmers. The knowledge of the factors which influence production decisions at the farm level has been inadequate. Description of the production systems is useful in the design of development strategies, in particular for identifying target populations and priorities and opportunities for development (Hintsa *et al.*, 2018). Attempts to improve the current animal husbandry systems in the rural settings necessitate better understanding of the components of the production systems and its operations, the current limitation, potentially feasible improvements and the opportunities to develop more productive system (Negewo *et al.*, 2018).

A detailed comprehensive database on traditional smallholder animal enterprises, aspects of the household, animal management and husbandry practices, the constraints to production and the interaction of animal farming with other farming activities would help to identify the major gap to be filled by research, extension and other animal development projects (Mahajan,2016). Development strategies should be geared to address farmers' real problems and constraints to help them expand their production and attain self-sufficiency. This, in turn, requires careful and detailed analysis and understanding of farmers' circumstances and practices before carrying out development activity (Tadesse *et al.,* 2014).

Livestock production system and potential for increased production by livestock species in varied areas differ markedly due to differences in resources contribution, climate, population, disease incidences, level of economic development, research support and government economic policies. Different systems of sheep production exist, including subsistence, extensive and intensive where the number of sheep kept is often a helpful factor that indicates the type of system (Llonch *et al.,* 2015).

In Ethiopia, sheep are maintained under two broad production systems namely, mixed crop-livestock farming system by subsistence farmers (agro-pastoral) and pastoral system (Gori Maia *et al.,* 2018). Under the mixed crop-livestock farming system that is practiced in the central highlands of Ethiopia, sheep depend mostly on grazing fallow lands, overgrazed natural pasture and crop residues usually with no extra-supplement and receive minimum health care, where the level of interventions in the areas of extension support is minimal.

Subsistence farmers usually keep small number of livestock and manage to use whatever feed resources are available at village level. Under the extensive production system, sheep graze and browse large areas of land that are usually of a marginal nature, and unsuitable for other agricultural use usually because of low or unreliable rainfall (SMohamed, 2016). On the other hand, in the intensive systems of sheep production, they have limited fed with cut grasses and industrial by-products accompanied by careful health care. Commercially sheep are not often intensively managed; instead, they are raised in small flocks,

particularly for fattening purposes (Varga *et al., 2016*). Mueller *et al.* (2015) on the other hand, under the agro-pastoral and pastoral production system, sheep production are associated with largely on rangelands, using natural vegetation. The subsistence oriented livestock productions that include sheep of smallholder farmers in Ethiopia are low in productivity (Liao, 2018).

Feed shortage can reduce the productivity of small ruminants through prolonging lambing/kidding interval, age at first lambing or kidding, reduced growth rate, reduced weight gain and reduced resistance to diseases (Gebre *et al., 2014*). A reliable supply of water is necessary for all sheep in a hot climate whereas they do not want to drink water in cooler climate and when feed on moist green vegetation (Gordon, 2017). Hence, to improve the productivity of sheep through improving the feeding system, the extension services delivery need to act on the promotion of techniques such as over sowing of productive grasses and legumes on pasturelands, planting fodder trees, manure application on grazing land, and hay production (Gurmessa *et. al,* 2015) and supplementation with crop residues and mineral salts are vital (Adesoji *et al,* 2016).

Breeding and selection practices in sheep with poor genotypes fail to produce adequately, even in environments where feeds are available, diseases can be controlled and management is satisfactory (Elhaj, 2017). In many countries in Sub-Saharan Africa, priority has not been given to identifying production traits among indigenous farm livestock and establishing sustainable livestock improvement programs (Gororo *et al., 2018*). Under the management conditions existing in the smallholder production system, selection within the indigenous breed seem better means of improvement than importing exotic germ-plasm (Leroy *et al., 2016*). Selection for body size, weight gain, weaning rate, adult weight and body conformation are important traits Gebre *et al.,* 2014). Selection for these traits could be manageable by a farmer's skills and indigenous knowledge and the technical advisory services they get from extension personnel.

Study conducted by (Fikru and Gebeyew, 2015) described that there is important luck in Ethiopia started to produce sheep currently. Like modest interventions on the existing flock

obstacle, such as minimizing flock loss through focusing on diseases and parasites control and proper feeding during dry seasons could potentially boost the flock performances.

Molecular characterization based on the traditionally recognized populations using micro-satellite exhibited. Indigenous sheep and goat genetic resources have developed specific adaptations to survive and produce under adverse local environmental conditions and to perform better under low input system (Zewdu *et al., 2015*). As a result, they are suitable to be used in the traditional, low external input production system (Haas *et al., 2016*). Akale *et al.* (2017) there is a need for exhaustive characterization of the existing genetic resource as the presence of sizeable genetic diversity in the country. A report oppositely indicated that sheep are distributed in the lowlands in similar proportion to the highlands that deviates from previous reports of larger distribution of small ruminants in the highlands (Abebe and Sisay, 2015).

The difference was due to variability in resources availability, climate, population, disease incidence, level of economic development, research support and government economic policies (Dagnew *et al., 2018*). Regarding factors associated with policy issues, despite the strategic importance of livestock including sheep reported on policy challenges; for instance, agricultural planners have had difficulty in understanding the complexity of livestock production systems and how these systems function with respect to quantification and comprehension and reported the result as ignoring potential development opportunities, particularly the potential for using livestock as a catalyst to derive agricultural development at macro level and diversification of livelihood means at households level (Weldegebriel, 2015).

2.2.5. Sheep marketing

Marketing includes moving products from producers to consumers and comprises exchange activities of buying and selling, the physical activities designed to give the product increased time, place and form utility, and the associated functions of financing, risk bearing and dissemination of information to participants in the marketing process (Kenfo *et al., 2018*). Sheep marketing involves the sale, purchase or exchange of products such as live livestock, and products such as milk, meat, wool and hides for cash or goods

in kind (Mutua *et al., 2018*). The ultimate goal of interventions aimed at enhancing productivity of sheep needs to consider the market aspect simultaneously (Meshack, 2015). Farmers need to be aware of the preferred characteristics of livestock as well as price patterns so that they can plan breeding and fattening programmes and breed selection consistent with the best seasonal prices and consumers' preferences (Asante *et al., 2018*).

Alleviating constraints to the export market and domestic trade and market structure increases the welfare of smallholder producers, urban consumers and improves the national balance of payments (Cafer and Rikoon, 2018). Population growth, urbanization and income growth increases need in meat and milk consumption and create actual livestock revolution. This revolution presents new and expanding market opportunities for smallholder livestock producers (Salmon *et al.*, 2018). Potential production and market opportunities for small ruminant meat have not been exploited because of limited knowledge of small ruminant demand patterns. An important aspect of production and its response to demand and supply is knowledge of markets and marketing systems. To shift production from subsistence to a more commercial outlook is especially important to describe and intervening aspects of marketing infrastructure and facilities, market channels and outlets, buyer preferences for live livestock and their meats, major market players, government intervention and role of the private sector (Dejene, 2017).

2.2.5.1. Structure and performance of sheep markets

Livestock markets are generally under the control of local authorities. Market locations in primary and secondary markets are usually not fenced; there are no permanent animal routes. Yet buyers and sellers are subjected to various service charges by the local authorities as well as other bodies (Nigussie *et al., 2017*).

Market information is crucial to producers, wholesalers and consumers to help them make decisions on what and whether to buy and sell. In general, information is required on prices, traded or available quantities, forecasts of future supplies and demand, and general market conditions. Information must be relevant, accurate and timely and reflect all sectors

of the market, especially consumer demand. Nearly in all parts of the country, there is no regular market information on prices and supplies, nor formalized grades and standards of sheep and goats as well as other livestock. Markets are dispersed with remote markets lacking price information. Generally, sometimes there is excess supply of livestock beyond demands which effectively contain producer prices. Hence, the more mobile trader is better informed on market prices, while better information combined with excess supply places the trader in a better position during price bargain (Worku *et al.,* 2017).

Livestock are generally traded by bargaining and weighing (it is uncommon) livestock. It sold on a per-head basis and price agreement reached by a long one-on-one bargaining between a seller and a buyer. Under such circumstances, prices paid will reflect buyers' preference for various animal characteristics (weight, sex, age, condition, breed, and color), the purpose of livestock purchased (for resale, slaughter, fattening or reproduction), the season of the year (occurrence of religious and cultural festivals) and the bargaining skills of buyers and sellers (Baye, 2017).

Marketing of sheep is characterized by strong seasonality and subject to fluctuation due to festivals and supply conditions. It is essential to consider linking production, products and by-products to markets in the context of the production to consumption systems in the 'food or commodity system framework' or commodity production and marketing chain (Snow *et al.,* 2018).

2.3. Empirical Review

2.3.1. Determinants of Participation in Improved Sheep Production

Similar to the other production activities, the decision to production of sheep can be affected by the existing social conditions, the economic holdings of producers and the prevailing economic and institutional circumstances producers. Size of land holding in farming households can serve as means of expanding wealth and diversifying income in addition to being source of feed input for livestock production (Mueller *et al.,* 2015). Producers to expand production and supply they need attractive market. That means

accessible and improved price is major determinant to decide for sheep production (Legese *et al*., 2014).

According to Feleke *et al.* (2016), the low performance of the sheep production participation may be recognized due to under developed rural infrastructure and absence of rural financial institutions that facilitate rural economic development. Access to credit is an important institution for all sectors of economic activities including the smallholder producers where credit challenge not only affects the purchasing power of farmers to procure farm inputs and cover operating costs in the short run, but also their capacity to make farm-related investments as well as avoiding risk behavior in technology choice and adaptation. On the other hand, in the presence of financial institutions, some farmers can have access to the formal and informal credit sources while others may not have due to problems related to repayment and down payment (Debela, 2017).

Extension and research systems that encourage participation of the producers, ensuring their needs are heard and their knowledge respected (Guo *et al.,* 2015). According to Siddo *et al.* (2018), the principles and facts (which answers why questions) and the skills (answers how questions) that can address the types of knowledge such as the biological processes, the management practices, new technology introduced, the market prices and trends and institutional processes as well as requirements. The extension services are expected to address this knowledge for improved production and productivity (Mezgebe *et al.,* 2018). Provision of extension in developing services, feed development and effective breeding are the major challenges in developing countries of the tropics reported that extension is often the weakest link in the chain of flow of information in agricultural research to the farmers (Gordon, 2017).

The growth of population together with urbanization results in a significant demand for animal sources. As a result, recently, the demand for feeds of animal origin is increasing (Maleko *et al.,* 2018). Similarly, many small ruminant genetic improvement programs in developing countries have not been very successful may be due to failure to perceive the multidirectional aspect of the problem; for instance implementing genetic improvement programs without taking into consideration other vital needs of the farmers (Zonabe and

König, 2016). Age influences participation of farmers in technology implementation negatively. Old aged peoples assumed to have fear risk and conservative behavior (thought); therefore, age would negatively contribute to the implementation of improved agricultural technologies (Tahir *et al.*, 2018).

According to Muller *et al.* (2015), the peasant household is the main source of labor for all types of farming and livestock production activities undertaken where the demand for labor could vary among seasons per the farming calendar of producers and school attendance of children. The total number of family members in a household is important for availability of economically active labour. It was observed that the relation between intensity of adoption decision of respondents and their family size is strongly and positively related. The size of family with respect to the availability of total labor in the households and the difference between non-participants and participants is significant. The study result implies that adopters do have more labour availability than non-adopters and more family size will encourage the intensive use decision of fattening package (Negassa *et al.*, 2017).

Education is the major demographic characteristic explanatory variable that differentiates adopters and non-adopters in all adoption studies. Farmers who educated are generally more open to innovative ideas and new technologies that will promote technical change had cited many adoption studies that show education as one of explanatory variable significantly and positively affecting adoption decision of individuals. According to Wang *et al.* (2018), pointed out that feed availability, lower educational level has effect on sheep productions therefore; all family members can be involved in their daily practice. The low level of educational achievement is attributed to less number of basic primary school coverage in the study area in general, their pattern of production in which herding animal flocks in grazing lands and pastures is the major responsibility of children at early age of schooling during which they heard the animal flocks in the grazing land or pasture (Kebebe *et al*, 2017).

Many studies have shown that women have important labor roles in animal production. However, male-headed households are able to avail a greater number of meals to their flock due to these reasons correlations indicate that the highest sheep-stocking rate

undertaken by male headed household (Taylor *et al., 2018*). The other determinant in improved fodder production is experience of house hold; this implies a number of years since he/she has started improved fodder operation. Moreover, farmers with longer improved fodder production experience are expected more knowledgeable and skillful (Akanbi and Ondari, 2018). When been experienced on producing improved fodder type on the grazing land/backyard they can encourage participating in improved sheep production. According to Gebrehiwot *et al. (*2017), households having experience of producing improved fodder type on the grazing land/backyard they can be encouraged on participating in improved sheep production.

