Socioeconomic determinants of small ruminant livestock production decision in Kacha Birra district, Kambata Tambaro zone, in southern Ethiopia

A Thesis Submitted to the School of Graduate Studies of Jimma University in the Partial Fulfillment of the Requirements for the Award of the Degree of Masters of Science (MSc) in Development Economics

BY:

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JIMMA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

DEPARTMENT OF ECONOMICS

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CERTIFICATE

This is to certify that Thesis Entitled ***Socioeconomic Determinants of Small Ruminant Livestock Production Decision in Kacha Birra District, Kambata Tambaro Zone, in Southern Ethiopia***. Submitted to the School of Graduate studies of Jimma University in the Partial Fulfillment of the Requirements for the Award of the Degree of Masters of Science (MSc) in Development Economics and is a record of valuable thesis proposal work carried out by **Mr.Zerhun Habte Hibso** under our guidance and supervision.

Therefore, we hereby decline that no part of this thesis has been submitted to any other University or Institutions for the Award of any Degree or Diploma.

Name of main advisor	Date	Signature
_____	_____	_____
Name of co-advisor	Date	Signature
_____	_____	_____

DECLARATION

I, Zerhun Habte Hibso declare that ***Socioeconomic Determinants of Small ruminant livestock (goat, sheep, or both alone) production decision in Kambata Tambaro Zone Kacha Birra District*** is my work and that all the sources that I have used or quoted have been indicated and acknowledged through complete references.

Name of researcher _____ Date _____ Signature _____

Approval Sheet

This is to certify that the thesis prepared by ZerihunHabte Hibso, entitled: ***'Socioeconomic Determinants of Small Ruminant Livestock Production Decision in Kacha Birra District, Kambata Tambaro Zone, in Southern Ethiopia*** and submitted in partial fulfillment of the requirements for the degree of Master of Science in Economics with the regulations of the University and meets the accepted standards with respect to originality and quality.

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External examiner: Signature Date

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Internal examiner: Signature Date

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Chairman: Signature Date

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Abstract

The main purpose of this study was to analyze the socio-economic determinants of small ruminant livestock production decisions in the Kacha birra district. The study used a multistage sampling (three-stage sampling) procedure to select districts, kebele, and households through purposive, simple random sampling and proportional sampling techniques based on agroecology of the districts respectively. The study used well-structured questionnaires and interviews to collect necessary data from 297 households. The selected data were analyzed in a form of descriptive, inferential, and econometrics analysis methods. The study employed multinomial logistic regression and negative binomial regression model to analyze socio-economic determinants of a small ruminant livestock production decision and to express the expected probability of decision of farmers affected by various socio-economic, demographic, and institutional factors respectively. The result of descriptive statistics indicated that sheep production is dominant in study area 130 (43.77%), 102 (34.34%) decided to alone goat and 65 (21.89%) of smallholder farmers both sheep and goat. The multinomial logistic regression model result shows that Socioeconomic factors like; the number of livestock owned, cultivated land size, policy factors (access of having a credit service and access to extension contact service), access to off-farm income, the experience of small ruminant livestock production affect and family size positively affects the decision of farmers whereas, marital status of the respondent, agroecology, and religion of respondents negatively affect the farmer's decision of small ruminant livestock $_{production}$ *at 1% and 5% significance level. The result of the Negative Binomial regression model shows that family size, extension service, agroecology, and the total number of livestock significantly affect the decision of the expected values of householders' small ruminant livestock production. Lastly, the study recommends policy factors (access of extension contact service and access of formal credit services) should be strengthened in a study area to increase smallholder farmers' small ruminant livestock productivity.*

Keywords: Farmer's decision, Kacha Birra District, Multinomial logistic, Negative binomial, Socio-economic determinant

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CHAPTER ONE

INTRODUCTION

1.1 Back Ground of Study

The majority of the world's estimated 1.3 billion poor people live in developing countries where they depend directly or indirectly on livestock production for his or her livelihoods (Swanepo. et al 2010). Globally, livestock contributes about 40 percent of the countries agricultural Gross Domestic Product (GDP) and contributes about 30 percent of the agricultural GDP within the developing countries (world bank, 2009). Although recently, the international community recognizes the importance of small ruminant livestock in terms of poverty reduction and economic opportunities and more than 150 million poor in Sub Saharan Africa depend on livestock activities for their survival (Melketo, G.et, al 2020). The report of FAO, (2004) clearly shows that livestock is considered as the main income source for landless and very small landowner farmers. This shows that the highlight of the major importance of small ruminant livestock production for Sustainable Agricultural Development (SAD) and economic reform.

The study of Mikias, (2016) shows that small ruminants are an integral part of livestock keeping in Sub-Saharan Africa (SSA) that are mainly kept for immediate cash sources, milk, meat, wool, manure, and saving. Small ruminants (goat and sheep) also have many social and cultural functions that vary among different cultures, socio-economies, agro-ecologies, and locations in tropical and sub-tropical African countries. The contribution of small ruminant livestock (goat and sheep) to the world's food supply, family nutrition, as an income source, employment, for soil fertility, livelihoods, and sustainable agricultural production continues to be a subject of great review and debate (Swanepoel, F., et al 2010).

According to the study of Nkonki. et al (2019) global livestock production is predicted to double by 2050, growing faster than the opposite agricultural sub-sector. Ethiopia has the largest livestock producer country in Africa, including more than 38 million cattle, 30 million small ruminants (goat and sheep), approximately 1 million camels and 4.5 million equines, and 40 million chickens, with livestock ownership currently contributing to the livelihoods of an estimated 80 percent of the rural population (Fantu. B., et al 2018).

Ethiopia is home to Africa's largest livestock population, and it is the continent's top livestock producer and exporter(Duguma and Debsu, 2019). The contributions of small ruminants include food production, input for crop production and soil fertility management, raw material for industry, power source, cash income, saving, fuel, social functions, and employment. In Ethiopia livestock contributes 12-16 %, to the total GDP and 30-35 %, to agricultural GDP (Ali, H, 2013). The livestock sector contributes about 8 % of the total export earnings and is the fourth major source of foreign currency through the export of live animals, hides, and skins. Livestock is an important sector in both highland mixed smallholder farming and lowland agro-pastoral systems in Ethiopia. The development of both highland smallholder's mixed farming and the lowland agro-pastoral/pastoral systems are paramount to the development of the economy of the country, contributing to food and livelihood security of the majority of the population of the country.

The research conducted by Abera (2019) shows that in Ethiopia, there is various small ruminant livestock (sheep and goat) production system categories are practiced, likes the highland sheep-barley system, mixed crop-livestock system, pastoral and agro-pastoral production system, ranching, and concrete, and per-urban (PU) sheep production system. The mixed crop-livestock production system is predicated on limited communal and/or private grazing areas and therefore the use of crop residue and stubble. The study of Bachewe et al. (2018) indicates that the pastoral production system is predicated on extensive communal grazing whereas, agro-pastoralists are characterized by a mixture of both pastoral and mixed crop-livestock production.

However, the productivity of small ruminant livestock was determined by various socio-economic and environmental factors to determine the production of small ruminant livestock production, like increasing population density, urbanization, economic development, change of livestock market demand, climate variability, and technology trends contributes to the change in a livestock production system (Bachewe *et al.*, 2018). According to the report result of central statically agency A. L. Duguma and Debsu (2019) despite the country has a huge potential to produce livestock there are chronic challenges of livestock production development in many parts of Ethiopia. As many studies highlighted that livestock production and productivity is proportionally lowered by various socioeconomic, institutional ,livestock management problems, prevalence of major endemic dieses , insufficient data to improve policy directions besides on small ruminant livestock production,

andinadequate information on how to improve animal breeding and extension service (Kedija et al., 2008).

Other negatively contributing factors include low genetic potential; policy issues Tegegne et al. (2002) lack of market information, institutional problems, the problem of credit facilities, and other personal related factors Personal and Archive (2016). The study result of Gobena (2016) finds out in Ethiopia several socioeconomic and institutional factors determine the production of small ruminants including a traditional way of production, lack of modern technologies, limited supply of inputs (feed, breed, stock, water scarcity, veterinary service), poor access of extension service, lack of real market information, lack of infrastructure, distance from the nearest market place, and limited credit services directly affects the small ruminant livestock production.

According to the research study of Mohammed and Wondimagegn (2018), there are various research and development activities have been carried out in the past, however, there is no significant increment of productivity was achieved. Therefore, improvement programs are necessary to increase productivity and sustainable development of small ruminants in different farming systems of the country in an innovative approach to meet the demands of the human population.

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; like implementing genetic improvement programs without taking into consideration other vital needs of the farmers (Budisatria et al., 2007). Besides, the poor performance of imported breeds from the temperate developed world under sub-optimal management conditions, which prevail in most tropical countries, has created a negative image for genetic improvement programs (Duguma, 2012). However, Production without available market access is also a problem for many livestock producers in tropical countries (Belete S, 2009).

The study of Ali, H (2013) indicates that livestock marketing involves the sale, purchase, or exchange of products such as live animals, milk, wool, and hides for cash or goods in kind. The services include the provision of market information, quality control and grading of meat or milk, operation of auction markets, facilitation of marketing systems themselves, provision of marketing and processing facilities, and transport of livestock or raw milk.

The human population density of SNNPR ranges from 4 to 9000 persons per km^2 and is often cited as the most densely populated area of the country. Half of the total population is confined in the mid-and high-altitudes which comprise only 2.82% of the total regional land area. Diverse and huge numbers of livestock with a density up to 420 TLU/Km^2 are also confined in mid-and high-altitudes. Areas with high human and livestock population density practiced intensive cultivation in which land for livestock is scarce (Regional Atlas, 2004). As a result, grazing land occupies only about 13.3 percent of the total land area (Fikru and Gebeyew, 2015). The population pressure increases further and farm sizes decrease, the role of large ruminants reduces and small ruminants that constitute less competition for arable land predominate (Otte and Chilonda, 2003).

Small ruminant livestock, kept in vast geographical locations, diverse socio-economic and cultural settings and a range of farming practices in the SNNPR play an immense role in the livelihoods of rural farms. The lack of up-to-date and location-specific information on production and marketing systems is often a major limitation to productivity and production improvement endeavors in sheep and goats (Katema, 2017). To design improvement measures relevant to specific systems and thereby properly respond to the growing domestic and foreign sheep and goat's requirements, a systematic description of the production and marketing systems is indispensable.

However, the output of the small ruminant (goat and sheep)livestock is influenced by different socio-economic, demographic, and institutional factors. Additionally, the research study of (Belete S, 2009) indicates that various research and development activities have been carried out in the past, but there is no significant increase in productivity of small ruminant livestock production was achieved. Therefore, improvement programs are necessary to increase productivity and sustainable development of small ruminants in different farming systems of the country in innovative approaches knowing the main socio-economic, demographic, and institutional factors are well to meet the demands of the human population.

Moreover, there is a high scanty of information on the socioeconomic factors and their effect on small ruminant livestock production in the Kambata Tambaro Zone and Kacha birra district. Therefore, it is important to analyze the major socio-economic, demographic, and institutional factors that determine farmers' decisions of small ruminant livestock production. Therefore, the general intent of this study was to analyze socio-economic, demographic, and institutional factors that determine the decision of households with small ruminant livestock production in the study area.

1.2 Statement of the Problem

According to the studyAbidoum,(2018) small ruminant livestock globally, one of the mainstays of agricultural communities, globally provide 50% of agricultural outputs, and also they provide 1/3 rd values of developing countries. In Ethiopia, livestock production as the one component of agriculture covers 40% of the agricultural output playing an important role in the national economy as it contributes 13-16% of the total GDP. The previous study of Gebremedhin and Kennedy (2015)also, indicates that small ruminant livestock production is crucial in Ethiopia as a source of milk, food, and income-generating.

Small ruminants are a crucial part of livestock rearing in terms of an imidate source of income, milk, meat, fleece, manure, and economic growth in Sub-Sahara Africa. Also, they are major sources of revenue in Ethiopia comprising about 30.70 million heads of sheep and 30.20 million heads of goat in the nation. They also play a vital role to the farmer for rural farmers as manure. Nonetheless, there are a lot of socioeconomic, demographic, and institutional (policy) factors that hinder sheep and goats' production yet they can be overcome on account of the uncountable opportunities which they possess.

In Ethiopia, livestock production covers 40% of the agricultural output & it contributes about 12-16% to total GDP (Abidoum,(2018). However this huge potential of the small ruminant livestock production was affected by various socioeconomic, policy and demographic factors & can't be promoted fully in the country level (Dawa 2017). Most of the economic study result shows that small ruminants kept as for account (cash) purpose only, and most of producers have less concerned about small ruminant production in a narrow sense & they haven't get clearly analyzed data/information about socioeconomic determinant factors (Adams, 2015a).

Many researchers like Belay et al. (2014), and K. Belay et al.(2014), conducted a study on factors determining livestock production in Ethiopia with pastoral areas by comparing small ruminant livestock production with value of income and asset development without considering the socioeconomic factors determining the farmers decision of small ruminant livestock production mind. Also the economic importance of small ruminant non-market outputs is difficult to measure by livestock technical staff and cannot be analyzed detail by policy analysis's (Getu,

2015).Additionally, many researchers likes A. L. Duguma and Debsu (2019) , (Belay *et al.*,2014) and Geberkidan Tesfaye (2018) in Ethiopia, Shafique (2017) in Pakistan, Olwale (2014) in Gambia, Onuk (2016) in Nigeria, and Senjet et al. (2017) in India studied on factors determining livestock production by using multiple linear regression model & only one dependent variable but this study uses more than two dependent variable & Multinomial logistic regression and Negative Binomial models to analyze socioeconomic determinants & to determine the probability of a farmer chooses sheep alone, goat alone or both alone (analyze the various effect of explanatory variables) on the decision of households small ruminant livestock production which fills the methodology gaps of previous studies.

Also this study gives a clear information to farmers in order to decide based on socioeconomic determinant factors and the previous research study focused on male household headed as final decision makers on small ruminant production but this study breaks the ideal dominance communities by increasing decisional participation of female households which fulfill the conceptual gaps of pervious researchers & this study includes socioeconomic, institutional & demographic variables in order to fulfill the variable gaps of past researchers .Lastly there is no currently published research in study area regarding to socioeconomic determinants of small ruminant livestock production decision which fulfills the area, and time gap of the study.

This study has aimed to answer the following main research questions,

- ✓ What are the main socio-economic factors that influence farmer‘s decisions to own small ruminant livestock in the study area.?
- ✓ What are the main constraints that influence the production of small ruminant livestock in the study area?
- ✓ What institutional factors influence the farmer's decision to own small ruminant livestock in the study area?

1.3 Objectives of the Study

1.3.1 General Objective

The general objective of this study is concerned with Analyzing Socioeconomic Determinants of Small ruminant livestock (goat, sheep, or both) production decisions in the Kacha Birra district.

1.3.2 Specific Objectives

The Specific objectives of this study include the following items:

- To analyze the main Socio-economic factors which influence farmers 'decision in small ruminant livestock (goat, sheep and both alone) production in the study areas.
- To identify the main constraints of small ruminant livestock (goat, sheep, or both alone) production in the study area.
- To identify which institutional factors mainly determine farmers' decision of small ruminant livestock production in the study area.

1.4 Significance of the Study

This study attempted in Kacha Birra District Kambata Tambaro Zone Southern Ethiopia to analyze the socioeconomic determinants of small ruminant livestock production decisions. Besides, the study identifies the main socio-economic and institutional factors that determine the small ruminant livestock production decision significantly which will be an important input for designing appropriate intervention policy and strategies to satisfy the demand for small ruminant livestock products. The study tries to generate valuable information on small ruminant livestock production and farmers' decisions that would assist policymakers in designing appropriate policies for intervention.

Governmental and non-governmental organizations that are engaged in the development of the livestock sub-sector would benefit from the results of this study. The findings of this study are also believed to be useful to small ruminant livestock producers, investors, and marketing agents to make informed decisions. The work also serves as a reference document for researchers to embark on studies of the same or related kinds in other parts of the study areas.

Therefore, it is hoped that results from this study would have practical use mainly to this area and used for a baseline study for further researchers in the study area especially it serves as an input for different stakeholders like governmental

organizations Kacha Birra woreda Agriculture and Rural Development office, Animal and Fishery office and Plan Commission office, also NGOs (Non-Governmental Organizations) and any decision-makers to be shaped with and extrapolating the findings to the nearby sub-districts by using these studies as a benchmark.

1.5 Scope of the Study

The study is restricted to the Kacha birra district Kambata Tambaro Zone, which is found in Southern Nation Nationality and the Regional State of Ethiopia. Kacha birra district has twenty-one local administrative kebeles namely, Awaye, Ashira, Buge, Lein, Hobicheka, Walana, Wererama, Lada, Wonko, Hoda, Homma, MisrekLeisho, Mino, Masafe, Masa a, Eta, Burchena, and Hobicheka 01 kebele. This study was conducted on smallholder small ruminant livestock producer farmers which selected from purposively selected five locals administrative kebele of Kacha birra district based on agroecology. nThese areas are involved in small ruminant livestock production and have the potential to supply small ruminant livestock products to the consumers of the districts and others. The study has focused on this area to describe socioeconomic determinants of a small ruminant livestock production decision and to identify socioeconomic and institutional factors that determine farmers' livestock production decision, challenges, and prospects of small ruminant livestock production in the Kacha birra district.

1.6 Organization of the Research

The thesis is organized into five chapters. In chapter one introduction, chapter two, review of theoretical, empirical, and conceptual works related to socioeconomic determinants of a small ruminant livestock production decision. Chapter three discusses the research methodology used in the study. Results and discussions were presented in chapter four. Lastly, Chapter five includes, conclusion on the findings of the study and state recommendations based on the findings.

1.7 Limitation of the Study

Every study indeed has its limitations. The researcher mainly limited due to the small ruminant producer farmer’s location is skewed, which leads to a researcher to limits the study with only five kebeles from a total of 21 kebeles found in a district and additionally that makes the researcher limit the sample size to only 297 with the shortage of financial access and shortage of time. The researcher is limited only to the

actual small ruminant livestock producers not the potential entrants to ruminant production.

This study does not investigate the specific preference for small ruminant livestock products and the purchasing ability of the consumers concerning to marketing system of small ruminant livestock products. The study could reflect great importance if it would study in all parts of the Kambata Tambaro zone but due to limited finance and time resource, it focused only on the Kacha birra district with selected five kebeles (Awaye, Buge, and Lein, Eta, and Wererama kebeles).

Additionally, the study makes use of cross-sectional data, it would be appropriate to imply the study does not include the other factors over some time and the socioeconomic and demographic characteristics of each member of the households in each province of the study district. So, it may limit the ability to estimate socioeconomic factors determine small ruminant livestock production decision.

Finally, this study does not investigate the specific preference for small ruminant livestock products and the purchasing ability of the consumers concerning to marketing system of small ruminant livestock products. The study focused only on the Kacha birra district with selected five kebeles (Awaye, Buge, and Lein, Eta, and Wererama kebeles).

1.8 Definition of Terms

Livestock production systems: This is a subset of the farming systems, which can be defined as a population of individual livestock keepers that have similar resource bases, enterprise patterns, household livelihood strategies, farming practices, and constraints and for which similar development strategies and interventions can be applied.

Small Ruminant production can be defined in various ways. One way of this is conceptual meaning of small ruminant (Goat and sheep) production is a very significant component of livestock production throughout the world and more especially familiar in the developing countries.

Agroecology is an approach that takes into account natural ecosystems and uses local knowledge to plant a diversity of crops that boost (keep) the continuous sustainability of the farming system as a whole (Kinyili, et.al, 2020). It helps to deliver contextualized solutions to global issues concerning to ecosystem.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Theoretical Literature Review

2.1.1 Overview

The literature review written for this study found gaps in the research that needed to be addressed. Also, the chapter reviews the literature on the historic development of ruminants, small ruminant production system, marketing system of livestock in Ethiopia, the role of institutional policy on farmer's decision of small ruminant livestock production, demographic factors that determine small ruminant production within a sequence of theoretical reviews, empirical reviews and conceptual reviews respectively.

Since the second half of the twentieth century, the problem of small ruminant production has gained importance among scholars of universities, and on national and international platforms. But the concept was not deeply ingrained into Ethiopian policy and strategy documents livestock development is indicated as one of the focus areas of the government. Since 1992 the government of Ethiopia has introduced a range of policies, strategies, and programs to guide economic development and to address the food insecurity problem. The policies and strategies for agriculture and rural development reflect the potential of the agricultural sector in the nation's development (ILRI, 2013).

This study mostly uses different types of published literature that are mainly related to socioeconomic determinants of small ruminant livestock production decisions regarding householder males and householder females. Most of the researches is out of Ethiopia, like Pakistan, Gambia, Nigeria, Ghana and other related literature reviews are from the different journals of Ethiopia and out of Ethiopia.

According to the research report of (Peacock, 1988), the concept of small ruminant production has a long history in the world, but the production system lacks attention compared with the farming system. While agro-ecological conditions determine the types of crops and livestock systems suitable to any one location, the prevailing ruminant production systems have evolved in response to the total availability of land, the type of crop production practiced the frequency of cropping, the area of uncultivated wasteland, and the density of animal populations.

Furthermore, the researcher's report shows that closing the policy gap regarding livestock production is essential to increase livestock productivity, achieving substantial development, and reducing poverty. This section reviews a variety of studies on socioeconomic determinants of small ruminant livestock production decisions to form some methodological, literature, and study points to increase small ruminant livestock production productivity of smallholders. The section also describes the frameworks that have been used to conceptualize and socioeconomic determinants of small ruminant livestock production.

2.1.2 Concept and definition of small ruminants

According to studies of Demissie et. la, (2014) small ruminants are an integral part of livestock keeping in Sub-Saharan Africa (SSA) that are mainly kept for immediate cash sources, milk, meat, wool, manure, and saving or risk distribution. Livestock production systems (LPS) are defined as a system during which quite 90 percent of dry matter fed to animals comes from rangelands, pastures, annual forages, and purchased feeds and fewer than 10 percent of the entire value of production comes from non-livestock farming activities.

2.1.3 Socioeconomic role of Small Ruminant Livestock production

According(Sarwar and Amir 2017) socioeconomic status has been operationalized in a variety of ways, most commonly as education, social class, or income. Small ruminant livestock production is an important source of money income and plays a crucial role in ensuring food security and alleviating poverty(Gizaw *et al.*, 2013). The livestock sub-sector in Ethiopia contributes about 12 up to 33 percent of the entire and agricultural gross domestic product (GDP), respectively, and provides a livelihood for 65 percent of the population (Solomon G et.al 2010).

However, the study of Geberkidan Tesfaye (2018)indicates that keeping small ruminants varies with production systems. Traction ranked highest, followed by milk and reproduction/breeding (males and females) in both crop-livestock and agro-pastoral systems. Manure production is also considered important by most crop/livestock and agro-pastoralist farmers, but as a secondary instead of a primary purpose. In contrast, reproduction/breeding requirements received higher ranks in pastoralist systems, and, for females, requirements for breeding outranked the importance of milk production(Workneh and Rowlands, 2004).

The study of Dossa et al. (2008) shows that the small ruminant livestock production and farmers' production decisions are strongly influenced by socio-economic and

institutional variables, as well as policy and demographic factors. However, the factors that influence smallholder farmers 'decisions to manage important small ruminant livestock, especially sheep and goat, are not clearly understood (Dossa et al. (2008).In general; women also tend to have limited non-farm employment opportunities, compared with men (Faizal Adams 2015). Women's constraints on lineage land-use further limit the use of such family land as collateral to secure credit in the formal Financial market sector (Jones-renaud, 2016).