There is growing evidence that the major factor explaining low adoption of technology in Africa is due to lack of appropriate institutional and policy support (Strategy, 2018). As reported by front line adoption of improved technologies is strongly affected by the policy environment like input supply, market, credit, price policies, health service and improved technology supply system. Poor linkage between research and extension, high cost, low return, inappropriateness of technologies, lack of credit facilities, the prevalence of animal diseases, absence of transport and marketing infrastructure are some of problems affecting diffusion of technologies (Fentaw, 2017). Farmers' adoption of crossbred technology depends positively on his access to credit (Dill *et al.*, 2015). The findings Kebebe (2015) show that credit has positive and significant influence on agricultural technology adoption.

A study by (Luyombya, 2014) confirmed those farmers' characteristics such as participation in training (field days and demonstration, attendance at workshops and seminars and contact with extension) has significant influence on perception and thus agreement to participate farmers. Communications in extension, which seeks to provide knowledge and information for rural people to modify behavior in ways that provide sustainable benefits to them and society in general (Gedefaw, 2017). Chen (2018) considered that the main purpose of extension systems should be to assist potential participants to place implementation assessment in context. The decision to participate, or to adopt an innovation, is considered to be an information-seeking-and–processing activity where individuals are motivated to reduce uncertainty about the advantages and disadvantages associated with a new practice (Ugochukwu and Phillips, 2018).

Cooperative is one of social factor serve as an important source of rural credit and producers who are members of cooperatives are likely to get inputs and production information and thus can participate and supply the products to the market than those who did not participate**.** Risk and uncertainty have been discussed in previous empirical studies as hindering technology (Lamuno *et.al,* 2018) has shown that total agricultural production and non-farm income has significant effect on the adoption of crossbred dairy cows in his study area.

2.3.2. Impact of participation in improved sheep on income of smallholder farmers

The impact of improved sheep production on farm income of smallholder farmers and households' social and financial security are well established in literature. Sheep have a number of advantages for being an integral component of the agro-pastoral production system. The small size of sheep has distinct economic, managerial and biological advantages. Economically, there is small initial investment and correspondingly small risk of loss by individual deaths. Managerially, they are conveniently cared for by women and children, occupy little housing space, lower feed requirements, and supply both meat and milk in quantities suitable for immediate family consumption (Oluwatayo, I.B. and Oluwatayo, T.B., 2012).

Moreover, sheep are kept for a variety of economic reasons including savings and investment, security and insurance, stability, and social functions. Sheep appear to withstand drought better than cattle, and their short reproductive cycle allows them to quickly recover from rapid resumption of breeding following drought or devastating disease infestation. The role of sheep as a continuous source of protein during and immediately following a period of drought is one major reason for making them the most important component of livestock in agro-pastoral and agro-agro-pastoral production system (Wilson, 1991).

In contrast to large ruminants like cattle which are normally concentrated and remain in the hands of a restricted number of producers (high income rural households), sheep are dominant in almost every low income rural household (Takele, 2016).

Because of their small size, sheep provide more convenient sources of meat than cattle as shown by. It is generally more suitable to slaughter a sheep than a large animal such as a cow to feed community members engaged in communally private fieldwork. Also, sheep provide cultural and economic benefits for households Turner *et al.*, 2017.

Sheep are also kept by poor rural households for ready cash income to meet immediate needs such as acquiring agricultural inputs, paying school fees and purchasing larger animals such as cattle. This is because rural households find it easier to find a buyer for a goat or a sheep than a cow. More importantly, sheep play a key role in stock association building between members living in the same community in rural areas (Mengesha, 2016).

Small ruminants consumed only 7% of the average total capital invested in livestock in the mixed crop-livestock production system, but they account on average for 40% of the cash income and 19% of the total value of subsistence food derived from all livestock production. Sheep contribute a quarter of the domestic meat consumption; about 40% of fresh skins and 92% of the value of semi-processed skin and hide export trade. It is estimated that 1,078,000 sheep and 1,128,000 goats are used in Ethiopia for domestic consumption annually. There is also a growing export market for sheep and goat meat in the Middle Eastern Gulf States and some African countries. Ethiopia can export 700,000 sheep and 2 million goats annually, and at the same time supply 1,078,000 sheep and 1,128,000 goats for the domestic market (Amejo *et al.*, 2018).

It is likely that smallholder farmers are mainly targeting small ruminant for market rather than using for meat purpose which nowadays restricted to holidays or especial occasions. It was reported that a total 14 million sheep and 13 million goat skins produced annually from which 95% of the sheep and 70% of the goat skin is recovered at the market. During 1995-1996 the export value of sheep/lamb skins amounted to be about 82 million US$ (Nwogwugwu *et al., 2018*). Live livestock are also exported to Middle East countries and sources for foreign currency; for example at 2009 Ethiopian gain 11.3 US$ dollar from livestock; 15-17 % of livestock sector was from sheep and goat. Due to its peculiar characteristics to grow fast, short reproduction cycle and better morphology improved

breed enable producers to get improved income compared to non-participants (Abebe, 2015).

2.3.3. Challenges of Sheep Production

The major challenges of sheep production are drought, land shortage, lobour shortage, lack of awareness, lack of credit and occurrence of disease that affects sheep production and productivity. Feed shortage is one of most important constraint of sheep production it may raise when drought prolonged for long period and rainfall has been under average (Hintsa *et al.,* 2018). Livestock weight loss can be occurred due to less nutritious feed. This low body weight leads production decrease due to decrease maturity rate, extended lactation and large calving interval and absence of twin birth (Lakew *et al.,* 2018).

Improvement in housing of sheep can make a better environment for production and management easier. The type of housing depends on the system of production for instance sophisticated housing are found only in intensive unit where the high capital investment and high level of production, the common type of housing is simple shelter (Mohapatra *et al., 2018*). Challenges like: shortage lobour, and grazing land, diseases and parasite condition; new input technology access; extension support and credit access influencing the production of sheep at high land areas of Ethiopia (Gebreyowhens *et al.,* 2018).

In central highland of the country, small ruminant production is characterized by low productivity due to most important challenges like feed stress, pneumonia, eye disease and internal and external parasites (Simoni *et al.,* 2017). Infectious diseases, internal and external parasites are threatening sheep production similar to other classes of livestock through increased morbidity, mortality, slow growth, low fertility and decreased output in Sub-Saharan Africa which has been estimated at loss of US$4 billion (Thornton *et al.,* 2018).

The most common internal parasites of sheep are roundworms, tapeworms, liver fluke and lung worms and the most commonly types of external parasites of sheep are ticks, lice and mites and flies. These parasites can be controlled by spraying insecticides or dipping and the humid tropics are ideal places for the high production of larvae because of the rainfall

and humidity while in more arid areas; roundworms can be less problematic as high temperatures on the pastures kill both eggs and larvae. It is after and the rains before next rain start that worms may become a severe problem in these semi-arid areas (Gordon, 2017).

According to Ibidhi and Salem (2018) there are three general categories of challenges used here include: Ecological: land, climate; Biological: water, feed; livestock, livestock nutrition, health, parasites, and predators; livestock genotype-production and adaptation traits as well as socioeconomic: labor availability and management skills; consumer taste/preference and disposable income; credit availability and cost; marketing infrastructure; and policies of trade, prices, and land tenure.

Land shortage and climate inconsistency are primary ecological challenges of the plant species that can be grown and, in turn, of the livestock species that can be produced in an ecosystem. Constraints that impact on livestock production are: land (topography and soil fertility) and climate (rainfall, temperature, and growing season). Of these, only soil fertility is readily amenable to change, and only if required nutrients can be applied economically (*Dagnew et al.,* 2017).

Biological challenges; less nutritious feed supply is the most determined constraint to livestock production. It is directly dependent upon the production of plant biomass, both in grazing and crop/livestock systems. It is an absolute requisite that must be treated in the broadest context, including native and improved pastures, forage crops, feed crops, crop residues, and by-products. Feed supply has both quantitative and qualitative dimensions. Quantity can be increased by the proper stocking of rangelands, the establishment of improved pastures to complement native pastures, the planting of forage crops, soil and water conservation practices, and the timely harvest and storage of crop residues. Quality relates to the overall nutrient adequacy of pastures, forages, and other feeds consumed, as well as the means to correct any deficiencies through improved pasture management, fresh cut and stored forages, and/or supplementation (Ventura-Cordero *et al.*,2017).

Seasonal fluctuations in feed supply can be a special problem, especially in the wet/dry seasons. Whereas feed may be abundant in the rainy season, inability to preserve this abundance leads to dry-season deficiencies. The impact of these shortages in constraining the higher potential reproductive efficiency of sheep and goats is critical to the economics of investing in cropping/forage systems to provide feed and in preserving and enhancing the digestibility of roughages commonly found on small farms in the tropics and sub-tropics Nigussie *et al.,* 2015).

Health problems: Constraints imposed on sheep and goat production by diseases, parasites, and predators are substantial and highly visible. Substantial progress has been made in technology for prevention and treatment of animal health problems. However, the means to deliver this technology is frequently lacking in developing countries where health officers are in short supply, roads are poor, and producers are wary of government programs. Small ruminant health problems in the developing countries fall into the broad categories of: Lowered resistance caused by poor nutrition leading to death from disease, parasitism, or accidents that might otherwise have been avoided (Biffa *et al.,* 2006).

Genotype: It is most important challenge in sheep and goats' production in developing countries, genetic potential for adaptation takes preference over improved productivity. Often there may be negative genetic correlations between traits for adaptation and production (Hayes *et al.,* 2012).

Socio-Economic constraints are focused at the producer or organizational (e.g., cooperatives, marketing agencies) level in sections dealing with major economic and social variables which influence small ruminant numbers and productivity as well as institutional and policy constraints are noted (Sparrow and Traore, 2017).

Policy and institutional environment: Despite the potential, the livestock sectors in many African countries are generally characterized by an absence of effective enabling policy and institutional environment, leading to sub-optimal levels of productivity, supply and competitiveness, and limited market orientation. A lack of policies and support facilitating private sector involvement in key areas of animal health, genetics and breeding, and land

use for livestock-related value chains have constrained development of the sector, particularly access to land for the production of feeds and forages (Kebebe *et al.,* 2015).

2.4. Conceptual Framework

The conceptual framework for this study was mainly based on determinants of smallholder farmers' participation in improved sheep production. There is a general consensus with idea of literatures, advisors, experts and researcher experiences those differences determinants of HHs' participation in improved sheep production. Selected determining factors which are similar with study of (Gebremedhin *et al.,* 2015; Tesfaye *et al.,* 2017 and Lakew *et. al,* 2017) such as sex of house hold head, age of household head, education level of house hold head, distance from *kebele* center, access of animals' health services, membership of cooperatives, participation in credit, size of land in hectares, farm income, Off farm income, household lobour, frequency of contact with development agents, and distance from near market center.

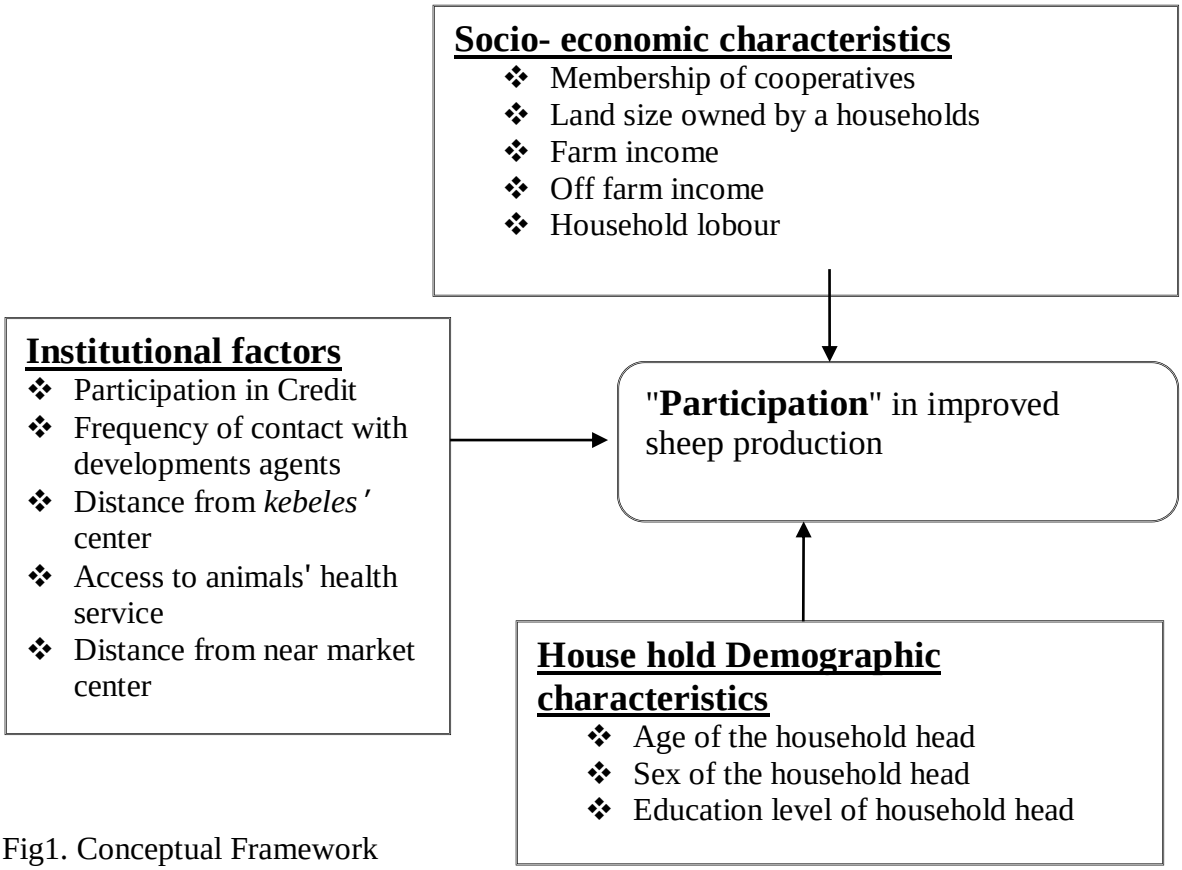

Fig1. Conceptual Framework

(Source: Developed after reviewing literature, 2018)

3. RESEARCH METHODOLOGY

3.1. Description of the Study Area (*Doyogena*)

Doyogena is one of District found in *Kembata Tembaro* zone, Sothern nation, nationality and peoples region which is high land area. It bounded by *Angecha* district by eastern direction, *Lemo* district by North, *Duna* district by West direction and *Kachabira* district by south direction. The area is about 258 k/m Addis Ababa in south direction and 171 km south west of Hawassa. It constituted of 13 rural and 4 urban *kebeles*. The district found mostly high land agro-ecological zone and its altitude ranges from 1900– 2800 masl. Annual rainfall is 1200- 1800 mm and the mean temperature varies 10 to 18°C (DDANRO, 2017).

The total population of district is males 56863 females 59185 and total 116,048 from this number total households' heads are male 8228 (80.9%) female 1943 (9.1%) total 10171. The district is much potentiated in sheep production and total number of sheep 32920 out which 10534 was improved. Majority of population dependent on mixed agriculture and in PSNP as well as few populations are dependent on petty trade, civil servant and daily laborer. The 60% of HH income was from crop production while 40% comes from livestock production from this share 19% comes from sheep and 21% from other species (DDFEDO, 2017).

The total area of the district is 18,091.34 ha, which comprises cultivated land 12,248.6 ha (67%), forest land 3573 ha (20%), grazing land 1110 ha (6%), degraded land 435 ha (2.5%), swampy land 358.33ha (2%), potentially cultivable land 202.4 ha (1.5%) and others 164.01 ha (1%).The maximum, average and minimum land holding per household is 3.5ha, 0.75 and 0.35ha, respectively and with an average family size of 5 members (DDARDO, 2012).

The major crops produced in the area include wheat, potato, fava bean, *ensete*, berly, haricot bean, and field pea and *teff* also different types of livestock reared, in this area. Major proportion goes to cereal crop production particularly for wheat production followed by *teff* production. In the study area, there is a very serious grazing land scarcity, greatly

affecting the livestock production, resulted from high population pressure and extended farming practice that shrinks grazing land and compete with livestock production. The farming society in the study area used crop by product for animal feed (DDARDO, 2012).

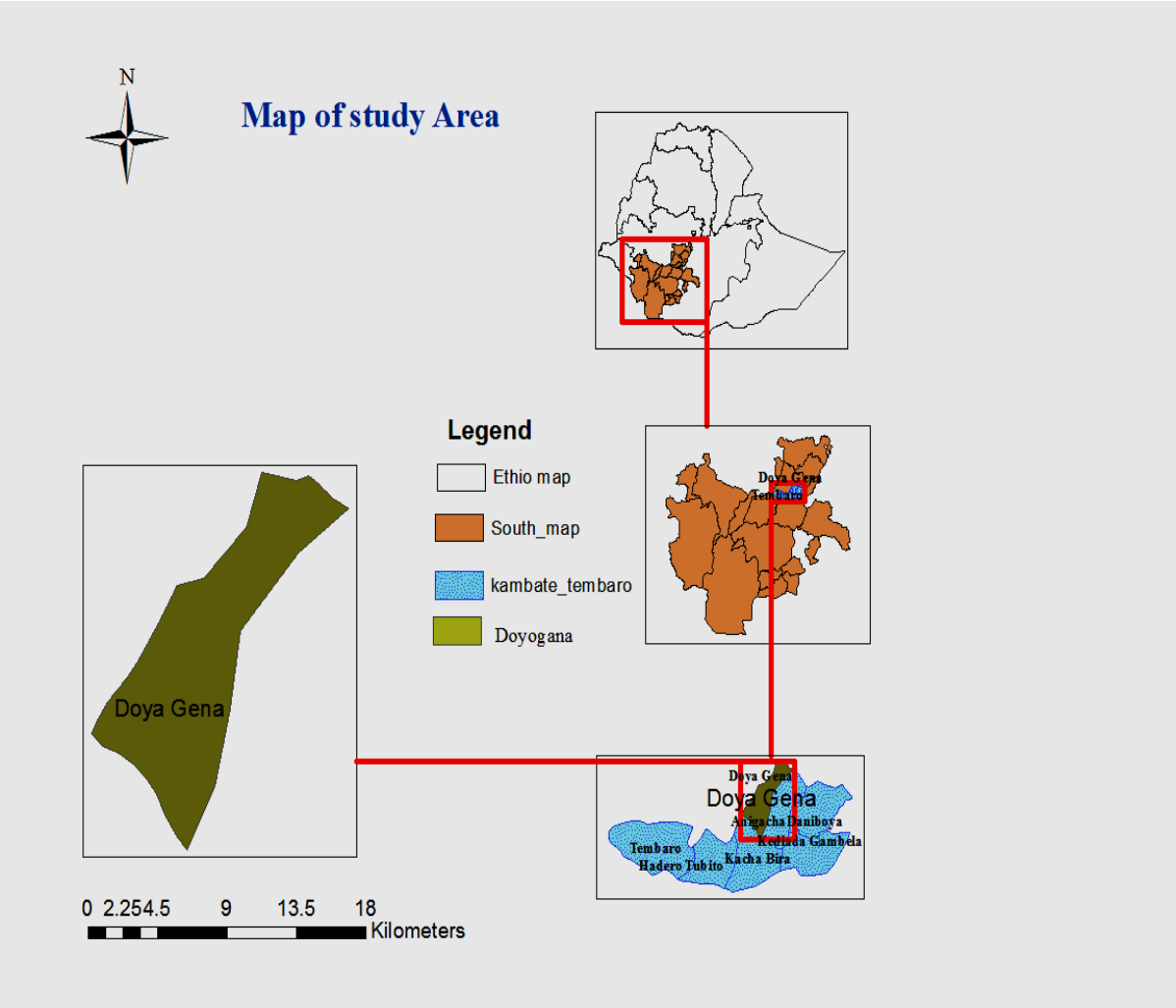

Fig.2: Map of study area

3.2. Research Design

Across sectional survey design was used in this study. According to (Kothari, 2012), cross sectional design is considered as favourable because of its time effectiveness, minimizes biases and maximize reliability. Based on the specific objectives and the nature of the research questions of the study required, quantitative data were collected and appropriate analytic techniques were employed. The quantitative data were substantially supplemented by qualitative data in order to make the results sound. Quantitative data were collected,

using interview schedule, with the aim of analyzing the substantial data and was made generalizations from the result.

3.3. Sampling Method and Sample Size Determination

3.3.1. Sampling method

For this study multi stages sampling technique was used. Firstly, *Doyogena* district was selected purposively, due to existence of improved sheep production experiences and its accessibility. Secondly three *kebeles* namely *Serara Bokata, Ancha Sedicho and Hawora Arara* were selected by simple random sampling technique due to their similar production potential. Thirdly, 144 sample households were selected by systematic random sampling methods from all the three *kebeles.*

3.3.2. Sample size determination

The sample size determination was computed by using Yamane (1967) sampling formula at 95% confidence interval, level of precision 8%

$$n = \frac{N}{1+N(e)^2}$$ ---------- Yemane (1967) ---------- (1)

$$n = \frac{1900}{1+1900(.08)^2} = 144$$

Where: n is the sample size, N is the population size (total household heads size), and e is the level of precision.

In general, the sample size, total number of sheep producers household heads from the *kebeles* and the proportion of sample size summarized in Table 1 and appendix Fig. 1.

Table 1. Sample size determination from selected *kebeles*

Kebeles	Population (HH heads)			Sample size		
	Male	Female	Total	Male	Female	Total
Serera-Bokata	342	242	584	32	13	45
Ancha-Sedicho	396	288	684	36	16	52
Hawora-Arara	353	279	632	32	15	47
Total	1091	809	1900	100	44	144

(Source: Computed from own survey data, 2018)

3.4. Data types, sources and methods of data collection

3.4.1. Data types

Both quantitative and qualitative types of data were gathered through different data collection methods from primary and secondary sources.

3.4.2. Data sources

The data both from primary and secondary sources were collected and used to generate valuable information. **Primary data sources** were 144 sample respondents, key informants and focus group discussions. Secondary data sources were *Areka* research center (branch at *Doyogena*), District's livestock and fishery, Cooperative development, Agriculture and natural resources, Finance and economy and Trade and industry offices, relevant published and un-published reports.

3.4.3. Method of data collection

Individual interview: Totally**,** 144 sample respondents were selected and considered for interview. Three enumerators who have a collage diploma and experience of agricultural activities were recruited and trained to implement both qualitative and quantitative data collection using interview schedule. Before data collection, the interview schedule was translated in local language (*Kembatigna*), and pre-tested on nine farmers but not included to the final sample households. Hence, appropriate modifications and corrections were made on the questionnaire and data were collected under continuous supervisions of researcher

Key informants interview: For this study, in addition to individual interview, data from key informant interview data were also collected from development agents (coordinators), managers of respective *kebeles,* District's livestock and fishery, Agriculture and natural resources, cooperative development, trade and industry as well as Administration offices expertise focal persons (total of eleven key informants). These participants were selected purposively in order to obtain relevant data.

Focus group discussion: Focus group discussions were held with three groups one in each *kebeles* ***(***including twelve members in each group***).*** The composition of groups was farmers such as developments group leaders, model and non-model farmers as well as respective *kebeles'* leaders who were selected purposively for seeking appropriate information. It was also aimed to increase the reliability and trustworthiness of the information. The group members were familiarized to the discussion points and encouraged to forward their opinion they felt without any reservation. The idea dominance as much as possible tried to control. Both key informants and focus group discussions mainly used to generate qualitative data that supported the findings of survey based on predetermined checklists.

3.5. Methods of Data Analysis

After compiling, screening and cleaning the data in the interview schedule of 144 respondents was analyzed. Descriptive and econometric analyses were used to analyze the data collected from respondents. Both descriptive and econometric methods were employed to analyze relationship between dependent and explanatory variables by using Statistical package for social Sciences (SPSS, version 20).

3.5.1. Descriptive analysis

Descriptive analysis statistics basically used to describe distribution of variables and provides brief profiles. Descriptive statistics such as frequency, mean, standard deviation, and range whereas inferential statistics used to examine data for differences, associations and relationships to answer hypothesis. Inferential statistics such as χ^2 and t- tests were used. Also textual (qualitative) analysis was used to comparing socio-economic, demographic and situation of respondents as well as triangulating survey data.

The data related with determinants analyzed both by descriptive and econometric analysis which described by using descriptive statistics such as mean, sta.dev, range and frequency as well as inferential statistics of t-test and chi-square. Impact of participation in improved sheep production on income of smallholder farmers analyzed by descriptive analysis and used descriptive statistics of mean, sta.dev, range and frequency as well as inferential statistics of t-test.

3.5.2. Econometric analysis

A purpose of this study was to analyze the determinants of participation of smallholder farmers on improved sheep production. The dependent variable in this case is a dichotomous variable, which takes a value of 1 if household participate, otherwise 0. Demographic and socio-economic characteristics as well as institutional factors that were assumed to be correlated with participation of improved sheep production were entered along these classifications.

Model, which include a ‘’yes’’ or ‘’no’’ type dependent variable, are called dichotomous or dummy variable regression model. Such models approximate the mathematical relationship between explanatory variables and the dependent variable that is always assigned qualitative response variables (Gujarati, 2015; Crowder, 2017). The four most commonly used approaches to estimate dummy dependent variable regression models are (a) the linear probability model (LPM), (b) the logit, (c) the probit and (d) the Tobit model. They are applicable in a wide variety of fields (Gujarati, 2015).

The major point that distinguishes these functions from the linear regression model is that the outcome variable in these functions is binary or dichotomous. Besides, the difference between logistic and linear regression is reflected both in the choice of a parametric model and in the assumptions. Once this difference is accounted for, the methods employed in analysis using logistic regression follow the same general principles used in linear regression (Braimllari and Sala, 2016). The probability model, which expresses the dichotomous dependent variable (Y_i) as a linear function of the explanatory variables (X_i), is called linear probability model (LPM). Due to econometric shortcomings like non normality of the disturbances(U_i), heteroscedastic variances of the disturbances, non-

fulfillment of $0 < E(Y_i/X_i) < 1$ and lower value of R^2, as a measure of goodness of fit, linear probability model(LPM) failed to test the statistical significance of estimated coefficients. In the case of logit and probit, the estimated probabilities lay between logical limit 0 and 1 and they are the most frequently used models when the dependent variable happens to be dichotomous as well as the choice between these two models revolves around practical concerns such as the availability and flexibility of computer program, personal preference, experience and other facilities. In fact, it represents a close approximation to the cumulative normal distribution (Gujarati, 2015).