2.1.4 Small ruminant livestock production system in Ethiopia

In Ethiopia, almost all small ruminant livestock (sheep and goats) are produced in mixed crop-livestock and pastoral and agro-pastoral production systems which is characterized by low levels of input and technologies, feed scarcity, and pandemics disease challenge(A.L.Duguma and Debsu 2019). The mixed crop-livestock production system was mainly familiar in the highland agro-ecological areas and livestock production is a secondary production system next to the crop production system. The system comprises very small flock sizes due to shrinkage of grazing areas per household, limited feed availability, and land degradation (Mohammed and Wondimagegn, 2018). However, that pastoral and agro-pastoral production systems are found in the arid and semi-arid agro-ecological zones where most of the small ruminants (goat and sheep) are concentrated. These areas are the major sources of livestock products for the Ethiopian export market (Mohammed and Wondimagegn, 2018). Also, the pastoral system is characterized by wide-ranging communal grazing lands primarily using natural vegetation where thorny enclosures are common while the agro-pastoral system is a combination of pastoral and mixed crop-livestock production systems with periodic use of crop residues(Mohammed and Wondimagegn, 2018).

Due to a large number of indigenous small ruminant livestock (sheep and goats), their contribution to the agricultural and the overall national economy is far below compared to their potential (Legese and Fadiga, 2014). Similarly, compared to all other countries and the global average, the productivity of Ethiopian small ruminants (goat and sheep) was reported to be one of the lowest. This could be attributed to their various interactive factors such as poor genetic performance exacerbated by low input traditional production systems (Mayberry *et al.*, 2018). Cognizant of this fact, several small ruminant livestock (sheep and goat) improvement programs, aimed at

improving the performance of indigenous breeds without losing their capacity to survive in harsh environments, were conducted in the past years (Eticha,2016).

The researcher like Katema (2007) studies about livestock production system and their relative importance and potential for increased production by livestock species in varied areas differ markedly due to differences in resource endowment, climate, population, disease incidence, level of economic development, research support, and government economic policies. The livestock production system has the relative importance and potential for increased production by livestock species in varied areas differ markedly due to differences in resource endowment, climate, and population, and disease incidence, level of economic development, research support, and government economic policies (Thsedeka, 2007).

The study of Solomon Gizaw, A.al, et (2010) shows that in Ethiopia, small ruminant livestock (sheep and goats) are maintained under two broad production systems those are mixed crop-livestock production system and agro/ pastoral livestock production system. Estimates indicate that 99.72 percent of the sheep and 99.97 percent of the goats are indigenous breeds that are evolved to survive in harsh environments at the expense of all other factors production included (Mutimura *et al.*, 2018).

The study of Abera Afras (2019) indicates that in Ethiopia, most sheep and goats are produced in mixed crop-livestock and pastoral systems. Whereas agro-pastoral production systems are characterized by low levels of input, low levels of technologies, feed scarcity, and disease challenge.

The Study of Solomon *et al.*, (2014) shows that a mixed crop-livestock production system is typically familiar in the highland agro-ecological zones, and the livestock production system is secondary compared to the crop production system. In the highland agro-ecological system very small flock size sheep are found due to shrinkage of grazing areas per household, and limited feed availability. On the other hand, the pastoral and agro-pastoral production systems are found within the arid and semi-arid agro-ecological zones where the majority of small ruminants are concentrated.

Both arid and semi-arid agroecology system is the source of livestock products for the Ethiopian export market (Mohammed and Wondimagegn, 2018). But the pastoral agro-ecological system is based on wide-ranging, communal grazing lands primarily using natural vegetation where thorny enclosures are common while the agro-pastoral system is characterized by a mix of pastoral and mixed crop-livestock production

systems with periodic use of crop residues (Oumer et.al 2018). According to recent studies in the southern neighborhood of Ethiopia, Alilo, B.et.al (2018) acknowledged that smallholder farmers in crop-livestock mixed systems kept small ruminants mainly for cash generation.

In Ethiopia, sheep and goats are maintained under two broad production systems (Solomon *et al.*, 2014). The assembly system during which sheep and goats are kept is differing markedly. Differences exist not only in production systems but also in relative importance and potential for increased production. Variations arise because of differences in resource endowment, climate, population, disease incidence, level of economic development, research support, and government economic policies (Thsedeka, 2007).

The study of Shigute and Anja (2018) shows that the production systems of small ruminant livestock determined with the existence of private commercial and parastatal production systems on a limited scope. But based on the study of Getu (2020) traditional small ruminant production system classified into four categories, annual crop-based system; located in northern, northwestern, and central highlands, perennial crop-based; mostly found in southern and south-western highlands, livestock-based systems; these systems usually exist in agro-pastoral and semi-arid-areas and tiny ruminant dominated systems; found in pastoral and arid areas of eastern and north-eastern part of Ethiopia.

The study report of CAADP, (2005), shows that the production of small ruminant livestock also varies across the various agro-ecological zones within the country, where farmers within the highland areas predominantly rare goat, and sheep producing farmers within the lowland area mostly produce sheep and goats. The estimates show that the highland crop-livestock farming constitutes about 80 percent of cattle, 75 percent of sheep while the pastoral and agro-pastoral farmers like Afar region, Somali region, Borena, and others contribute about 75 percent of goats to the Ethiopian economy.

2.1.5 Role of small ruminant in livelihoods of smallholder farmers in Ethiopia

Livestock is an important component of smallholder farmer livelihoods in Ethiopia. Not only are they an important source of cash income, but they also provide draught power, milk, meat, manure, and skins. The study of Pica-Ciamarra (2005) shows that livestock plays an important role in ensuring food security and alleviating poverty. Small ruminants are generally considered as a main source of income for smallholders and they play crucial economic and cultural roles and are reared in different agro-ecological systems in Ethiopia as studies showed in Alaba and Dale districts of Southern Nations Nationalities and Peoples Region (Mekuria *et al.*, 2018). Also, the study of Matawork (2016) shows that small ruminant livestock is playing an important role in the economy of farmers in the high lands of the southern mixed farming system of Ethiopia.

According to recent studies in the southern part of Ethiopia,Getahun, (2008), found out that smallholder farmers in crop-livestock mixed systems kept small ruminants mainly for cash generation. In the Alaba and Dale districts of Southern Nations Nationalities and Peoples Region (SNNPR), small ruminants are also primarily kept for cash generation purposes (Deribe G. 2009). In the central Rift Valley of Ethiopia, where uncertainly of rainfall is observed, women and children are involved in owning and keeping small ruminants for immediate income generation (Belete .S 2009). Likely, smallholder farmers are mainly targeting small ruminant for the market rather than using for meat purpose which nowadays restricted to holidays or special occasions.

Most of the literature reviews show that Sheep and goats are highly adaptable to a broad range of environments. Certain breeds of Sheep and goats are tolerant to diseases and parasites like helminthic (Thsedeka, 2007).The small size small ruminant livestock (sheep and goats) has distinct economic, social, and biological advantages. Low individual values mean a little initial investment and a correspondingly small risk of loss by individual deaths. They occupy little housing space, lower feed requirements, and provide both meat and milk in quantities suitable for immediate family consumption, which is a vital insight of lack of means of preservation (Solomon, et.al 2014). For similar reasons, Alilo, et.al (2018) reported that sheep production is becoming a viable alternative for urban production considered as a way to satisfy parts of home consumption and income needs during a severe shortage of money.

According to the study of Pica-Ciamarra (2005), lack of adequate feed resources was the main constraint to small ruminant livestock production and more pronounced in the mixed crop-livestock systems, where most of the cultivated areas and high human population are located. Although the study of (Endeshaw, 2007; Tsedeke, 2007; Getahun, 2008) shows that in the southern part of Ethiopia, although the degree of shortage varies within farming systems/agro-ecologies feed shortage is reported as a serious constraint for little ruminant production (Deribe Gemiyu, 2009). The study of Belete .S (2009) shows that diseases are very serious constraints for small ruminant production in Ethiopia has been the high prevalence of diseases, parasites, high mortality amongst kids and lambs, diminishing the benefits of their high reproductive performance. Also, water shortage is additionally reported as limiting decision of smallholder farmers based on their agroecology mostly the lowland areas to a limited extent in midland agroecology especially in eastern, north-eastern, and south-eastern part of Ethiopia there is a critical shortage of water access. The study of (Adina and Elizabeth, 2006; Getachew et al., 2008) indicates that road is one of the really important infrastructures within the small ruminant livestock production and marketing system.

The report of (Berhanu et al., 2006) shows that the major problems in the small ruminant livestock production are traditional management system and not market-oriented producers, underdeveloped marketing and lack of infrastructural system, and poor credit access facility Also the study of (Endrias and Tsedeke, 2006) indicates that near market distance is an important barrier for small ruminant production and it positively facilitates the direct benefit through the sale of their livestock without the involvement of brokers.

The study of (Berhanu et al., 2006) indicates that poor marketing information, not having access to credit services negatively affects the benefit of the smallholder farmers. Also, the study of Markos Tibbo(2006) indicates that not having adequate infrastructure like road accessibility and lack of market facilities affect negatively the farmer's small ruminant livestock production decision.

According to the research study of Wondatir (2010) the livestock marketing structure of Ethiopia follows a four-tier system. Most actors of the first tier are local farmers and rural traders/rural assemblers who transact at the farm level. Those small traders from different corners bring their animals to the local market second tier. Traders/whole sealers purchase a couple of large animals or a reasonably sizable

number of small animals for selling to the secondary markets. Within the secondary market (third tier), both smaller and bigger traders operate and traders (whole sealers or retailers) and butchers from terminal markets come to shop for animals. Within the terminal markets (4th tier), big traders and butchers (wholesalers or retailers) transact a larger number of mainly slaughter-type animals. Consumers get meat through the purchase of the animals from terminal markets and slaughter reception or they all get meat from markets or they all access from butchers who process the meat via abattoirs. The marketing of sheep and goats is characterized by strong seasonality and subject to fluctuation. Demand and price increases during festival periods.

The study of Gizaw et al. (2013) shows that factors affecting market supply, as measured by the amount offered, include high demand during religious festivals, lambing season, quality and quantity of grazing, also as cash needs for crop inputs and, later, for food purchase before harvesting. Also, the research of Stroebel, et.al (2010) facilitating credit services positively enhances small ruminant livestock production and marketing system. However, climate change negatively affects the decision of smallholder farmers to produce small ruminant livestock production (Bachewe *et al.*, 2018).

The study result of Tu et al. (2018) shows that older individuals in rural sub-Sahara Africa tend to raise large numbers of small ruminants, compared with younger household heads because such older far farmers have higher household sizes (children and women) to shepherd and manage the small ruminant livestock. According to the study of Asafu-Adjei and Dantankwa (2001) also reports that the daily tasks associated with raising small ruminants in northern Ghana tend to be under the care of older household members because such members are less inclined to migrate to distant locations for alternative employment outside agriculture. Although, the findings of Oluwatayo and Oluwatayo (2012) who established that household size is an important factor in any rural development intervention have a positive impact.

The recent study profile of Baah et al. (2012) shows that the small ruminant farmers in urban Ghana communities are much older household heads compared to young hold heads. Mahabile et al. (2005) also find that older household heads, along with large household sizes, frequently manage livestock in Botswana. In a similar study for northern Benin, Dossa et al. (2008) report that older household heads are more willing to acquire and raise small ruminants than younger household heads.

The research study of Oluwatayo and Oluwatayo (2012) done in African countries shows that a positive relationship between a farmer‘s educational level, and ownership of small ruminant livestock. The study of Pender and Gebremedhin (2006) reports that higher formal education, jointly with higher income, influences livestock ownership. Similarly, Ampire and Rothschild (2010) observe that higher general education and technical training in livestock husbandry help farm households to realize the profit potential of livestock production and, therefore, are more likely to raise such animals as a business.

The study report of Udry (1995) shows that a smallholder individual with a higher family size has a higher tendency to own small ruminant livestock because such family members tend to have adequate labor for tasks such as herding, watering, and gathering supplemental livestock feed. Similarly, Verbeek et al. (2007) note that the likelihood of livestock ownership is higher for households with a higher dependency ratio (defined as the number of individuals in the household per small ruminant stock).

Various studies suggest a positive relationship between non-farm income and household members ‘decision to raise livestock (Duku et al., 2011). Many researchers published in developing countries and they all suggested a positive correlation between household heads ‘access to extension services and ownership of small ruminant livestock production innovations (Adam et al., 2010; Kalinda et al., 2012).

The study of (Abdeta 2011) shows the negative effect of climate changes on small ruminant livestock population dynamics was not fully investigated and analyzed in Ethiopia. Consequently, awareness creations on the effects of climate change on ruminant livestock population dynamics can provide appropriate management practices which enable to cope with the problems.

Additionally, the more experienced they are from cattle production, the more efficient their enterprise and more the farmers’ experience, the more their abilities to manage general and specific factors which affect the cattle business. This finding is in agreement with the result of (Sharaunga, 2015).

The study of Alilo, et.al (2018) concludes the climate change-related factors were grouped into four categories, namely flood, drought, increased temperature (heat stress), and decreased temperature. The feed-related factors that affected smallholder goat and sheep numbers were grouped into many categories. The socio-economic

significance of livestock in the highland mixed crop-livestock and lowland pastoral systems is widely recognized.

The study of Wakjira and Mulema (2019) indicates factors that influence the productivity of livestock production of male and female producers, particularly sheep and goats, are not established. Thus, intra-household data, including gender in small ruminant management hardly exist (Paudel et al., 2009). Additionally, the research study result of Ogunlade (2007) confirms that the male dominance of agricultural production activities in most parts of Nigeria, including Yobe State.

Most of the Studies published in developing countries support that there is a positive relationship between a farmer‘s age and small ruminant productivity (Fakoya and Oluwatayo, 2012).In literature, a farmer's age is used as a proxy to farming experience and is expected to influence small ruminant productivity positively (Epeju, 2010). Also, the research report of Oluwatayo and Oluwatayo (2012) shows the farmer's wisdom and social status improve with age and in this case, those farmers tend to control the productive resources required for increasing production and productivity. Similarly, Marinda et al. (2006) also claim that older farmers gained more skills and experience in livestock farming and this may be related to increasing small ruminant productivity. Among women, Dossa et al. (2008) claim that older women in rural areas tend to increase small ruminant productivity more than younger females because the former tends to control productive resources.

The effect of marital status on small ruminant productivity of both male and female farms is mixed. Such productivity is higher for married males and lower for married female farm managers. The marital status of a farmer is often used to indicate extra labor availability, especially of spouses and children (Epeju, 2010). Also, the finding Lawal& Musa (2015) agrees with that of Mohammed, who opined that marriage, is a sacred institution that is cherished among humanity which confers and expands the frontiers of responsibilities on the individuals.

Farmers with higher access to extension contact are more likely to increase small ruminant productivity than farmers with no or less extension access. Frequent contacts with extension services are expected to increase small ruminant production and productivity(Gebremedhin and Kennedy2015). Extension education improves farmer’s access to information on new farming Melketo, G.et, al (2020)to increase productivity. In addition, such education provides data on input and output markets to farmers (Marinda et al., 2006) to increase productivity. Hence, extension education is

expected to positively influence small ruminant productivity. Consistent with this hypothesis, Oluwatayo and Oluwatayo (2012) report a positive relationship between a farmer‘s (women) access to extension service and small ruminant productivity in Nigeria. Similarly, Zhang et al. (2012) find out that extension contact positively influences small ruminant technology adoption leading to increased sheep and goat productivity.

Access to extension service is expected to reduce the odds of farmers experiencing feed shortage and diseases and parasites attacks. Livestock extension serves to educate farmers on the best farm management practices such as improved husbandry methods, use of good livestock inputs as well as prevention of diseases and pests attacks on the farm (Bosman et al., 1996b; Elizabeth, 2006; Marinda et al., 2006). It follows then that, livestock farmers who have stronger ties with veterinary extension agents become less susceptible to diseases or parasite outbreaks (Turkson, 2003). In a study for Zambia, Kalinda et al. (2008) report a strong relationship between extension training and livestock ownership. Kalinda et al. (2008) conclude that farm households with access to extensive training have a higher probability of receiving financial credits to purchase inputs including veterinary drugs and feeds than households without extension training

Small ruminant productivity is higher for small ruminant managers (male and female farms) who access credit facilities from formal institutions more readily. the study result of Dzadze et al.(2012) observes that access to credit is highly related to increased livestock productivity, particularly among female farmers. Credit access enables farmers to participate in livestock production through the purchase of inputs to increase productivity. Consistent with this hypothesis, Faizal Adams (2015b) report a positive correlation between farmers who access formal credit and adoption of small ruminant technologies relevant to increasing productivity. Epeju (2010) also makes a similar observation where both male and female farmers ‘access to credit is a precursor to increasing agricultural productivity of which livestock is no exception.

According to Martin (2004) increasing livestock production is important for improving the income and welfare of the rural poor, for livestock enterprises to develop there is a need for more physical, financial, and human capital in the form of husbandry knowledge and skills. Technological innovations would be suitable to better utilize the available resources. Moreover, access to market outlets and input delivery systems will greatly promote livestock production.

However a large number of small ruminants and their contributions to the livelihood of the farmers and the national economy small ruminants productivity in Ethiopia is low due to different factors including, weak attention from scientists, administrators, and legislators, low genetic potential and policy issues, Market and institutional problem and the problem of credit facilities; shortage, seasonal unavailability and low nutritive (poor nutrition) value of feed and; the prevalence of different diseases and parasites labor shortage, lack adequate veterinary service, water shortage, capital shortage, market problem and capital shortage Afars A.et, al (2018).

Improvements were too slow due to a lack of identifying the actual on-farm situations by giving due attention to the socio-economic and social benefits of sheep and goats for smallholder farmers. Small ruminants (sheep and goat), kept in the vast geographical locations, diverse socioeconomic, demographic, and cultural settings, and a range of farming practices in the southern nation nationality people regional state (SNNPR) play an immense role in the livelihoods of rural farms (Afars Abera Alilo 2018).

2.2 Empirical Literature Review

Analytical works that examine socioeconomic determinants of small ruminant livestock production decisions in Ethiopia are very scarce. Even the available ones are mostly descriptive focusing on explaining the extent of the determinants of small ruminant livestock production only but cannot include socioeconomic and institutional factors.

2.2.1 Empirical review on socioeconomic determinants of the small ruminant livestock production decision

The study of Issa, et.al (2017) indicates that the main socio-economic characteristics of small ruminant producer farmers. The study indicates that the owning of small ruminant livestock is an important source of income and wealth accumulation. The findings of the Issa, et.al (2017) study show that women own small ruminants (goat, sheep, and both alone) and other backyard animals. The majority of the farmers (70.83%) were females. The mean age of the respondents was 41.21 years and the level of literacy was high (85%). About half of the farmers (50.83%) are Muslim. The mean rearing experience of the household respondent was 6.31 years, the mean household size of the farmers was six persons, the mean herd size of smallholder was

nine and the mean income was N10, 005 (USD 86.55) implying smallholders' characteristics. Additionally, the study revealed that goats are more popular than sheep. This may probably be because goats are perceived to be a lower-risk investment than sheep. The majority (72.5%) of the respondents are married. This may probably explain why in sub-Saharan Africa, marriage increases herd ownership and May probably be one of the common ways for women to gain access to land and their land rights.

The study of Berhanu Kuma (2012) studied in the haramaya district shows that the participation of farmers in extension activities such as technology demonstration, pieces of training, and field days enhance their capacity building and to adopt livestock production technologies and increase production and productivities of smallholders. However, only 7.9% of farmers hosted dairy technology demonstration, 14% attended dairy technology demonstration trial or field days and 17.3% attended the training. About 66% of farmers owned radio and 38% of them often heard agricultural programs broadcasted. About 17.3% of farmers accessed written materials on dairy production and 9.4% of them accessed once per week. This implies that the use of extension media was almost nonexistent and should be strengthened to reach the majority of farmers to boost the dairy value chain.

The study of Bilaliib Udimal et al. (2017) additionally shows that a sizeable proportion (35%) of the small ruminants was produced using the extensive system, while most farmers (57.50%) employed semi-intensive systems and very few (7.55) practiced intensive systems. Goat rearing implies the environment as it has been shown that intensive and semi-intensive systems constitute a nuisance to the environment than extensive systems. Small ruminants (goat and sheep) are kept around on small farms without large fodder. Hence, the majority (72.5%) of the farmers depend on forage grazing due to the high cost of concentrate. The result implies sustainable management of the agroecosystem.

Generally, empirical analysis of Ndebbio (2014) study shows that when the constraints were ranked in order of severity by farmers, lack of assets such as capital/credit (93.33%), lack of access to land (90.83%), pests, and diseases (86.7%) and feed shortage (81.7%) featured as most serious constraints. It has been shown that an unequal distribution of land could hinder economic growth Pica-Ciamarra (2005) Security of land tenure is the key to having control over major decisions in agriculture and livestock production: what technique to use, which products to sell, and which to

consume are examples. The law of succession influences the distribution of land, the security of tenure and it is often a pre-condition for access to capital/credit and a key link in the chain from household food security production to national food security (Oluwatayo, 2012). When people have more assets, they experience less vulnerability and insecurity in the face of risks; conversely, the more assets are eroded, the greater is people's vulnerability (Fakoya and Oloruntoba, 2017).

From the beginning, the main livestock production constraints in Ethiopia are feed shortages, livestock diseases, the low genetic potential of indigenous livestock, and lack of marketing information. Abattoirs play a very important role in the surveillance of various zoonotic diseases, and it allows for all animals passing into the human food chain to be examined for unusual signs, specific diseases Tesema (2020).

The study of A.Duguma (2019) aimed to identify opportunities and determinants of the small ruminant livestock production development of smallholder farmers in rural areas of the Bedele district by using a multiple linear regression model. In this study, the number of livestock has been taken as the dependent variable and ten explanatory variables were included. The result of the multiple linear regression models shows that six of the explanatory variables were found to be statistically significant at a 1% and 5% significance level. Determinants of livestock production development of smallholder farmers; shown by the studies are artificial insemination, the spread of extension services, educational level, expansion of veterinary facilities, market information, and availability of grazing land in the study area so that it must be given carry for those resources. The opportunities available for livestock production are the availability of water, availability of market information, the supply of improved breed, feed availability, credit services, veterinary supply, and mixed crop-livestock production system. The main weakness of this study did not include socioeconomic and institutional factors in a study.

The study result of Fikru and Gebeyew (2015) shows that small ruminants (sheep and goats) are primarily kept to generate income (53.3%) and milk production (24.3%) and majorities (96.6%) of goat owners extensively milk their flock for household's consumption. From the interviewed small household farmers, 42.2%, 20%, 11.1%, 8.9%, and 4.4% of them utilize communal grazing, private grazing, roadside grazing, indigenous browser, and riverside grazing are the major feed source for sheep and goat, respectively. Flock water is largely coming from ponds water (33.3%), harvested water (28.9%), and deep well (17.8%). The main lambing and kidding

periods of small ruminants occurred in the main feed availability season and death of small ruminants was reported by households over the last 12 months. The average mortality rate of suckling age groups for male lamb 1.9 ± 0.31, female lamb 2.02 ± 0.34 and male kids 1.36 ± 0.27, female kids 1.93 ± 0.29 for small ruminants (sheep and goat), respectively at smallholder household levels. The major constraints for small ruminant (goat and sheep) production system were: diseases and parasites (31.1%), drought (31.1%), feed and grazing land shortage (11.1%), water shortage (11.1%), and marketing problems (2.2%). The main problem of this study was compared with only socioeconomic factors rather than including institutional factors.