Crowder (2017) pointed out that a logistic distribution has got advantageous than others in the analyzes of dichotomous outcome variable. There are two primary reasons for choosing the logistic distribution. These are: (a) from a mathematical point of view, it is an extremely flexible and easily used function, and (b) it tends itself to a logically meaningful interpretation also state that, the logit model is simpler in estimation than the probit model. After reviewing the strength, drawbacks and assumptions of different models, the binary logistic regression model was employed to address the core objective of the study i.e. analyzing determinants of participation of small holder farmers in improved sheep production;

$$P(x) = E(Y=f/x) = \text{---------- 1}$$

$$P(x) = E\ (y = 1/x) = \frac{1}{1+e-(B0+BiXi} \text{---------- (1)}$$

For ease of exposition, we write (1) as:-

$$P(x) = \frac{1}{1+e^{-zi}} \text{---------- (2)}$$

Where P(x) = is a probability of being participant ranges from 0 to 1

Z_i = is a function of n-explanatory variables (x) which is also expressed as:

$$Z_i = B_o+B_1X_1 + B_2X_2 + \text{---------- } + B_nX_n$$

PART= $\beta 0 + \beta_1$ AG + β_2 SEX + β_3 EDU + β_4 LOBOUR+β_5 LAND SZ + β_6 FI + β_7 OFI + β_8CU+ β_9MSC+ β_{10} DFKC+β_{11}FDC+β_{12}AHS+β_{13} DFNMC

Where,

X_1=Age of household head

X_2= Sex of household head

X_3= Education level of household head

X_4=Household labour size in ME

X_5= Land size owned by HH

X_6= Farm income

X_7= off farm income

X_8= Credit utilization

X_9=Membership of cooperatives

X_{10}=Distance from *kebele* center

X_{11}=Frequency of contact with development agents

X_{12}= Access to animals' health serves

X_{13}= Distance from near market center

B_o = intercept

B_1, B_2..... B_n = are slopes of the equation in the model

The probability that a given household participant is expressed by (2) while, the probability of not participates is:-

$$1- P(x) = \frac{1}{1 + e^{zi}} \text{ ---------- (3)}$$

Therefore we can write:-

$$\frac{P(x)}{1-P(x)} = \frac{1+ e^{zi}}{1+ e^{-zi}} = e^{zi} \text{ ---------- (4)}$$

Now P(x) / (1 P(x)) is simply the odds ratio in favor of participation. It is the ratio of the probability that a household participated to the probability that did not participate. Finally, taking the natural log of equation (4) we obtain-

$L_i = \underline{\ln [P(x)] =} Z_i$ ---------- (5)
1-P(x)

$Z_i = B_o + B_1X_1 + B_2X_2 +$ ----------+
B_nX_n

If the disturbance term, (U_i) is introduced the logit model becomes

$Z_i = B_o + B_1 X_1 + B_2 X_2 + ...+ B_nX_n + U_i$---------- (6)

L_i = log of the odds ratio, which is not only linear in X_i but also linear in the parameters.

X_i = Vector of relevant explanatory variables

Changing an independent variable in this case, was expected to alter the probability that a given individual becomes participant, and this helped to predict the probability of participating.

3.5.2.1. Estimation procedure

Given that the model selected for analysis was the binary logit model, the dependent variable was assigned by value of 1 or 0, representing participant or non-participant, respectively. Estimated the values of B_0 and B_i's, a set of data were fitted into equation 6. Since the method of OLS does not make any assumption about the probabilistic nature of the disturbance term (U_i), the parameters of the model are estimated using the maximum likelihood (ML) method (Gujarati, 2015).

Before estimating the logit model, existence of multicollinearity among the continuous variables was checked and the association among discrete variables was also verified by checking covariance. Existence of multicollinearity seriously affects the parameter estimates. In short, the coefficients of the interaction of the variables indicate whether one of the two associated variables should be eliminated from model analysis (Kothari, 2012).

Accordingly, Variance Inflation Factors (VIF) technique was employed to distinguish the problem of multicollinearity for continuous explanatory variables (Gujarati, 2015). Each

selected continuous variable was regressed on the other continuous explanatory variables and an evaluation was made on the coefficient of determination (R^2_j). If an approximate linear relationship exists among the explanatory variables, then this results in a 'large' value for R^2_j in at least one of the test regressions. A popular measure of multicollinearity is VIF defined as:

$$VIF(X_j) = \frac{1}{1-Rj^2} \quad \text{..... (7)}$$

A rise in the value of R^2_j that is an increase in the degree of collinearity does indeed lead to an increase in the variances and standard errors. A VIF value greater than or equal 10 is used as a signal for the strong collinearity. In the same way it is necessary to test whether there is or not interaction between discrete variables that can lead to problem of association among each other using coefficients of contingency. If the value of CC greater than or equal to 0.75 it is used as signal for the existence of strong association among the discrete variables (Gujarati, 2015).

$$CC = \sqrt{\frac{X^2}{n + X^2}} \quad \text{..... .....} \quad (8)$$

Where CC is coefficient of contingence, x^2 is the chi-square test and n is total sample size.

3.6. Definition of Variables

3.6.1. The dependent variable of the model

The dependent variable for this study was smallholder farmers' participation in improved sheep production. Participation**"(PISP)"**which was dependent variable for the binary logit analysis as dichotomous variable and represented by 1 for participant and 0 for non-participant household heads.

3.6 2.The independent variables of the model

After the logical procedure clearly delineated, the potential explanatory variables were identified that determined participation of small holder farmers in improved sheep production. The independent variables of the study are variables that expected to influence farmers' participation in improved sheep production and can be many types. Here an explanation of the thirteen potential hypothesized explanatory variables was presented & summarized in appendix Table 1 as following. Consequently, review of literature, past research findings, and expert's opinions were used to identify the potential determinants of participation of farmers on improved sheep production in the study area. Thus, taking participation as dependent variable, the following explanatory variables were identified and their influence in participation of smallholder farmers examined.

Age of the rural farm household head (AG): It is a continuous variable, defined as the farm household heads age and measured as the number of years from t he date of birth to the day of the survey interview. When farmers' age increase their maturity also increases and they will be eager to apply new technology. According to Assan (2014), those household heads having matured age due to a good farm experience have much better association with more productivity. Hence, in this study it was hypothesized that when household head's age increases it affects participation in improved sheep production positively and significantly.

Sex of the household head (SEX): this is a dummy variable that assumes a value of "1" if the head of the household is male and "0" otherwise. Sex is biological difference of being male or female of respondents. With this background male headed households have better probability of mobility, participate in different meetings and have more exposure to information about better production participation; According to Urgessa (2015), women headed household less likely control over economic resources and the nature of their economic activity. Then, it was hypothesized that male headed households have more chance to participate in improved sheep production and it influence positively and significantly.

Education level of house hold head (EDU): It is continuous variable and measured by years of schooling. When education levels of farmers' increase, they have a better ability to identify the problem of their farm income as well as can calculate its costs and benefits. According to Mathebula (2015), high level of educations was expected to have more exposure to the external environment and accumulate knowledge of farm practicing. Therefore, in this study it was hypothesized that advanced in school level affect participation in improved sheep production positively and significantly.

Household lobour in ME: It is continuous variable and measured by number of members under control of one HH head in man equivalent ratio. Sheep management most of time consuming labour and availability of labour can ease the management of sheep in house hold. According to Haile *et al.* (2015), in farming household, for improved sheep rearing and routine management practices, the availability of productive labor is mandatory. Hence, in this study availability of labour was hypothesized that affect the participation of small holder farmers' in improved sheep production positively and significantly.

Size of land in hectares (LAND SZ): Land is Continuous variable measured in number of hectares by the household. Land is one of the key productive resources for the small holder farmers to generate their livelihood. Owning larger area of land can be a means of accumulating wealth and source of animal feed. Households who have better land holding have better capacity to participate in improved sheep production. According to Muller *et al.* (2015), a larger size land implies more possibility of having large flock size and availability of feeds. In this study it was hypothesized that sizes of land holding by the household have positive and significant influence on participation of improved sheep production.

Farm income (FI): It is continuous variable measured in amount of money the household earns annually from sale of agricultural product (both crop and livestock) in ET Br. When increase in productivity of agriculture enable to get huge money and enhancing improved breed and other production input purchasing power. According to Rasch *et al*. (2016), the rural households with better farm income have better possibility to be participating in improved sheep production. In this study it was hypothesized better farm income influence

smallholder farmers' participation in improved sheep production positively and significantly.

Off-farm income (OFI): It is continuous variable measured by amount of money the household earns annually from sale of family business, remittance, day labourer in others farm or non-farm activities and any incomes sources in ET Br. When households get off-farm income adequately, they can have capacity to run improved sheep production. According to Babatunde *et al*. (2015), off-farm income is determining explanatory variable that can positively affected the probability of participation in improved sheep production. In this study it was hypothesized getting off-farm income influence smallholder farmers' participation positively and significantly.

Credit participation (CP): It is dummy variable which takes the value of 1 if the household utilized credit and 0 otherwise. Credit is an important instrument to solve liquidity problem that farm households are facing. Households who participated in credit; they could purchase agricultural inputs including livestock. According to Kebebe (2015), credit participation can ensure households purchase improved breed and other production inputs. In this study credit part was hypothesized that credit participation influence smallholder farmers' participation in improved sheep production positively and significantly.

Membership of cooperatives (MSC): This was coded as a dummy variable, which took the value of 1 if the farmer was a member of cooperatives and 0 otherwise. Cooperative societies are one of the important institutions in rural and agricultural development. Cooperatives serve as an important source of rural credit and producers who are member of cooperatives are likely to get inputs and production information and thus could participate and supply sheep to the market than non-members. According to Hennessy *et al.* (2012), membership in farmers' cooperatives significantly raised the probability of technology adoption. Therefore, in this study being member of cooperative was hypothesized that membership of cooperatives have positive and significant relationship with participation in improved sheep production.

Distance from *kebele* center (DFKC): It is continuous variable which measured by number of kilometers from center of *kebele* to their home. Distance from *kebele* center is amount of kilometers farmers walk to reach the *kebele* center. Farmers living closer to *kebele* centers likely to get update information and adopt improved sheep breed than those who are living at far. According to Deress *et al*. (2014), when farmers come from far, probability of improving agricultural technology adoption decrease. It was hypothesized that distance affects participation in improved sheep production negatively and significantly.

Frequency of extension contact (FDC): It is continuous variable which measured by number frequency of contacts per year that the respondent makes with development agents. Frequency of extension contact is one type of sharing knowledge and experience with development agents. According to Elias *et al.* (2016), farmers who make contact with development agents frequently have better access to information on technology and have better possibility to change their intent into action. In this study it was hypothesized maximum frequency of extension contact with development agents have positive and significant influence on smallholder farmers' participation on improved sheep production.

Access to animals' health service (AHSC): It is dummy variable; it takes the value 1, if the respondent gets access and "0" otherwise. Access to health service is very critical variable that can affect the motivation of farmers to participate in improved sheep production. When sheep health care access is improved, productivity will increase as well as farmers will be encouraged to participate in improved sheep production. According to Robinson *et al*. (2017), unless a farmer having access to health services, s/he cannot decide to participate in improved sheep production. So, in this study it was hypothesized that improvement in access to animals' health services affect decision to participate in improved sheep production positively and significantly.

Distance to a nearest market center (DTNMC): It is continuous variable which can be measured by number of kilometers takes from their home to reach near market. The closer they are to the nearest market, the more likely to have update market information and enabled to participate in improved and intensive farming activities. Meanwhile, the farmers

who live far away from market places, the likelihood of adopting the technology will decrease (Berihun *et al.,* 2014; Afework and Lemma, 2015). So, in this study it was hypothesized that distance from near market to their home is expected to influence participation in improved sheep negatively and significantly.

4. RESULTS AND DISCUSSION

In this section, the potential determinates of smallholder farmers' participation in improved sheep production were analyzed, impact of participation in improved sheep production on income of smallholder farmers were investigated, challenges and suggested solutions of improved sheep production as well as the household personal and demographic, socio-economic characteristics were assessed and discussed. The results were presented using descriptive statistics such as mean, frequencies, range and standard deviation. Inferential statistics of *t-test* and chi-square (χ^2) test were employed to see the relationships between selected variables. Qualitative data was also analyzed and interpreted for strengthening survey findings through triangulation as well as logit model employed for further justification and prioritizing interventions for study findings.