The study results of Zelalem Tamirat (2017) clearly show that in addition to the biological aspects being critical to the adoption of forage species, the socio-economic characteristics of the farmer and the farm are important factors in the adoption of forages among adopters of contour hedgerows. It was shown that when a farmer is facing a liquidity or capital constraint, there is less likelihood that adoption of forages was taken place because of the accompanying costs of adoption. Likewise, the role of having education access facilitates the uptake of technologies cannot be overemphasized, as implied by the results of this study. Education is not necessarily confined to formal education, but rather could encompass the whole range of training and extension activities that promoted information and knowledge dissemination concerning new technology.

The study of Legesse (2008) claims that in Ethiopia the majority of farmers (93%) mainly Muslims from the Kofele community manage only sheep compared with goats or both animals. However, Christians and other religious societies equally important use both animals during festival seasons. Thus, it can be hypothesized that Muslim farmers are more likely to rear sheep alone compared with goat alone or both sheep and goat animals, all other things remains constant.

The study of Johnson and Aminu (2020) reported that the sale return from sheep and goats is positively affected by the number of small animals owned by smallholder farmers. Also, the research study of Sila (2020)shows demographic and socioeconomic factors like age, family size, income, and small animal rearing experience determine the production of small ruminants in Abia State, Nigeria. Similarly, the study reported by Dossa, R.et.al, (2008)concluded that gender, ethnicity, and perception of risk related to species are major determinants of rearing small ruminant livestock (goat and sheep) in Southern Benin.

Many studies show that Factors affecting the decision of farmers' small ruminant livestock production but, there is scanty literature on socioeconomic and institutional factors affecting livestock production decision in Ethiopia. Several socioeconomic and institutional factors determine the decision farmer's small ruminant livestock production likes, farmer's education level, access to have extension visits by extension agents, agroecology, farm size, access to have formal credit service, religion, age, and distance from nearest market centers (Kuma, 2012).

2.2.2 Empirical studies of Multinomial Logistic regression model

The empirical literature shows that the determinants of livelihood diversification strategies in Ethiopia in general and study areas in particular in the local context were less researched. The study of Tariku Loreto (2019) used the multinomial logistic regression model to examine the determinants of rural household livelihood diversifications strategy in the South Gondar zone, using cross-sectional data. The study was done by researchers (Res, H.et, al (2012) investigated livelihood diversification status, challenges, and factors influencing pastoral household's engagement in livelihood diversification activities in Bale zone, Ethiopia pastoral livelihood by using The study of Dawa(2017) used a multinomial logistic regression is useful in analyzing data where the researcher is interested in finding the likelihood of a certain event occurring. In other words, using data from relevant independent variables, multinomial logistic regression is used to predict the probability (p) of occurrence, not necessarily getting a numerical value for a dependent variable (Gujarati, 1992). Dougherty (1992) explained that the procedure for formulating a multinomial logistic regression is the same as for binary logistic regression. Whereas in binary logistic regression, the dependent variable has two categories, in multinomial logistic regression, it has more than two categories. Thus, multinomial logistic regression is an extension of binary logistic regression. The model OLS cannot be used because it violates the fact that the probability has to lie between 0 and 1 if there is no restriction on the values of the independent variables hence the multinomial logistic regression guarantees that probabilities estimated from the Logistic model will always lie within the logical bounds of 0 and 1 (Gujarati, 1992).

The multinomial Logit model is therefore used to model choices in this study because it relies on the assumption of independence of irrelevant alternative (IIA) which is not always desirable. Thus assumption state that the odds of preferring one class over another do not depend on the presence or absence of other "irrelevant" alternatives. It

also assumes that data are case-specific that is each independent variable has a single value for each case. The advantage of the Multinomial Logit model is that it permits the analysis of decisions across more than two categories, allowing the determination of choice probabilities for different categories (Woodridge, 2002). On the contrary, the binary Logistic models are limited to the maximum of two choice categories (Maddala, 1983) a multinomial logistic model.

The research study of Mulie (2014) used a Logistic model to analyze factors affecting livestock household milk market entry decision and used the Tobit model to analyze marketed milk surplus in Ada'haLiben district in the Oromiya region. Findings revealed that the education level of household head, extension visits, and income from nondairy sources had a positive relationship with entry decisions. He also found that dairy cow breed, loan, income and extension visit, education level of a spouse, and distance from milk market are related to marketed surplus positively. Distances from district and education level of household head negatively affected marketed milk supply. Nevertheless, he did not consider the contribution of household access to milk market information, credit sources, and separate contributions of modern and traditional production techniques. However, the study model cannot include socioeconomic factors and uses only two choices these show the main weakness of the model.

2.3 Conceptual Framework

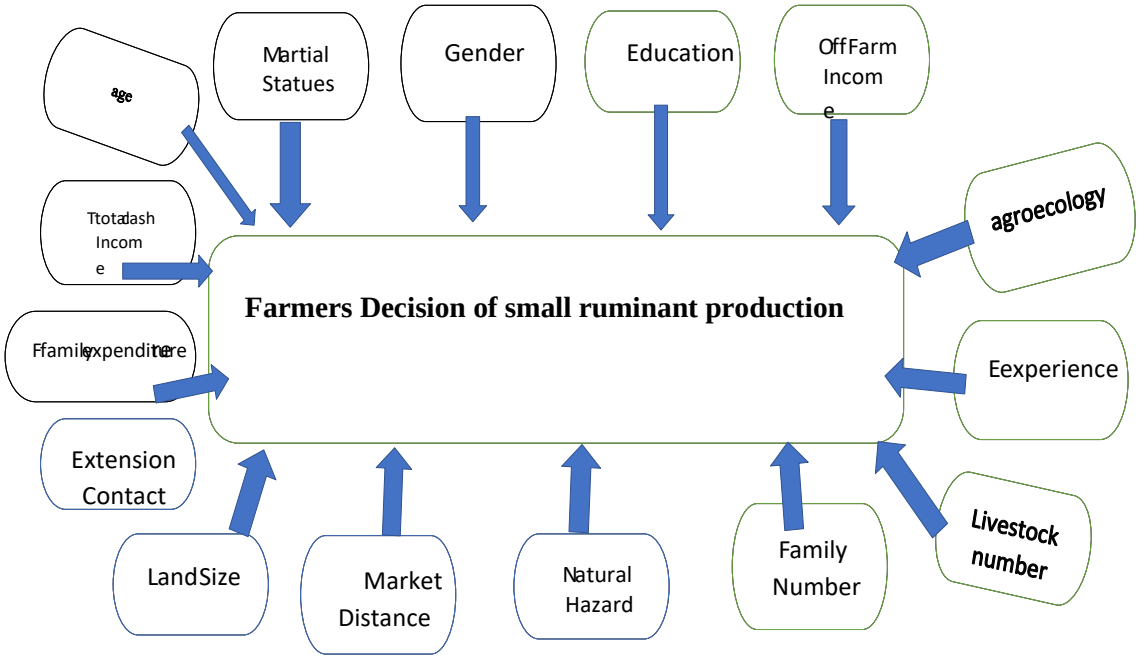
2.3.1 Conceptual framework of the small ruminant production system in Ethiopia

The conceptual framework below in the diagram illustrates the interrelationships in the study, the key variables involved, and how they are interrelated. Socioeconomic characteristics are the background factors like (age, education level, gender, household income, and household income), institutional factors like (access to extension service, access to credit service) and market factors like (distance to the nearest market) influenced farmer's small ruminant production decision. The concept of small ruminant production has a long history in the world and Small ruminant production systems form a component of farming systems (Devendara, 2009).

Thus, the effect of explanatory variables like age of household head, gender of the household head, family size of household, level of education of the household head, Total livestock ownership, size of landholding, total cash income in birr, Income from

off-farm activities, family expenditure, experience in small ruminant production, access of extension contacts, natural hazard, distance to the nearest market center and agroecology on outcome variables, socioeconomic determinants of a small ruminant livestock production decision. This may take the form of the following form which gives figurative knowledge on the impact of external variables on the internal variable.

The study conceptualizes those farmers' small ruminant production decisions as determined by socio-economic and institutional factors. Socio-economic factors include; household size, age, gender of the household head, education level, and herd size, and off-farm income. Institutional factors include; access to extension services, access to credit from institutions. These factors also determine the household's extent of a small ruminant production decision. The small ruminant production decision is mainly influenced by the market factors which include; infrastructure, distance to the market, Information availability, means of transportation, and road types. The extent of market participation and the choice of marketing outlets consequently determine the household income that impacts on household's livelihoods.



Source:- self-conceptualization

Figure 1: Diagrammatical Conceptual frame of a small ruminant livestock production decision

2.4 Summary of Literature Review

All the literature has shown that small ruminant livestock production is very important to the households in rural communities, yet its potential is limited by various socioeconomic, demographic and institutional (policy) factors. The researches published by the livestock sector to improve the production system of small ruminant livestock is much emphasis only on the technical aspects of production, with little recognition to the socio-economic, demographic, and institutional factors that determine the decision of farmer's small ruminant livestock production. But the main socio-economic, demographic, and institutional factors that determine the decision of farmer's small ruminant livestock production are not researched in detail as Ethiopian and Southern Nation Nationalities people's Regional context. The socio-economic literature reviewed shows that the impact of most of these technical aspects in livestock development interventions to the traditional system has been minimal because such programs often do not reflect the production objectives and livelihood needs of local smallholder farmers. Farmers 'production objectives and household livelihood needs associated with managing small ruminants (goat, sheep, and both alone) are influenced by socioeconomic and demographic factors, as well as policy (institutional) factors. Hence, the need to expand the broad range of small ruminant livestock production the socio-economic dimensions that capture factors that influence farmers 'decision to participate in small ruminant production, institutional (extension service access and having to access of credit service) and other demographic, and socioeconomic constraint analysis cannot be overemphasized.

Many kinds of literature show that smallholder farmers own small ruminant livestock's not only for marketing purposes (sales) but also to perform important nonmarket functions (manure).

For the determinants of small ruminant production, the literature reveals that depending on whether the dependent variable is nominal and more than two dependent, the multinomial logistic, Poisson/Negative Binomial can be applied in his study, the Poisson/Negative Binomial is applied since the dependent variable is categorical, measure the probability of farmers' decision as to the number of small ruminants livestock's owned.

The multinomial logistic regression model, on the other hand, is used to determine socio-economic factors that influence farmers' decisions of small ruminant livestock

production, where the dependent variable is more than two and discrete. Generally, this chapter follows discusses the theoretical, empirical pieces of evidence and conceptual frameworks besides socioeconomic determinants of small ruminant livestock production decisions for the study. Finally, this chapter cannot conclude that all research studies related to socioeconomic determinants of small ruminant livestock production decision but some kinds of literature are included and some weakness of previous researchers,their study results and model applications were discussed briefly.

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter mainly provides the research methodology deployed in the study to achieve the research's main objective. The chapter presents the description of study areas, types and sources of data, method of data collection, sampling methods and research design, model specification, variable description, and data analysis methods described briefly.

3.1 Description of the Study Area

The study was conducted in the Kacha Birra district which found in Southern Nation Nationalities and Peoples Regional State (SNNPR) in Kambata Tambaro Zone administrative zone and is located 297 km away from Addis Ababa, with driving direction of Shashamne and 133.4 km away from Hawassa which is the capital of Southern Nations. Geographically Kacha birra district lies between latitude 70 14' 60" N and longitudinally 37^0 44' 59.99" and it contains 21 kebele and its capital town is Shinshicho bordered on the south by an exclave of the Hadiya Zone, on the southwest by the Wolayta Zone (WZ), on the west by Hadaro Tunto Zuria woreda (HTZW), on the northwest by the Hadiya Zone (HZ), on the north by Doyogena and Angacha, and on the east by Kadida Gamela woreda (KGW).

Based on Altitudes the district has three agro-ecological zones with 30 percentage of woredas Kola (Lowland <1500m), 29 percent Woina Dega (Mid-Altitude 1500-2300m), and 41 percent of Dega (Highland >2300m) and it was one of the most densely populated areas in the country with an average of 290 peoples per km^2. Based on the 2007 census conducted by the Central Statistical Agency, the woredas total population of whom males 55, 827 females 57,860 total113, 687are females CSA,(2007) from the entire population of woreda 15,848 are urban dwellers and living in rural areas and 7, 565 living in a populated area.

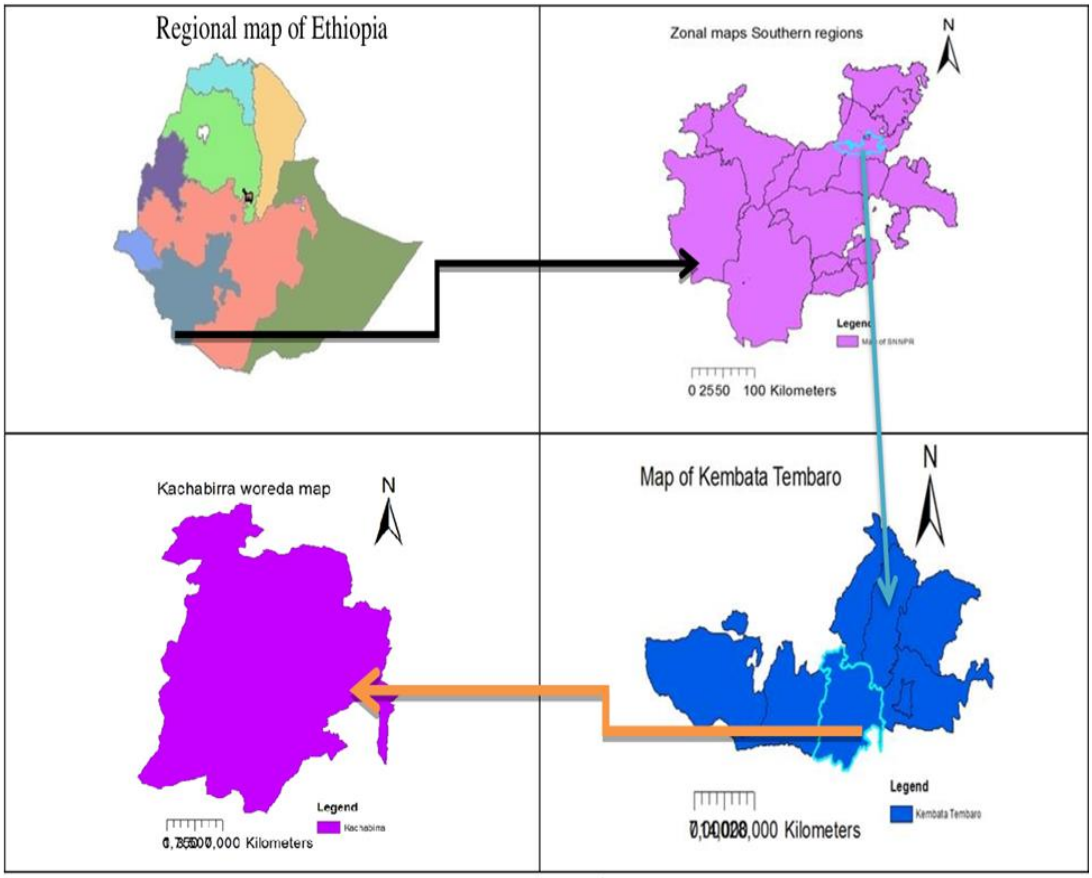


Figure 1: Location map of the study area

Figure 2: ***Locational Map of the Kacha Birra woreda***

Source Kacha birra woreda finance socioeconomic data

3.2 Sampling Design Techniques and Procedures

The target population of the study was the smallholder farmers who produce small ruminant livestock's in the Kacha Birra district. A multi-stage (three stages) sampling procedure was used in the selection of representative samples. The first step involved the purposive selection of Kacha Birra based on its potential for small ruminant livestock production, agroecology. Secondly, five kebeles (Awaye, Buge, Wererama, Lein, and Eta) were selected purposively based on their agroecology (highland, midland, and low-land) and a large number of small ruminant livestock productions. Finally, a total of 297 farmers were selected from selected kebeles by randomly using a simple random sampling method to give a proportionate chance to each kebele with the help of a kebele extension officer. The required sample size was determined by using Taro Yamane's (1967) sample size determination formula at 95% confidence level and 0.05 (5%) level of precision. Probability Proportional Size (PPS) sampling technique was used to determine the number of sample households from each kebeles.

$n = \frac{N}{1+N(\varepsilon)^2}$Where as **ε**= marginal of error and N is total households found in the study area that produces small ruminant livestock. Whereas N=1150 household headed found in this five kebeles, e=0.05 putting this into a

Formula $n = \frac{N}{1+N(\varepsilon)^2}$=$\frac{1150}{1+1150(0.05)^2} = \frac{1150}{1+1150(0.0025)}$ =$\frac{1150}{3.875}$=296.774≈297

To fix the sample size of the selected kebeles respondents proportionate sampling formula. So that for those selected individual kebeles sample population N_i should be calculated to distribute questionnaires and interviews proportionally. The total households in each kebeles taken from Kacha Birra district Finance and Economic Development office from socioeconomic data core process analysis data from selected five kebeles is 1150 households (KWAO).

Lein (N_1 =215), Eta (N_2 =260), Buge (N_3 =245), Awaye (N_4 =180) and Wererama (N_5 =250) by using a formula of proportionate sample for each kebele.

$n_i = n.\frac{N_i}{N}$, i =1, 2,3,4,5

$n_1 = 297x.\frac{215}{1150}$= 56,$n_2 = 297x.\frac{260}{1150}$= 67,$n_3 = 297x.\frac{245}{1150}$= 63 $n_4 = 297x.\frac{180}{1150}$= 46

and $n_5 = 297x.\frac{250}{1150}$= 65Where, $N_i \Rightarrow$ *total number of households of i kebeles*

Table 1:sample kebeles and sample size respondents

No	**Name of kebele**	**Type of agroecology**	**Number of HHs**	**Sample selected**
1	Buge	Low land	245	63
2	Awaye	Highland	180	46
3	Lein	Highland	215	56
4	Wererama	Midland	250	65
5	Eta	Highland	260	67
	Total		1150	297

Table Source self-computation survey data from(KWAO, 2021)

3.3 Research Design and Data Collection

To achieve the objectives of the study with a high degree of validity and reliability, a combination of quantitative and qualitative research approaches is used. The qualitative method is used to collect first-hand participant information and a deep understanding of socioeconomic determinants of small ruminant livestock production

decisions in the study area. On the other hand, a structured questionnaire was developed to collect quantitative data from the sampled households.

3.3.1 Types and Sources of data

Both primary and secondary data are used in targeted study areas. Important secondary data are obtained from various sources, including journal articles; unpublished databases district assemblies, and information from kacha birra woreda food agricultural offices. These data help to describe the study areas and also provide sufficient information on the background of the study. The cross-sectional or primary data are collected from the sampled households in the study area. The survey used cross-sectional data collected in 2021. There were two sets of data are collected during the survey time. The first set was a random sample 297 of households selected from five kebeles in study areas. The specific information collected includes demographic and socioeconomic characteristics of data. Although to strengthen the data collection process and to have real information pre-interview discussion was made with key administrates of kebeles, and from each kebeles, the kebeles development agents (top-up) officers were included in data collection time. In addition, data, whether a farmer-owned goat, sheep, or both owned, are collected. The second set of data was on only households who owned small ruminant livestock's are interviewed based on questionnaires well-structured detail and the interview questioners were developed in the Amharic language.

3.3.2 Data Analysis

The data collected is coded and entered into Microsoft excel version 2007 and STATA version 13 and SPSS version 22 software for analysis. Analytical techniques applied include frequency table, central tendencies (mean), the measure of dispersion (standard deviation), percentages, besides mean comparisons of independent samples, and relation of sample category with variables in questions. The t-test (compassion of means for continuous explanatory variables) and (χ^2)–tests (for dummy explanatory variables) as well as various regression models like multinomial logistic regression, and, negative binomial regression models were applied to analyze socioeconomic determinants of a small ruminant livestock production decision and to analyze the probability of explanatory variables affecting the decision of farmers decision respectively.

3.4 Theoretical Model

3.4.1 Random Utility Maximization

This study was built on two utility theories: the utility of random utility and the utility maximization theory. The decision of farmers to produce small ruminant livestock alone is not a binary choice (yes/no), because due to the nature of the dependent variables, that was more than two goat alone, sheep, alone, or both alone decisions.

The decision of farmers to alone goats, sheep, or both was considered under the general framework of utility maximization (profit maximization) Norris and Batie, (1987); Pryanishnikov and Katarina, (2003). According to Greene, (2003), the Random Utility (RU) maximization model is appropriate to investigate the household's choice behavior, The Random Utility (RU) model specifies that an individual (Economic agent) (farm household) is confronted with a choice (sheep, goat, or both); then such individual chooses one alternative over the others (Greene 2003; Ouma et al. 2003). That is the farmer chooses the option with higher utility (net benefit or well-being) over others. Farm household utilities are indirectly observed, and the individual actions are seen through the choices they make (decided).

The utility is a benefit from a small ruminant livestock producer n can derive from choosing a type of small ruminant $\boldsymbol{i}$from a choice set of alternatives$\boldsymbol{J}$. Every farmer is assumed to be a rational decision-maker relative to his/her choice.

Consider a small ruminant livestock producer J who is confronted with the goat alone, sheep alone, and both alone decision on the type of small ruminant animals, the decision to alone goat, sheep or both of such a species can be described as a discrete choice. The decision of a farmer to produce a small ruminant livestock type depends on his perceived utility of the product and the farmers' characteristics. The utility-maximizing behavior of the farmer is reached when the utility associated with production $\boldsymbol{i}$exceeds the utility; he/she can derive from goat, sheep, or both alone decisions.

Mathematically assume that Yj and Yk are households' utility for options (goat, sheep, or both alone), denoted by and, respectively.

The corresponding Random linear utility model may be specified as:

$\Pr(J) = \Pr(Ij^{*})$ .....equation (1)

$\Pr(Uj > Uk, k\#j)$ .....equation (2)

$\Pr(\beta jXi + \varepsilon j - \beta kXi + \varepsilon j > \frac{0}{x}, k\#j)$ .....equation (3)

$\Pr(\beta jXi - \beta kXi + \varepsilon j - \varepsilon k > \frac{0}{x}, k\#j)$ .....equation (4)

$\Pr(x^* xi + \varepsilon * > \frac{0}{x}, k\#j)$ .....equation (5)

$\Pr(x^* xi + \varepsilon * > \frac{0}{x}, k\#j) = F(\beta^* Xi)$ .....equation (6) is called the cumulative distribution function of where Pr is the probability of function and Uj, Uk and $Xi$are defined as follows $\varepsilon *$.

$\varepsilon * = (\varepsilon j - \varepsilon k)$ .....equation (7), shows the random disturbance term in a model.

$\beta j * = (\beta j - \beta k)$ .....equation (8), shows a net influence of vector of independent variables which influence the decision of goat alone, sheep alone and both alone.

$F(\beta^* Xi)$ shows a cumulative distribution of $\varepsilon *$ evaluated by $(\beta^* Xi)$ and the distribution function of F depends on the error term$\varepsilon *$. whereas $U_{j=} \beta j\, Xi + \varepsilon$ and $U_{k=} \beta k\, Xi + \varepsilon$ whereas Uj and Uk represent utilities associated with choices in option (j) and option(k)respectively; is the vector of explanatory variables that influence the option, are regression parameters while are error terms assumed to be independently and identically distributed (Maddala,2001).