4.1. Demographic and socio-economic characteristics of sheep producer sample households

Totally, 144 sample households' heads were considered in this study. As has shown in Table 2, out of the total sample respondents, 100 (69.4%) and 44 (30.6%) were male and female headed. The overall mean age of the sampled household head was 53 years with standard deviation of 5.6695, this implies that majority of them working group and the age differs among farmers was 5.6695 years. The other demographic characteristic was education level which has shown average education grade level was grade 4 with standard deviation of 1.2975 which indicates major group of farmers achieved similarly lower grades. The average land was 1.465 hectares with standard deviation of .392. This is less than the national average which is 1.37 hectares but it can be varies from place to place (CSA, 2013).

Table 2. Demographic and socio-economic characteristics of sample sheep producers

Variable		Fren.	%
Sex	Male	100	69.4
	Female	44	30.6
		Mean	**Standard deviation**
Age in year (AGEcont)		53	5.6695
Educational status (EDU)		4	1.2975
Land size		0.935	0.356

(Source: Computed from own survey data, 2018); Fren= frequency, % =percentage

As described in Table 3 below the major crop in study area was wheat which covers 42.5% of total of cultivable land. The second potentially produced crop was potato (14%) out of total cultivable land as well as others described shows these crops are mostly high land areas' crops. The live stock production was also other farm practice by mixed approach the most dominant livestock types were cattle and sheep.

Table 3. The Livestock and crop types in the study area

Types of crop grown in the study area	Land coverage (Ha)	Land coverage in percent	Types of livestock	Number of livestock
Wheat	5200	42.5	Total sheep	32920
Berly	1221	10	Improved sheep	10534
Teff	1450	12	Goat	4501
Pulse crops			Pack animals	10213
Faba bean	1036	8	Bee in hive	3101
haricot bean	450	4		
Field pea	295	2		
Potato	1750	14		
Ensete	714	6		
Oil crops	20	0.5		
Others	112.6	1		
Total	12,248.6			

(Source: Computed from own survey data, 2018)

As described in Table 4, the study area known by land shortage and most of (67.7%) cultivable land, 19.75% of forest land and only 6.14% grazing land were used for livestock production.

Table 4. The land use of farmers in the study area

Types of land use	Coverage in (Ha)	Percentage
Cultivated land	12,248.6	67.7
Grazing land	1110	6.14
Forest land	3573	19.75
Degraded land	435	2.4
Swampy land	358.33	1.98
Potentially cultivable land	202.4	1.13
Others	164.01	0.9
Total	18,091.34	

(Source: Computed from own survey data, 2018)

4.2. Descriptive Statistics Analysis for Discrete Variables

4.2.1. Household heads' sex

The result in Table 5, has shown that 144 respondents who included in this study 100 (69.4%) and 44 (30.6%) male headed and female headed households respectively. Out of 51 participants 42 were male headed household s which is 82.4% and 9(17.6%) female headed. But in non-participants group out of 93 non-participants 58 are male headed which is 62.4% of non- participants 35 (37.6%) female headed HHs. The participation of females in improved sheep production still very least.

The study result showed that biological difference between males and females influenced participation significantly at 1% significance level (χ^2=6.201***; p< 0.01). Based on evidence obtained from focus group discussions male dominance on resource was very high. Due to this, contacts with development agents to share new information and knowledge enabled males better than females. It is in line with study of Musgrave (2016) production of sheep needs high production resources and power due to this most of time males been suitable to undertake heavy management activities than females.

4.2.2. Access to animals' health services

Accessibility of animals' health services is one of crucial factor for production and productivity of sheep. The result of this study has shown in Table 5, indicated that out of 51 participants 36 (70.6%) of participants in improved sheep production had access of animals' health services. And out of 51 participants 15 which are 29.4% did not get access of animal health services.

In other ways out of 93 non-participants 24(25.8%) got access and 69(74.2% not get access. There is association between access for animals' health services and participation in improved sheep production. Farmers during focus group discussions and at key informants' level confirmed that there was shortage of health post and animal health officers. Observed that only one animal health expert was assigned for three *kebeles* during the survey. For this reason farmers complained about inappropriate and inadequate animals' health services. Also focus group participants explained that the experts focused on larger ruminants than small ruminants like sheep.

Unfortunately, those participating on improved sheep production were having animals' health service from different sources such as non-governmental organizations, research center (*Areka* research center branch) and community based breed selection cooperatives. The accessibility of health services influenced the smallholder farmers' participation significantly. This result similar to (Getachew *et. al*, 2015) the health accessibility influenced the participation in improved sheep production significantly at 1% significance level (χ^2=27.176, p<.01). Moreover, in line with (Theodoridis *et al*, 2018) which has specified that animals' health services encourages farmers to participate in improved sheep production significantly.

4.2.3. Membership to cooperatives

As indicated in Table 5, the existence and operation of institutions such as cooperatives for marketing, saving and credit can enhance livelihood of smallholder farmers and be alternative sources of information, knowledge and credit to members. Out of 51 participants 38(74.5%) have been membership of cooperatives and 13(25.5%) are not

members in any cooperatives. Out of 93, non-participants were 68(73.1%) which did not be member of any cooperative organization but only 25(26.9%) bee member of cooperatives. This study result has shown that membership of cooperative plays a significant role at 1% significance level (χ^2=30.361, p<.01) which influenced the participation of smallholder farmers in improved sheep production and similar with study of (Yin *et. a.,* 2018) membership of cooperative is one way of transferring knowledge and getting credit for production and which influenced participation of farmers positively and significantly.

4.2.4. Credit participation

In situations where financial capacity of an individual can limit to expand production activities, participating in credit from any source had influence on new technology practices. As described on Table 5, in the study area out of 51 participants on improved sheep producers 40(78.4%) participated in credit from any of organizations. But out of 51 participants 11(21.6%) did not utilize credit from any organizations.

Out of 95 non-participants 30(32.3%) did utilize credit but not participated in improved sheep production. This result has shown credit participation had strong association with participation in improved sheep production and there was significant relationship exists at 1% significance level (χ^2=28.110, p<.01). According to focus group discussions and key informants' responses, the credit utilization difference between participants and nonparticipants was due to the presence of different governmental and non-governmental organizations which facilitated the saving and credit associations mainly among participants.

However, majority of respondents criticized on OMO microfinance service for its high interest rate, inability to get the loan despite their request and lack of other lending institutions as alternative. This result in line with (Silong, 2017) participation in credit can influence adoption of new agricultural technology positively and significantly.

Table 5. Descriptive statistics' results of discrete explanatory variables

Variables		Participants		Non-participants		*P-value*	*Chi-square*
		Fren.	%	Fren.	%		
Sex (SEX)	Male	42	82.4	58	62.4	0.009	6.201***
	Female	9	17.6	35	37.6		
	Total	51	100	93	100		
Access to animals health services(AHS)	Yes	36	70.6	24	25.8	0.000	27.176***
	No	15	29.4	69	74.2		
	Total	51	100	93	100		
Membership of cooperatives(MSC)	Yes	38	74.5	25	26.9	0.000	30.361***
	No	13	25.5	68	73.1		
	Total	51	100	95	100		
Credit utilization(CU)	Yes	40	78.4	30	32.3	0.000	28.110***
	No	11	21.6	63	67.7		
	Total	51	100	93	100		

(Source: Computed from own survey data, 2018); Fren. = frequency; % = percentage; p = probability; ***, **, (1% & 5%) significant respectively

4.3. Descriptive Statistics Analysis Results for Continuous Variables

4.3.1. Age of household head

Table 6 has shown that average ages of participants and non-participants were 44.53 and 61.27 years respectively. This has indicated that the younger age group was the one who participated more than the older ones. Younger was better capable in managing assets and hence more productive than older aged households. The age variances were 6.775 and 4.564 between participants and non-participants respectively. This indicates that the households who participated in improved sheep production were younger than the non-participated. The age variation among non-participants was very low compared to participants. In other way elders were at similar age level. The age influenced participation significantly at 1% significance level ($t=17.642$, $p< .01$). This result in line with study of (Bhattarai *et. al*, 2015) stated that level of innovativeness in agricultural technology adoption to be lower among older farmers.

4.3.2. Educational status of household heads

As indicated in Table 6, the educational level of respondents mean grade of participants and non-participants were 5& 2 respectively. Household heads with high level of education participated in improved sheep production better than the one who had less education grades. Education has relationship with participation at 5% significance level (t= 17.404, p< .05). The variations of education level were 1.568 and 1.027 among participants and non-participants respectively. This means, variation among non-participants was very less (non- participants achieved similarly lower grades level).

Hence, the data analysis showed that high level of the education had significant association with the trends of participating in improved sheep production. This finding in line with (Tegegne, 2017) educated households tend to have higher productivity, use of information and able to adopt new production techniques than the less educated households

4.3.3. Distance from *kebele* center

Distance from *kebele* center to their home plays vital role in rural communities in case of knowledge exchange at *kebele (*farmers training center). The result of the study has indicated in Table 6, the average distance between participants and non-participants were 1.18 and 2.91 kilometers and standard deviation of .478 & .351 respectively. This indicated most of participants living around *kebele's* center compared to non-participants where as variation of distances among them has shown the way of reaching farmers was shallow and tends ignoring who live at distances.

Generally, the farmers who live far from *kebele's* center faced the problem of participation in improved sheep production. In this study distance from *kebele* center influenced the participation significantly at 5% significance level; t=24.927; p< 0.05). Brown (2017) reported similar relationship between distance from *kebele* and participation in improved livestock technology in *Dejen* district.

4.3.4. Size of land holding

Responses of focus group discussions implied that most of smallholder farmers in the study area use their land only for all farming activities which include; production of food crops and cash crops, house construction, tethering livestock during the rainy season and tree planting. The sampled households did not get extra land even for renting.

As described on Table 6 the mean land holding of participants and nonparticipants in study area was 1.12 ha and .75ha respectively and standard deviation of .448 and .264 respectively. This has shown there was significant difference among participants and non-participants and non-participants had similarly very low land size. Land holding affected participation at 1% significance level ($t= 6.179$; $p< .01$). This trend is similar to south nation, nationalities and peoples region where 81.8% of the households own less than one hectare and only 3.8% of the farming households own greater than 2 ha (Teffera *et. al,*2018) which could be due to variations in the population density.

4.3.5. Farm income of household

Households' farm income position is one of the important factors determining adoption of improved technologies. The amount of household income obtained from sale of crops and livestock after the household consumption requirement could be used for purchase of farm inputs. Improved sheep production often requires an intensive input which has great implication on cost of production. Due to this, improved sheep production need to have the required amount of income from their agricultural activities to run the activities. According to Table 6, the average annual farm income of the participating and non-participating sample households was 9627.45 and 6105.38 birr as well as standard deviation of 2999.739.and 2079.839, respectively.

This shows that income variation among participants and non-participants group was different that means among non-participants compared to participants' farm income was less and non-participants were obtained low farm income similarly. In this study agricultural income influenced participation positively at 1% significance level ($t=8.272$,

p< .01).Therefore, a household with relatively higher farm income was expected to better adopt improved sheep production package and it is in line with study of (Olson, 2017).

4.3.6. Households' off farm income in a production year

Households' income sources in rural areas are as diverse as households' activities even within agricultural sector. Table 6, has shown that the annual off farm incomes among participants and non-participants were 2196.08 and 1066.77 ETBr respectively and with standard deviations among each other were 626.725 and 466.679 respectively. Based on FGD discussion most of farmers who get remittance from abroad and from different sources in the country were more likely to participate on improved sheep production. The households who had better off farm income had higher probability to participate in improved sheep production and affected participation significantly at 1% significance level (t=12.261; p< .01). It is similar with study of (Asante *et. al*, 2018) off-farm income enables farmers to purchase new agricultural technology.

4.3.7. Household labour

The overall mean of family labour size in man equivalent were 4.98 and 2.36 for participants and non-participants with sheep producers and the variation of labour size for participants and non-participants labour was 1.295 and 0.602 respectively. As Table 6, has indicated there was very few variation of labour size among non-participants compared to participants (non-participants households had similarly less labour among them). The result of test statistics has shown that availability of labour influenced participation significantly1% significance level (t=16.553, p< .01).

According to focus group discussions and key informants, household with large working labor force was in a position to manage the labor-intensive agricultural activities including livestock production such as rearing and watering activities are accomplished by boys and girls. Tethering, providing of feeds, cleaning the shed are activities of women and children while taking to medication are the responsibilities of adult men and women. Selling and purchasing of sheep are the responsibilities of the owner in most instances the head of the household. It is similar with (Cafer and Rikoon, 2018) availability of enough labor in the

family is expected to be significantly and positively related to adoption of improved agricultural technology.

4.3.8. Distance from near market center to their home (DFNMC)

Distance from near market center plays vital role in rural communities in case of market information exchange. The result of the study indicates in Table 6, the average distances from participants and non-participants were 4.45 and 6 kilometers and standard deviations of 1.487 & 1.707 respectively. The result indicates participants living far from near markets' center faced the problem of having update market information at same time less participated in improved sheep production compared to the one who live near market due to lack of market information. But, it is not significantly associated with participation ($t=5.444$; $p>.05$). The focus group discussion responses state that even though, market problem was common, this area had not serious problem of access to market.