3.4.2 Empirical Model Specification

The methodological framework and the selection of the econometric model depend on the main objective of the study and, specific objectives verified in the study. To analyze socioeconomic factors that determining the discrete choice of farmers decision to alone small ruminant livestock (sheep, goat, or both alone) without intrinsic order having more than two dependent variables which lead deploy the multinomial logistic model to analyze the data(Maree ,2012) The model is written as follows **J** categories of dependent variables represented as

$$\boldsymbol{log}\frac{\boldsymbol{Pr(Y=J)}}{\boldsymbol{Pr(Y=J^*)}} = \boldsymbol{a} + \beta_{1X_{1+}}\beta_{2X_{2+}}\beta_{kX_{k+}}\varepsilon \ldots\ldots\ldots\ldots\ldots\ldots \textit{equation(9)}$$

Whereas $\boldsymbol{J}$ represents a given category of sheep alone, goat alone, and both alone. Thus, the variable was investigated with $\boldsymbol{J = 3}$ categories (goat, sheep, or both alone). Thus, y represented a little ruminant type raised (sheep alone=1, goat alone=2, or both alone=3), while $\boldsymbol{X_i}$ represents the personal status of the respondents, economic variables (age, religion, sex, farm size, marital status, agroecology, institutional variables and$\boldsymbol{J}^*$ is a reference category. Additionally, α is the constant term, and β_i are the parameter estimates of each explanatory variable and show the magnitude or

direction. Inferences about the coefficient (**β**)are often explained as the change in log odds concerning a unit change within the explanatory variable, assuming other factors are held constant. Hence, a positive or negative coefficient increases or decreases the log odds. Moreover, expressing the log odds (parameter estimates) in odds ratio (exponentiation the coefficient (e) is the best, easier to interpret, and easy for understanding (F Adams and Ohene-Yankyera,2014). How interpreting with odds ratio does not show how much dependent variable is affected by explanatory variables.

The choice of a farmer's decision to alone small ruminant **β** is parameters to be estimated and ε is a randomized error. With **j**alternative choices, the probability of choosing small ruminant livestock production decision j is given by,

$\boldsymbol{prob(i=j)} = \frac{\boldsymbol{\varepsilon_{zj}}}{\sum_{k=0}^{j} \boldsymbol{\varepsilon_{zk}}}$……..equation(10), Where $\boldsymbol{Z_j}$ is a choice and $\boldsymbol{Z_k}$ is a choice that could be chosen (Greene, 2000). The model estimates are used to determine the probability of choice of a choosing small ruminant livestock production decision***J*** factors that affect the choice $\boldsymbol{X_i}$ with many alternative choices, the log odds ratio is computed as

$\ln(\frac{p_{ij}}{pi_j^*}) = \alpha + \beta_{1X_{1+}}\beta_{2X_{2+}}\beta_{kX_{k+}}\varepsilon$…….equation(11)

$\mathbf{P_{ij}}$, and $\mathbf{P_{ik}}$ are probabilities that a farmer chose a given outlet and alternative outlet of small ruminant livestock production decisions respectively. $\ln(\ln(\frac{p_{ij}}{pi_j^*}))$ is a natural log of the probability of choice $\boldsymbol{J}$ relative to probability choice $\boldsymbol{k}$, and **α** is a constant, **β** is a matrix of parameters that reflect the impact of changes in $\boldsymbol{X_i}$ on the probability of choosing a given outlet, **e** the error term that is independent and normally distributed with a mean zero.

However, the parameter estimates of the multinomial logistic model provide only the direction of the effect of the independent variable on the dependent (response) variable but do not represent either the actual magnitude of change or probabilities.

The Marginal effects (marginal probabilities)are a measure of the instantaneous effect that a change in particular explanatory variables has on the predicted probability of when other covariates are kept constant.

Marginal effects of the attributes on choice are determined by getting the differential of the probability of a choice and it is given by,

$(\delta) = \frac{\partial pi}{\partial Xi}$=$pi(\beta j - \sum_{k=0}^{j} pk\beta k)$=pi ($\beta j - \beta$)……equation (12)

The multinomial logistic model is given below;

$p_{ij} = \beta_0 + \beta_{1}x_{1+}\beta_{2}x_{2+}\beta_{k}x_{k+}\varepsilon$……..…equation (13)

Factors that determine small ruminant production decision of farmers Choice

$P_{ij} = \beta 0 + \beta 1$ AGE + $\beta 2$ FMSIZE + $\beta 3$ MARTL STAT + $\beta 4$ TOTLIVSTCK + $\beta 5$ INC OFF FRM+ $\beta 6$ EXPRNCE SRPROD + $\beta 7$ EXTNSION CONTCT + $\beta 8$ AGROLGY + $\beta 9$ SIZELAND + $\beta 10$ RELGN + $\beta 11$ CRDT ACCESS+ $\beta 17$ RELGION error term…….equation (14)

The marginal effects measure the expected change in probability of a particular choice being made concerning a unit change in an explanatory variable (Greene, 2003). The independent variables expected to affect the decision of farmers to produce small ruminant livestock production likes, demographic characteristics (age, marital status, sex, family size, and education status of household), the socioeconomic variables (number of livestock, farmland size), land characteristics (agroecology), and Institutional variables (credit access, market information, and access to contact extension service).

The odds ratio (OR), which is the ratio of the probability of happening of an event to the probability of not happening of that event associated with a change in the independent variables is calculated. The variables having higher multi-co linearity were dropped in the final model to improve the values of the variables but OR cannot express the farmer's choice of a small ruminant livestock production decision and canot show how much dependant variable is affected by explanatory variables.

3.4.4.3 Wald test statistics

The Wald test statistics are used for testing the significance of an individual or each parameter in the multinomial logistic regression model.

That the test is used to test (Wald) =$\frac{\beta i}{se(\beta i)}$ equation (15) whereas βi is the parameter and $se(\beta i)$ standard error the parameter beta. That is Wald test of statistics uses to test each variable and tested as follows

$H_{o,}$ $\beta i=0$ against $H_{A=}\beta i \# 0$ whereas βi , i=1,2,3….17 explanatory variables. when the computed values of /Wald/ $\leq Z(1-\alpha/2)$ we don't reject the null hypothesis, while as /Wald/> $Z(1-\alpha/2)$ we reject the null hypothesis.

3.4.3 Test of the overall goodness of model fit

It is used to assess the overall goodness fit of the model. The likelihood ratio test looks at the model chi-square (χ^2) difference) by subtracting deviance (-2L) for the final (full) model from deviance for the intercept-only model. The degrees of freedom in this test equals the number of terms in the model minus one (for the constant). This is the same as the difference in the number of terms between the two models since the null model has only one term. Model chi-square measures the improvement in the fit that the explanatory variables make compared to the null model. The likelihood ratio test is thus a test of the overall model. The overall test statistic for the likelihood ratio test is given as Likelihood ratio test: $\mathbf{G^2 = -2(L\ null - L_k)}$……..equation (16) where: L_{null} is the log-likelihood of the null model andL_k is the log-likelihood of the model comprising k predictors. Under the global null hypothesis,

H_O =all parameters in the model are equal to zero in the likelihood ratio test. Statistic, G^2 , follows a Chi-square distribution with p degrees of freedom.

3.4.4. Estimation of model parameters

In fitting the logistic regression model, the maximum likelihood estimator (MLE) is the most common method used to estimate parameters included in the model. The maximum likelihood method seeks to maximize log-likelihood which reflects how likely it is (odds ratio) that the observed values of outcome may be predicted from the observed values of the predictor, let y_1, y_2……yn be n independent random observations corresponding to random variable Y_1, Y_2……Yn respectively.

L=$f(y_1,\ y_2 \dots \dots y_n) = \prod_{i=1}^{n} \prod_{i}^{y_i} y_i\ (1-\pi_i)^{yi}$…….…… equation (17)

3.4.5 Econometric Approaches to modeling farmers small ruminant livestock production decision

To analyze the socioeconomic determinants of small ruminant livestock production decisions the multinomial logistic regression model is suitable, and a researcher is interested to find the likelihood of a certain event occurring. In other words, using data from relevant independent variable multinomial logistic regression is used dependent variables Guajarati, (1992), states that the odds of performing one class over another don't depend on the presence or absence of other "irreverent alternative". Also, the multinomial logistic regression was used in this study because the choices of farmers are multiple or more than two rather it is better and it relies

upon the assumption of independent irrelevance alternative which is not always desirable.

3.4.6 Poison Regression Model

Since farmers have a discrete choice of small ruminant livestock production decision which follows a farmer random utility choice and the parameter estimates does not show by how much a particular explanatory variable increase or decrease the likelihood of decision of farmers small ruminant livestock production. In such a case we can use the count-count regression model and we can calculate the marginal effect of the independent variables (Woodridge, 2002).

A Poisson regression model allows modeling the relationship between a Poisson distributed response variable and one or more explanatory variables. It is suitable for modeling the number of events that occur in a given period or area.

The standard Poisson distribution is a fundamental distribution to understand regression counts models. It was developed to model discrete count data since it is easy to interpret in many aspects. According to Sturman (1999), the Poisson comes with two restrictive assumptions. First, the variance and mean of the count variable are assumed to be equal. The other restrictive assumption of Poisson's models is that occurrences of the event are assumed to be independent of each other. The Poisson regression model assumed that the mean and the variance of the response variable is equal but in practice, the observed variance of the data may be larger than the corresponding mean. In these cases, the data is said to have involved overdispersion, the variance is larger than the mean, for such situations, the Poisson model is not appropriate and the Negative Binomial Regression (NBM) model is appropriate (Osgood, 2000). However, if the variance is larger than the mean, it induces deflated standard errors and inflated standardized normal (Z-normal) value and these make Poisson regression less adequate (Elhai et al, 2008). Some researchers suggest that when there is an over-dispersion it is better to use other models, such as negative binomial which can take care of the Dispersion problem (Cameron and Trivedi, 1998).

The scalar dependent variable,y_i is the number of occurrences of the event of interest, and,x_i is the vector of linearly independent explanatory that are thought to determine,y_i A regression model based on this distribution follows by conditioning

the distribution of,y_i on a k-dimensional vector of covariates,$x_i = (x_{1i+x2_i} + xk_{\beta k})$ and parameters β, through a continuous function $E(^{yi}/_{xi})$ (Cameron and Trivedi,1998).

Poison regression is used to the response variable(Y) that is counts and it tells which explanatory variable (X) has a statistically significant response to (Y).

The Poisson probability density function below directly follows the derivation De Groot &Schervish (2002)

$\frac{e^{-\lambda}\lambda^x}{x!} = f(\frac{x}{\lambda})$, equation (18) For x=0, 1, 2…whereas x is a random variable with a discrete distribution, and it is supposed to be a non-negative integer, and λ is a mean under the probability function of X following the Poisson probability function.

The probability of choosing K activities given independent trials is represented by the binomial distribution (Dusen, 2000):

$[Y = k] = \binom{n}{k} p^k (1-p)^{n-k}$ …… equation(19)

Whereas $\binom{n}{k} = \frac{n!}{k!(n-k)!}$ ……..equation (20) and p is the probability of choosing k activities.

The random utility modeling of a repetition of a series of binomial choices asymptotically converges to a Poisson distribution as n becomes large and p becomes small (Heller stein and Mendelsohn, 1993)

$\lim n\sim\infty \binom{n}{k} p^k (1-p)^{n-k} = \frac{e^{-\lambda} u^k}{k!}$.....equation (21)

Where λ=p/n is the mean of the distribution, (mean sheep, goat or both herd size managed per farm household head). The above model can be used to determine the probability that a household chooses sheep and goat herd size k given a parameter, the sample mean.

3.4.3 The negative binomial regression model

The Poisson regression model assumed that the mean and the variance of the response variable is equal but in practice, the variance of the dependent variable these contradicts the assumption of Poisson regression, we can reject Poisson regression instead we can use Negative Binomial Regression (NBM) model is appropriate Osgood (,2000) to determine the probability of a smallholder farmer chooses sheep alone, goat alone or both alone, and to analyze the various effect of explanatory variables (socioeconomic and institutional factors)on the decision of farmers small ruminant livestock production.