4.3.9. Frequency of contact with development agents

Extension contact is supposed to have a direct influence on the behavior of farmers to intensify and improve their production through resolving problems and improving efficiency to make use of opportunities. When there is contact with extension agents (DA), there is greater the possibilities of farmers being influenced to adopt agricultural innovations and improve their productivity.

In Table 6, the average contact with development agents for participants and non-participants were 37.29 and 14.77 with standard deviation of 2.773 and 6.478 respectively. This implied that participant made a lot of contacts with development agents with very minimum difference among each other compared to non-participants. It affected significantly at 1% level ($t=23.639$, $p< .01$); this finding is similar with study of (Vince *et. al*, 2018) which have indicated that the livestock production systems requires knowledge change accordingly through contacting with extension workers.

Table 6. Descriptive statistics' results of continuous explanatory variables

Variable	Participants		Non- participants		***P-value***	***t-value***
	Mean	Standard deviation	Mean	Standard deviation		
Age in year (AGEcont)	44.53	6.775	61.27	4.564	0 .002	17.642***
Educational status (EDU)	5.000	1.568	2.000	1.027	0.013	17.407**
Distance from *Kebele* center (DFKC)	1.180	0.478	2.91	0.351	0.014	24.927**
Land size (LANDcont)	1.120	0.448	0.750	.264	0.001	6.179***
Farm income (FI)	9627.45	2999.739	6105.38	2079.839	0.004	8.272***
Off farm income (NFI)	2196.08	626.725	1066.77	466.679	0.001	12.261***
Household labour in ME (HHLME)	4.980	1.295	2.36	.602	0.000	16.641***
Distance from near market center to their home (DFNMC)	4.450	1.487	6.000	1.707	0.328	5.444NS
Frequency of development agents contact (FDC)	37.290	2.773	14.77	6.478	0.000	23.639***

(Source: Computed from own survey data, 2018); ***, **, NS shows significance level at 1%, 5%, not significant respectively

4.4. Results of the Econometric Model/Logit)

In the previous section mainly had dealt descriptions of the sample population and tests of the association between the dependent and explanatory variables using the chi-square and t-tests. However, identification of these factors alone not enough to stimulate policy actions unless the relative influence of each factor is known for priority based intervention. In this section, econometric model (binary logit) was used to see the relative influence of different demographic, socio-economic and institutional variables on participation of farm households in improved sheep production.

Determinants which had significant relationship with the dependent variable were included in the Logit model. Generally, twelve out of thirteen variables that had significance relationship with dependent variable during descriptive statistics analysis were included in the binary logit model. Before running the binary logit model all the hypothesized explanatory variables were checked for the existence of multicollinearity problem. Contingency coefficients were computed for discrete variables and described in (appendix Table 3). Similarly, the VIF values diagnosed to check multicollinearity of continuous

variables which displayed in appendix Table 4. In both cases variables have no strong collinearity problem. Based on the above test, both the hypothesized continuous and discrete variables were included into the model.

4.4.1. Determinants of participation in improved sheep production

Estimates of the parameters of the variables expected to determine the participation of improved sheep production was displayed in Table 7. From total of thirteen potential explanatory variables twelve were incorporated into the econometric model out of which the seven variables influenced participation of smallholder farmers in improved sheep production significantly. Such as lobour size (HHLME), Age (AGE), frequency of contact with development agents (FDC), membership of cooperatives (MSC), land size (LANDSZ), Credit utilization (CU) and off farm income (OFI) which discussed as following.

Labour availability: participation in improved sheep production requires adequate labour supply to carry out the production processes. It was hypothesized that availability of labour is positively influence the participation in improved sheep technology. The finding of this study was similar to hypothesis that described like size of household labour (HHLME) influenced participation of small holder farmers in improved sheep production significantly and positively at 1% ($p< .01$). When labour increases by unit, participation increase by odds ratio of (12.061) or by 6.1% probability level. Thus households with large family size tend to improve their participation in production of improved sheep. It is similar to (Lima *et. al,* 2018*)* labour affect new technology adoption, production and productivity significantly and positively.

Age: The result of the study shows that age of the household head influenced participation in improved sheep production negatively at 5% ($p< .05$). This is different from hypothesis of this study. When age increased by a year, participation in improved sheep production decreased by odds of (3.466) or by 47% probability level. As fact indicated by focus group discussions and key informants in the study area, older people fear risk because sheep production involves high risks like heavy management tasks, fear of serious respiratory

diseases and feed shortage. These were some possible reasons for negative relationship between age of household head and participation in improved sheep production. This result of the study is in line with the study of (Bhattarai *et. al,* 2015) level of innovativeness to be lower among older farmers.

Also this finding agree with a study conducted by (Danso *et.al,* 2014) on the adoption of improved livestock technology which has reported that younger farmers were more likely to adopt and the effect of age on the probability of adoption was elastic. Moreover, (Ile *et.al,* 2016) found that smallholders' adoption of small ruminants in South Eastern high lands of Ethiopia reported that age had a negative effect on the adoption of new technology.

Frequency of extension contact: Development agents visit to farmers would enable the farmers to develop positive attitude towards the participation in improved sheep production. The finding was similar with hypothesis of this study which implied that contact with development agents personally as well as engaged in field days and training influenced positively and significantly at 1% ($p < .01$). The odds ratio (1.019) indicates the participation in improved sheep production increases by a factor of (1.019) or by 2% probability level as the result of one unit increase of the extension contact for the households. This finding is similar with study of (Vince *et. al,* 2018) which have indicated that the livestock production systems requires knowledge change accordingly through contacting with extension workers.

Membership of cooperatives: cooperatives are one of the important organizations in rural and agricultural development which serve as an important source of information, knowledge transfer and rural credit. In this study similar to hypothesis, participation in cooperatives had significant and positive influence on participation of smallholder farmers in improved sheep production at 1% ($p < .01$) and the probability of cooperative members participation in improved sheep production increased by odds of (21.802) or by 80% probability level as compared to non-members of cooperative. It is line with (Fufa, 2016) organizing farmers in cooperative society would facilitate access to credit, access to extension information and access to market. This implies being member in rural cooperatives can enhance adoption of new agricultural technology.

Land owned by households: results showed that respondents' less participation in improved sheep production was due to scarcity of range lands. The same as hypothesis of this study the result of study has shown that land size influenced participation decision in improved sheep production significantly and positively at 1% significance level ($p< .01$). When land increases by one hectare the probability of participation increased by odds of (29.283) or by 28% probability level.

The data gathered qualitatively from focus group discussions and key informants assured that participants had more land compared to non-participants in the study area and thus, non-participants keep their sheep more frequently under stall feeding or cut and carry system also use more of other types of feed such as supplements and expensive industrial by-products. It is in line with (Mishra *et.al*, 2017) land is very crucial input for livestock production and that can influence the production of improved livestock production significantly and positively.

Credit Participation: is a very important determinant for households' decision to take more risks and enhance their financial capacity to purchase inputs that complements package of sheep technologies, improved breed purchasing, veterinary purpose and other management activities. In this study, credit participation was similar with hypothesis and influenced significantly and positively at 5% significant level ($p< .05$). The probability of participation in improved sheep production increased by odds of (10.026) or by 3% probability level as compared to non-participants of credit. Participation in credit affects an improvement of participation in livestock technology production positively and significantly, this in line with (Silong, 2017).

Off farm income: households' income position and resource ownership was found to be important determinant in participation of improved sheep production. Similar to hypothesis the result of this study indicated that, households who had better off farm income from different sources participated well compared to those did not get access for off farm income. It influenced participation of smallholder farmers in improved sheep production positively and significantly at 1% ($p< .001$). When off farm income increased by one thousand ETBr, the probability of participation increased by odds of (1.002) or by .2% probability level. This means that a farmer who had better off farm income from different

sources was more likely to adopt improved sheep production. Is in line with study conducted by (Mwangi and Kariuki, 2015) petty trades, daily laborer on others' farm and non-farm activities as well as small business enable farmers to get additional income to have production inputs can influence positively and significantly new agricultural technology adoption.

Table 7. The results of the binary logit model

Variable	(B)	S.E	Wald Statistics	Sig. level	Exp(B)
Household lobour in ME	2.49	0.679	13.51	0.001***	12.061
Age of the rural farm household head (AG)	-1.243	0.589	4.456	0.035**	3.466
Sex of the household head (SEX)	-.242	1.092	0.049	0.824	1.274
Frequency of extension contact (FDC)	0.019	6	11.552	0.001**	1.019
Education level of house hold head (EDU)	0.395	0.322	1.501	0.220	1.484
Membership of cooperatives (MSC)	3.082	1.147	7.215	0.007***	21.802
Size of land in hectares (LAND SZ)	3.377	1.171	8.324	0.004***	29.283
Credit participation (CP)	2.305	1.119	4.24	0.039**	10.026
Farm income (FI)	0.000	0.000	0.705	0.401	1.000
Distance from market (DTNMC)	0.330	1.173	0.079	0.779	1.391
Off farm income (OFI)	0.002	0.001	8.596	0.003***	1.002
Access to animal health service (AHS)	5.821	0.606	5.537	0.217	333.309

Number of Obs=144; p=0.000; Nagelkerke R Square =78.947 Notes: Exp (B) shows the predicted changes in odds for a unit increase in the predictor; **and ***Significant at 5%, and 1% significant level; (Source: Computed from own survey data, 2018)

4.5. Impact of participation in improved sheep production on smallholder farmers' income

Sheep is one of the most affordable animals in the world and can be accommodated in any kind of weather conditions. They are also called poor man cow and rearing sheep contribute a lot to the economy by generating household income, providing local employment and export (Marino *et al.*, 2016).

According to survey result average farm income of participants and non- participants were 9627.45 and 6105.38 ETBr with standard deviation of 2999.739 and 2079.839 respectively. Generally, farm income difference between participants and non-participants of improved sheep producers were significant. Both focus group discussions and key informants data

confirmed that the income source of smallholder farmers is mainly farm (both livestock and crop) but the sheep production due to its potential in the area made bold difference in small holder household income.

Sheep production is increasing constantly in study area, due to constantly decreasing of arable land as well as trend of improving genotype of sheep (improving breed) at community level which initiate smallholder farmers (there is community based improved breed selection practice by different stakeholders). As described in Table 8, the average income from sheep production was 3447.06 and 1380.65 ETBr with standard deviation of 1584.343 and 230.433 for participants and non-participants respectively. It has shown participants average income was 3447.06 ETBr, but, in case of non-participants only 1380.65 ETBr there is 2066.41 ETBr difference between participants and non-participants.

Generally, participants of focus group discussions and key informants suggested that the impact of participation in improved sheep production was significant and made difference among smallholder farmers living style.

Table 8. Farm income of smallholder farmer in 2017

Variable	Participants		Non- participants		
	Mean	Standard deviation	Mean	Standard deviation	*t-value*
Farm income	9627.45	2999.739	6105.38	2079.839	8.272***
Income from heep production	3447.06	1584.343	1380.65	230.433	12.376***

(Source: Computed from own survey data, 2018); *** =1% significance level

The result in Fig.3 implies average income gained from sheep production in case of participants income obtained from sheep production ranges from 1,800-6,000 ETBr whereas non-participants' income ranged from 800-1,800 ETBr. This implies that participants gained better income from their sheep production compared to non-participants in improved sheep production. Based on response of focus group discussion and key informant data this income difference comes due to better market and financial support for participants from governmental and non-governmental organizations as well as technical

support from *Areka* research center (Brach at *Doyogena*. Again they suggested that the sheep production need both technical and financial support, so such reasons made income difference between participants and non- participants.

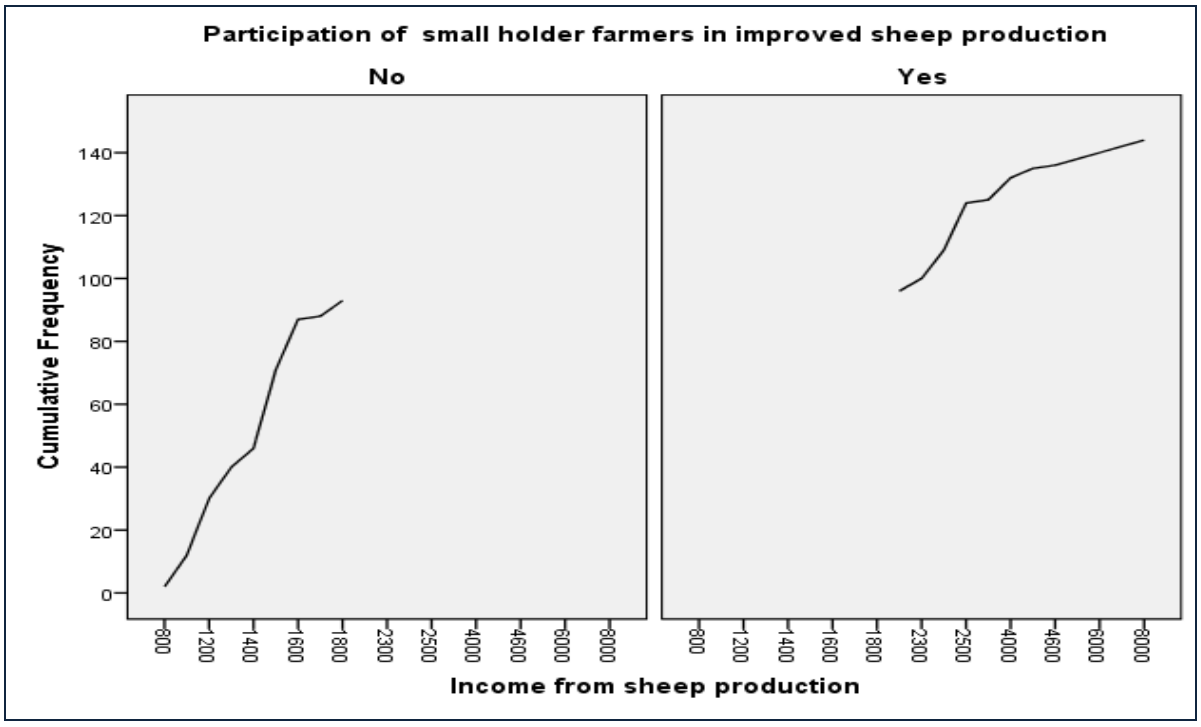

Fig 3. The farm income of participant and non-participant smallholder farmers
(Source: Computed from own survey data, 2018)

The result in Fig. 4 described that the farm income (which obtained both from livestock and crop) were ranges 4500-17,000 and 500-10,000 ETBr for participants and non-participants respectively. Most of participants obtained much income from sheep production due to the short term reproduction rate, early weaning of weight and better price of improved breed and weighing sell trend for improved sheep in study area. This result confirmed by focus group discussions that, the farmers in the study area have almost the same land size but the one who participated in improved sheep production earn more income due peculiar characteristics of *Doyogena* sheep breed (short term reproduction rate, early weaning of weight and better physical appearance) and most supports favoring the productivity of participants in improved sheep production. It is in line with Legese *et al.*

(2014) improving the sheep breed can enhance productivity as well as livelihood of stallholder farmers.

Also, participants of focus group discussions clarified that improved sheep production showed significant impact on livelihood of smallholder farmers. Most of households in study area faced the short term income due to this the smallholders farmers challenged to cover food costs, education fee, clothes and agricultural inputs. However, the living style of the one who participated in improved sheep production has being changed and enables to cover such costs easily compared to non-participants.

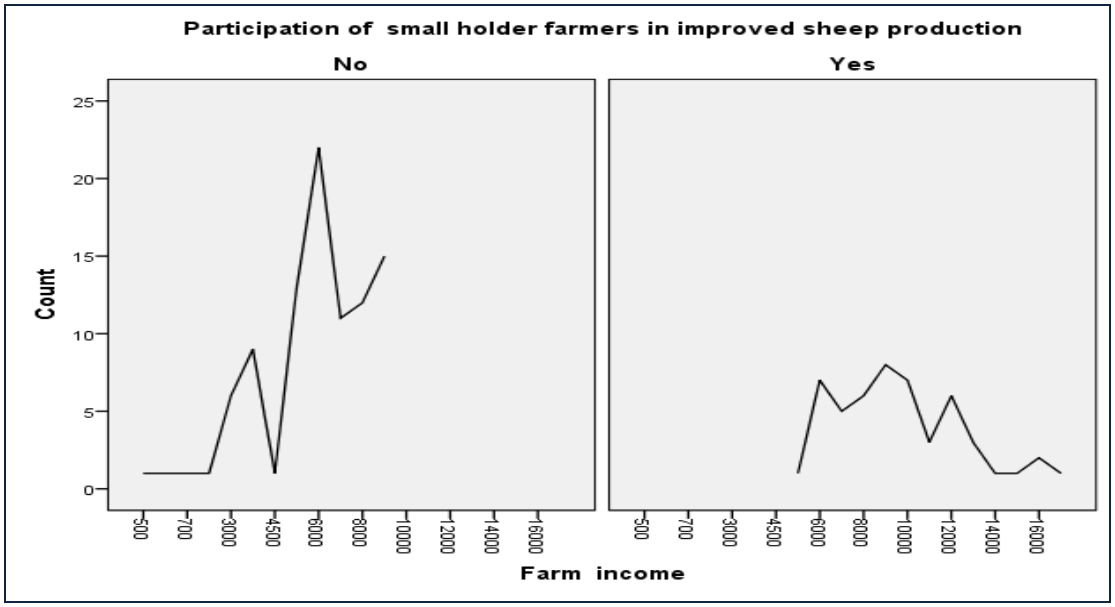

Fig 4. The income of participant and non-participant smallholder farmers from sheep production

(Source: Computed from own survey data, 2018)

5. SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. Summary and Conclusion

This study was conducted in *Doyogena* district, which is located in the southern part of Ethiopia about 258 km south of Addis Ababa. The farming communities are practicing diversified agricultural activities to support their livelihoods. Among these activities, livestock productions including the production of sheep are important livelihoods means.

The production of livestock is in a state of dynamism owned and the species of livestock being kept. As the result of the reduction in the quality and quantity of feed resources for livestock, due to expansion of cultivation and population pressure, the number of livestock being kept are reducing and in a state of shifting from large ruminants to small ruminants. Based on theoretical concepts on sheep production and their economic role to sheep producers, this research was conducted to address three objectives namely, to analysis determinants of smallholder farmers' participation in improved sheep production, to investigate the income contributions of participation in improved sheep production and to assess challenges of improved sheep production in the study area.

The expected output of the research was identifying the most likely determining factors, income contribution and challenges related to improved sheep production regardless of smallholder farmers. For this study multi stages sampling technique were used. Firstly, Doyogena district was selected purposively, due to existence of improved sheep production experiences and its accessibility. Secondly, three *kebeles* were selected by simple random sampling and thirdly 144 survey respondents were selected by systematic sampling. In addition to quantitative data, qualitative information was collected from FGD and KI by using predetermined checklist as well as secondary data were reviewed. The dependent variable of the study was "Participation" hypothesized to participate or not" because of various factors. To capture information about relationship between explanatory variables and dependent variable, quantitative and qualitative data were collected using the interview schedule developed for this study purpose. The explanatory variables concerning household characteristics include; Age of the rural farm household head, distribution of

household lobour, sex of the household head and education level of house hold head. The socio-economic explanatory variables include in this studied were; Membership of cooperative (social), Land size owned by a house hold, farm income, off-farm income, while the institutional variables assumed were credit participation, access to animals' health services, frequency of contact with development agents, distance from *kebele* center and distance from near market. The study exposed that the practice of producing sheep in the study area is a recent practice for the majority of sampled households and surprisingly a very important economic plan as means of generating and improving household's cash income to support their livelihoods and accumulate wealth.

In this study 100 males and 44 females included, out total 144 samples 51(35.4%) of the sampled sheep producers participated in improved sheep production.

The significance of variables checked by employing descriptive statistics such as t- test for screening nine continuous and chi-square (χ^2) for four discrete variables. All variables have significant relationship with participation except distance from near market center.

The description and interpretation of the data were mainly depended on, the research objectives and the situation of the study area. The inferential and descriptive statistics was used to analysis the major determinants affecting smallholder farmers' participations in improved sheep production.

Determinants that significantly limited participation of smallholder farmers in improved sheep production in study area were lobour, age, frequency of contact with development agents, land size, off farm income, membership of cooperatives and participation in credit

Labour influenced participation in improved sheep production positively and significantly. This indicates that labour size is an important determinant for improved sheep production activities like feeding, watering, taking to veterinary services and marketing. According to, survey results and focus group discussion responses, the households which had large size labour undertaken these activities accordingly than those had small size of labour and participated well in improved sheep production simultaneously.

The other determinant of smallholder farmers' participation in improved sheep production was age which influenced participation significantly and negatively. That means, compared to the young age farmers, old age smallholder farmers did not participate in improved sheep production. Based on focus groups and key informants responses aged farmers feared risk and management activities of improved sheep production, because of shortage of communal land for free grazing (the only means of feeding sheep was carry and cut system) and housing is also another challenge for elders.

Frequency of contact with development agents' enabled the farmers had update information about this new technologies and developed positive attitude towards the participation in improved sheep production. The one who contacted frequently with development agents personally as well as had engaged in field days and training participated in improved sheep production better than the one contacted less frequently. Therefore, frequency of contact with development agents influenced participation in improved sheep production positively and significantly.

Other determinant which influenced participation was land size owned by household in this study it affected significantly and positively; that means farmers who owned large size of land for free grazing, producing improved fodders, housing and other management practices participated in improved sheep production better than the ones had small size of lands.

Off farm income is very important determinant in the study area, which influenced significantly and positively. Households practiced small businesses and employed as daily laborers on others' farm and non-farm activities side to agricultural production as well as who sent their sons and daughters out of country and inside country sides for searching additional income to farm income were participated in improved sheep production better than who had not practiced on other sources of income.

Membership of cooperative influenced participation significantly and positively. The farmers engaged in cooperatives got new information about the way of producing improved sheep production and market. Thus, the one who had been member in some cooperatives

participated in improved sheep production better than those did not be member in any cooperatives in study area. As implied by focus group discussions the farmers included in any cooperatives got chance to had additional training, credit access and market information by different governmental and non-governmental organization in the area. This enabled farmers had production input and encouraging them compared to non-members.

Participation in credit enabled farmers had improved breed and other production inputs. The credit participation in this study influenced the participations significantly and positively, this means farmers participated in credits from governmental and non-governmental organizations participated better than those who did not participated in credit from any sources.

The impact of participation in improved sheep production on the economy of smallholder farmers' income was identified. Share of improved sheep on income smallholder households who participated in improved sheep production was enhanced and brought 2066.41 additional ETBr compared to non-participants. This amount of money regardless of farmers was very high and made difference in their living style.

5.2. Recommendations

- Family labour influenced participation positively and significantly. This was due to heavy management activities of improved sheep production which made fear on smallholder who had less labour. To solve this problem work efficient and achievable size flock should be reared and increased productivity on small size of sheep flock.
- Families obtained income from other off-farm activities and had remittance have participated more in improved sheep production than others. So, to enable those did not get chance to generate income from different off farm sources; development agents should train farmers to participate on small level businesses and linking to financial and technically supporting bodies collaboratively with trade and industry office as well as OMO micro finance office.

- Those farmers who frequently contract with development agents had information about production system, market price and participated in improved sheep production better than the one less contacted with development agents. This difference between farmers can be solved by awareness creation for farmers (training), employing enough development agents at each cluster of *kebeles* and strengthening monitoring and evaluation system to deepening support of development agents for smallholder farmers and rewarding best performing agents to encourage other development agents.

- Farmers who owned large size of land for grazing, improved fodders production, housing and other management practices participated better than those with small size of lands. Due to its scarce and expensive nature, farmers should be trained how to use effectively and economically the land they owned by practicing improved fodder production as well as cut and carry system.

- Participation in credit service and membership to cooperative created difference in participation of improved sheep production and affected significantly and positively. To enable smallholder farmers; organizing in cooperative groups, linking to micro finances and training farmers before participation in credit utilization should be undertaken collaboratively with development agents, livestock and fishery, district administration and cooperative development offices.

- The improved sheep production enhanced income of participant smallholder farmers significantly. So, to enable smallholder farmers who did not participate in improved sheep production, training farmers and intervention mechanisms should be designed and implemented by district, regional and national governments collaboratively.

- Future effort through effective policy should be intended to accelerate agricultural and rural development through effective utilization of improved sheep potential regarding smallholder farmers in study area particularly and in Ethiopia generally.

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7. APPENDIX

7.1. Appendix I

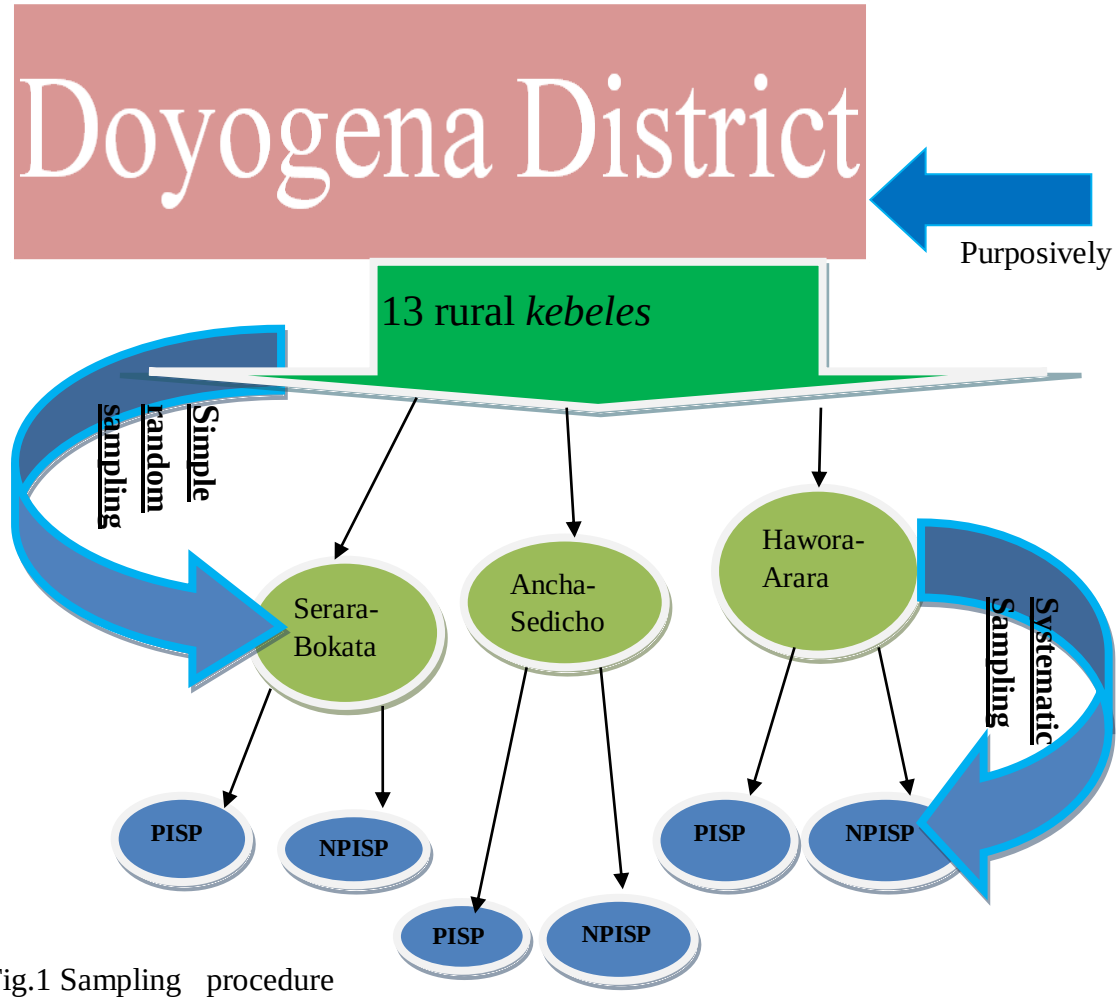

Fig.1 Sampling procedure

PISP=participated in improved sheep production; NPISP= non-participated in improved sheep production but all respondents were sheep producers

Appendix Table 1**.** Summary of explanatory variables description and expected signs

Variable type	**Variable nature**	**Unit of measurement**	**Expected Sign**
Age of HH head(AGEcont)	Continuous	Years	+
Sex of the household head (SEX)	Dummy	1 if Male and 0 if Female	+
Educational level of HH head (EDU)	Continuous	Years of schooling	+
Household lobour in ME (HHLME)	Continuous	Number	+
Land size owned by a HH (LAND SZ)	Continuous	Hectare	+
Farm income (FI)	Continuous	Number of ETBr.	+
Off farm income (OFI)	Continuous	Number of ETBr.	+
Participation in credit (CP)	Dummy	1 if Yes, 0 otherwise	+
Membership to cooperatives(MSC)	Dummy	1 if Yes, 0 otherwise	+
Distance from *kebele* center (DFKC)	Continuous	Kilometers	-
Frequency of contacts with DA (FDC)	Continuous	Number	+
Access to animal health service (AHS)	Dummy	1 if Yes, 0 otherwise	+
Distance to a nearest market center (DTNMC):	Continuous	Kilometers	-

(Source: Computed from own survey data, 2018)

Table 2. Conversion factor used to compute man equivalent (labour force)

Age group (years)	Male	Female
Less than 10	0.0	0.0
10-13	0.2	0.2
14-16	0.5	0.4
17-50	1.0	0.8
Above 50	0.7	0.5

Source: Stork*, et al., 1991*.

Table 3. Contingency coefficient for discrete variable

Variables	CU	SEX	AHS	MSC
Credit utilization(CU)	1			
Sex of house hold head (SEX)	-0.034	1		
Access to animals' health services (AHS)	-0.131	-0.073	1	
Membership of cooperatives(MSC)	-0.114	-0.106	-0.175	1

Source; Computed from own survey data, 2018)

Table 4. Variance inflation factor for the continuous explanatory variables

Variables	Collinearity Statistics	
	Tolerance	VIF
Age in year	0.320	3.121
Education level of house hold head	0.322	3.109
Distance from *kebele's* centers to home of farmers	0.217	4.617
Size of land in hectare	0.226	4.424
Farm income	0.650	1.538
Off farm income	0.455	2.200
Household labour	0.336	2.975
Distance from near market center to their home	0.770	1.298
Frequency of contact with development agents	0.220	4.546

(Source: Computed from own survey data, 2018)

7.2. Appendix II

The Interview schedule

Instruction for Enumerators

- Respect all respondents accordingly as culture of the area
- Introduce yourself to the respondent and ask their permission politely
- Tell to the respondent about the purpose of the study
- Check that all questions are asked and responses are filled accordingly

I. General background information

(1). Respondent Code_____ (2). Kebele_____ (3). Age_____

(4). Respondent's sex 1. Male 2. Female (5). Educational status 1. Cannot read and write 2. Can read and write 3. Literate

(5.1). If you are literate write education level_____

II. Flock dynamics

(6). Do you participate in improved sheep production? 1. Yes 0. No

(7). If yes for Q. 6 what type of breed you reared?

(8). Experience in sheep production_____years

(9). If yes for Q.6 what is reason encourage you to participate in improved sheep production? (10). If No for Q. 6 what is your interest now?

(11). Do you believe to participate in improved sheep production is better than local ones?

1. Yes 0.No

(12). If No for Q.6, what conditions determining you? (Can choice multiple answers) 1. Lack of interest 2.lack of seed money to purchase improved breed 3. Lack of awareness about importance of improved breed camper to local ones 4. Other reason specify

III. Availability of labor

(13). Labour force (Use by coefficients in Appendix Table2)

Age group (years)	Male	By man equivalent	Female	By man equivalent
Less than 10				
10-13				
14-16				
17-50				
Above 50				

(14). Who is responsible for the management of sheep in your household?

Activities	Who performs it
Rearing and feeding (cut and carry)	
Watering	
Stock rearing	
Taking to clinic	
Caring for sick sheep	
Cleaning shed	
Construction/repair of shed	
Selling of sheep	
Selling sheep skin	

-Insert who performs the different activities among the HH members (1=husband, 2=wife, 3=boys, 4=girls)

IV. Resources ownership (Land and Livestock)

(15)**.** What is the size of your land holding with exclusive right? _____ (ha) /timad

(16). How is the tenure ship of land? 1. Leased to others _____ Ha/ timad 2. Leased from others _____Ha/timad 3. Uses own land only_____Ha /timad

(17). Do you your livestock? 1. Yes 0. No

(18). If the question 17 yes, the kind and amount of livestock

Animal	No.	Animal	No.
Chicken		Sheep	
		Goat	
Cows		Donkey (adult)	
Ox		Donkey (young)	
Heifers			
Young bulls		Horse	
Calf		Mule	

V. Institutional Support

(19). Do you utilize credit either from GOs or NGOs? 1 Yes 0.No

(20). If you did not utilize credit, what are the reasons for not getting? (There can be multiple responses) 1. I did not want to borrow 4. I asked, but the interest rate high 2. I asked, but could not afford the collateral 3. I asked, but did not get for the reason
5. I do not know lending institutions 6. There are no lending institutions in our area

(21). Do you participate in any type of cooperatives? 1. Yes 0. No

(22). Have you ever got advise/training regarding sheep production? 1. Yes 0.No

(23). If yes for Q.22 frequency of contact with development agents in single month_____

(24). Distance from kebele center _____kilometers

(25). Can you get veterinary services for sheep from the nearby government animals' health posts? 1. Yes 0. No

(26). What is your satisfactions on general health care management services? 1. Very high satisfied 2.Satisfied 3.Medium 4.Low 5.very low

(27). Are diseases and/or parasites infestation a problem of sheep in this area? 1. Yes 0. No

(28). When is the occurrence of the internal parasites of sheep? 1. Throughout the year 2. During the wet/rainy seasons 3. During the dry seasons

(29). When is the occurrence of the external parasites of sheep? 1. Throughout the year 3. During the dry seasons 2. During the wet/rainy seasons

(30). Do you currently spray a caricides when you observe external parasites infesting the sheep flock? 1. Yes 0. No

(31). Do you currently practice de-worming (during the occurrence of parasites to reduce the infestation of internal parasites? 1. Yes 0. No

(32). If yes to Q. 30 and 31, are the practices of spraying a caricides and de-worming resulted in weight gain or improved growth of your sheep or similar to what they look before the treatment? 1. Improved 2. No change 3. Worsened

(33).Distance from your home to near market _____Kilometers

(34). Did you get information on the market price of sheep whenever you sell? 1. Yes 0. No

(35). If you have market information, what are the sources of the information? 1. Office of Livestock and fishery office 2. Own market visit 3.Neighbors 4.friends 5.Traders 6. Others

(36). Satisfaction on the current market price 1.Highly satisfied 2.Medium satisfaction 3. Less satisfied 4. Very less satisfied 5. Not satisfied

(37). How you see the current market price? 1. Highly improved 2. Improved 3. Stagnant 4. Very Less improved

(38). If the response to Q. 37 is improved or highly improved, are you motivated to improve your sheep production? 1. Yes 0. No

(39). If the response to Q. 38 is yes, what are the actions you have taken so far? (Can have multiple responses) 1. expanding the flock size of sheep by own production 2.Expanding the flock size by purchasing from the market 3. Has not taken actions due to various challenges

VI. Farm and off farm income

(40). Your farm income in one agricultural production year both from livestock and crop production _____ETBr

(41). Amount of income covered by sheep production. _____ETBr.

(42). Off farm income in one agricultural production year_____ ETBr

42.1. From daily labourer on others farm_____ ETBr

42.2. From small businesses and trade_____ ETBr

42.3. Remittance and other_____ ET Br

(43). Do you consider income difference among local sheep producers and improved sheep producers 1. Yes 0. No

(44). If yes for Q.43, how many difference exist between local and improved sheep production based on your former experience from single year sheep production share

1. 0-25 % 2. 25-40 % 3.40-60 % 4.60-80% 5. 80-100%

(45). Do you think agricultural technology adoption variability between local sheep producers and improved sheep producers? 1. Yes 0.No

(46). Housing style of your home 1.Grass roof 2.steel sheet

(47). Educating house hold members 1.Very educated 2.Educated 3. Less educated 4.very less educated 5.Not educated

(48). Food security level 1.Improved 2. Medium 3. Low

(49). Sanitation and dressing style 1.Improved 2.Medium 3.Low

(50). If yes for Q.49, how is input purchasing power? 1. High 2. Medium 3. Low

VII. Feed inputs

(51). Do you have experience of improved fodder production 1.Yes 0.No

(52). Where do your sheep graze browse during most part of the year? (There can be multiple responses) 1. Own plot 2. Rented/bought pasture land 3.Communal land 4. Stall fed by cut and carry system of feeding 5. Industrial by-products (nuge cake, wheat bran, linseed cake)

(53). Is pasture available throughout the year? 1. Yes 0. No

(54). In which months do you experience surplus or shortage of feeds for grazers

Months of the year	Grazers (sheep)		
	Enough	Surplus	Shortage
September - November			
December -February			
March - May			
June- August			

(55). Do you practice supplementation of feed such as purchased concentrate feeds (wheat bran, noug cake, salt lick etc.) and salts to your sheep in addition to browsing? 1. Yes 0. No

(56). If the answer to Q. 55 is yes, from where do you get the concentrate feeds?

1. Purchased from the nearby towns 3. Own production and formulation
2. Purchased from other towns far from here

(57). How money percent of your sheep flock improved 1.75-100% 2.50-25% 3. <25%

(58). Major challenges in improved sheep production

58.1. What are socio-economic challenges of improved sheep production?

58.2. What are institutional challenges of improved sheep production?

58.3. What are demographic related challenges of improved sheep productions?

58.4. What are cultural and other challenges of improved sheep production?

58.5. What are suggested solutions for influencing challenges in study area?

Date of interview ---------Name of interviewer----------Signature_____

Name of supervisor----------Signature----------

Open ended questions for Focus group discussion and Key Informants interview

1. Did you participate in improved sheep production?
2. What is reason encourage you to participate in improved sheep production?
3. If not to participate in improved sheep production what is hindering factors?
4. What are trends of improved sheep production in your area?
5. What are major advantages of improved sheep production?
6. To what extent improved sheep production improve the participant farm HHs' income?
7. What are determinants of smallholder farmers' participation in improved sheep production?
8. What is condition of market accessibility for improved sheep production?
9. What is willingness of farmers to participate in improved sheep production?
10. Challenges of in improved sheep production
    - 10.1. What are socio-economic challenges of improved sheep production?
    - 10.2. What are institutional challenges of improved sheep production?
    - 10.3. What are demographic related challenges of improved sheep productions?
    - 10.4. What are suggested solutions for challenges of improved sheep production?