The negative binomial distribution having gamma distribution written as

$$\Pr(Y = y_i/\mu_i, \alpha) = \frac{\Gamma(y_i+\alpha^{-1})}{\Gamma(y_i+1)\Gamma(\alpha^{-1})} * \left(\frac{\alpha^{-1}}{\alpha^{-1}+\mu_i}\right)^{\alpha^{-1}} * \left(\frac{\mu_i}{\alpha^{-1}+\mu_i}\right)^{y_i} \text{.....equation (22)}$$

$$\text{Whereas } \mu = t_i\mu\alpha = \frac{1}{v} \text{.....equation(23)}$$

The parameter μ is the mean incident rate

The result below makes use of the following relationship derived from the definition of the gamma function

$$\ln\left(\frac{\Gamma(y_i+\alpha^{-1})}{\Gamma(\alpha^{-1})}\right) = \sum_{j=0}^{y_i-1} \ln(j+\alpha^{-1}) \text{.....equation (24)}$$

The negative binomial regression model

In negative binomial regression, the mean of y is determined by the exposure time t and a set of k regressor variables(x). The expression relating to these quantities is

$$\mu_i = \exp(\ln(t_i) + \beta_1 x_{1i} + \beta_2 x_{2i} + \cdots \ldots + \beta_k x_{ki}) \text{.....equation (25)}$$

Often $x_1 \equiv 1$ in which case β_1 is called the intercept. The regression coefficients $\beta_1, \beta_2, \ldots \beta_k$ are unknown parameters that are estimated from a set of data.

Using this notation, the fundamental negative binomial regression model for an observation I is written as

$$\Pr(Y = y_i/\mu_i, \alpha) = \frac{\Gamma(y_i+\alpha^{-1})}{\Gamma(\alpha^{-1})\Gamma(y_i+1)} * \left(\frac{1}{1+\alpha\mu_i}\right)^{\alpha^{-1}} * \left(\frac{\alpha\mu_i}{1+\alpha\mu_i}\right)^{y_i} \text{.....equation (26)}$$

The regression coefficient is estimated using the method of maximum likelihood. Cmeron (2013) &Lawless (1987) gives the logarithms of the likelihood function as

$$L = \sum_{i=0}^{n}\{\ln[\Gamma(y_i+\alpha^{-1})] - \ln[\Gamma(\alpha^{-1})] - \ln[\Gamma(y_i+1)] - \alpha^{-1}\ln(1+\alpha\mu_i) + y_i\ln(1+\alpha\mu_i) + y_i\ln(\alpha) + y_i\ln(\mu_I)\} \text{.....equation (27)}$$

Rearranging gives

$$l = \sum_{i=0}^{n}\{\sum_{i=0}^{y_i-1}\ln(j+\alpha^{-1}) - \ln[\Gamma(y_i+1)) - (y_i+\alpha^{-1})]\ln(1+\alpha\mu_i) + y_i\ln(\alpha) + y_i\ln(\mu_I)\} \text{.....equation (28)}$$

The first derivative of L was given by Camero (2013) & lawless (1987) and equating the gradients to zero gives the following likelihood equation

$$\sum_{i=0}^{n}\frac{x_{ij}(y_i-\mu_I)}{1+\alpha\mu_i} = 0, \quad j = 1, 2, \ldots\ldots\ldots k \text{.....equation (29)}$$

$$\sum_{i=0}^{n}\left\{\alpha^{-1}\left(\ln(1+\alpha\mu_i - \sum_{j=0}^{y_i-1}\frac{1}{j+\alpha^{-1}}\right) + \frac{y_i-\mu_i}{\alpha(1+\alpha\mu_i)}\right\} = 0 \text{.....equation (30)}$$

Based on a case of failure the Poisson regression model states that the mean and variance of the predicted variable will be equal (equilibrium) the negative binomial regression model fits better, and available to fit the happened problem over-dispersion.

3.4.4 Likelihood ratio test

The maximum likelihood estimation method is used to assess the adequacy of any two or more two nested models by using the likelihood ratio test. It compares the maximum likelihood under the alternative hypothesis with the null hypothesis. For instance, the null hypothesis can be the over-dispersion parameter is equal to zero (the Poisson distribution can be fit the data well) and the alternative hypothesis is that the data would be better fitted by the Negative binomial regression (the overdispersion parameter is different $_{\text{from}}$ zero). The likelihood ratio test is defined as: $\boldsymbol{X^2 = -2(L - L_0)}$Where **L** and $\boldsymbol{L_0}$ are the log-likelihood of models under the alternative and null hypotheses. This has a chi-square (χ^2) distribution with degrees of freedom equal to the difference between the degree of freedom of the model under the null hypothesis and the alternative hypothesis, respectively. This method is not appropriate for models which are not nested one on the other.

3.5 Variable Description and Excepted Signs

Based on the kinds of literature, and considering personal characters of socioeconomic, demographic, and institutional factors determining the decision of farmer's small ruminant livestock production in study area defined as follows. The dependent variable is the decision of farmer's small ruminant livestock production. That shows the dependent variable is more than two (multiple) decisions of a household decided to goat alone (Y1), sheep alone (Y2), or both alone (Y3) respectively.

Dependent Variables

The dependent variable is the decision of farmers to produce small ruminant livestock in the study area.

The major independent variables that were included in this study are: -

i. **Age of household head (X_1):** - age is a continuous variable represented by positive integer values. The households' age is measured with years, expected either positive or negative effect on farmers decision to produce small ruminant livestock's.

ii. **Gender of the household head(X_2):** this is a dummy variable that takes a value (1, if the household head is male and 0 otherwise). Gender expected either positive or negative effects on the decision of farmers' small ruminant livestock production.

iii. **Family size of household (X_3):** It is a continuous variable and it refers to the number of people living in the same residence. The large the family members, the more the labor force available for production purposes, the high probability to default, to this fact large family size accepted that may able to produce enough because large households have enough labor force produce the small ruminant livestock's. The sign expected from family size positive relation with the decision of farmers small ruminant livestock production.

iv. **Level of education of the household head (X_4):** This is a continuous variable represented by positive integer values/number of years. Level of Education is likely expected to be a positive relationship with a small ruminant livestock production decision. Education is a social capital, which was impacted positively on household ability and well-informed about investment on small ruminant livestock production decisions. In this study case education level of a household is considered as dummy variable 1 for formal education, 0 otherwise. Because most farmers are assumed to be they have no formal educational statutes.

v. **Total livestock ownership(X_5):** it is a continuous variable. In these study farmers with a higher number of total livestock, ownership is expected to be a positive relationship with small ruminant livestock production decisions. This is because Livestock is considered as another liquid asset and security against crop failure.

A farmer with a high number expected to get a high income and total livestock was excepted positive effect on decision farmer's small ruminant livestock production.

vi. **Size of Landholding (X_6):** it is a continuous variable and in this study size of landholding expected to be a positive relationship with a farmer's decision of small ruminant livestock production. Because of that, the total farm size (in hectares) increased owned by the household is expected to be better off, if augmented with other factors of production, a large farm size may give higher produce that may enable the borrower to invest additional other income-generating activities. Therefore, if the household accumulates enough wealth the loan may not misuse for unintended purposes. it was excepted positive sign.

vii. **Total cash income in Birr (X_7):** this is a continuous variable. It refers to the total amount of cash that a specific household raised from different activities on cash which includes both on-farm and off-farm activities. Total cash income in birr was expected as a positive effect on the decision of farmer's small ruminant livestock production.

viii. **Access to get income from off-farm activities (X_8):** it is a dummy variable. Off-farm activities generate additional sources of income for smallholders. If the farmers get income from off-farm activity coded with 1 either it is 0. This study is expected as a positive relationship with farmer's decisions of small ruminant livestock production.

ix. **Family expenditure (X_9):** it is a continuous variable and it refers to the sum of household expenses on small ruminant livestock production. Family expenditure is expected as a negative relationship with farmer's decision of small ruminant livestock production. Because a farmer with high expenditure cannot participate in small ruminant livestock production.

x. **Experience in small ruminant production (X_{10})**: It is a continuous variable and measured with the total number of years. The household head having many years of experience expected to deice positively to produce a small ruminant livestock's.

xi. **Access to having Extension contacts :(X_{11})** is a dummy variable and it refers to access to contact extension agents to had information regarding small ruminant production, veterinary service, and other services. If the farmer's contact extension coded values 1, otherwise 0 and expected to be a positive influence on farmer's small ruminant livestock production decision.

xii. **Natural hazard (X_{12}):** It is a dummy variable taking a value of (1, if the natural challenges occur and 0 otherwise). This refers to those natural hazards such as flood, drought, frozen, pest and disease infestation of crop and death of animals. In this study, the occurrences of natural challenges are expected a negative relationship with farmer's decisions of small ruminant livestock production.

xiii. **Distance to the nearest market center (X_{13}):** It is the distance to the nearest input and output market center places and it is a continuous variable that is measured in kilometer. It is expected as a negative effect on farmer's decision of small ruminant livestock production. The farmer who is closer to the nearest market, the more likely to participate in small ruminant production rather than a farmer who lives far away from the market center.

xiv. **Agroecology (X_{14})** is a dummy variable that dominates the decision of smallholder farmers either positively or negatively based on smallholder's location It is coded by 1 lowland (Buge kebele) 2, midland (Awaye and Wererama kebeles), and by 3 highlands (Lein and Eta kebeles) agroecology. Based on district agroecology highland agroecology is much better for small ruminant livestock production compared to midland and lowland agroecology.

xv. **Marital status (X_{15})** is a categorical variable and it is coded by, 0 single, 1 married, 2, and 3 widowed. It has expected either a positive or negative effect on farmer's decision of a small ruminant production decision. Married households were expected to highly participate in small ruminant livestock production generate additional income to fulfill their additional cost.

xvi. **Access to credit (X_{16}):** it is a dummy variable coded 1 if the farmer has access to get credit and 0, otherwise. Access to credit eases the financial constraints faced by the Farmer's decision to produce small ruminant livestock. Availability of credit enhances the probability of farmers deciding to produce small ruminant livestock's it has a positive impact on the decision to her/his household.

xvii. **Religious Statues (X_{17})** it is a categorical variable coded by Muslim 0, protestant 1, orthodox 3 others by 4 it affects farmers production decision negatively.

3.5.1 Ethical Considerations in Data Collection of the Study

This study was considered every individual's opinion and expression as vital and respectful. The study was have cared about the morals of the individual/household head that struggled to give us time and allowed us to interview him/her. They studiously avoided everything which may hurt or undermine the integrity of the interviewee and considered the status he/she has in society. Moreover, the researcher was neutral and the method of data collection was respondent centers (willingness of the respondents).

Finally, the study where free from plagiarism, with fewer quality data, and unnecessary outdated data. As in every other aspect of the research, ethics have their important value-added to this research. To conduct interviews with the interviewees of this study, the following ethical procedures were followed:

Proper official letters and official contact must be important with district administration and with kebele administrative offices.

The purpose of the study is explained clearly and emphasized as well as the need to get desired information about the study and its aim regarding administrative offices

and kebele offices. The questionaries and the interviews of the study should be organized in an understandable manner in which they can clearly explain their opinion and giving a clear explanation to each questionary' during the data collection period.

CHAPTER FOUR

RESULT AND DISCUSSION

4.1 Introduction

The main aim of this study was to analyze the socio-economic determinants of small ruminant livestock production decisions of farmers in Kambata Tambaro Zone Kacha Birra district in selected five kebeles. Also, multinomial logistic regression analysis was used to show socioeconomic determinants of small ruminant livestock production decisions in a study area.

4.1.1 Household Socioeconomic and demographic Characteristics analysis

Table 2:Summary statistics of continuous explanatory variables with farmers' decision of production.

No	continues variable	N	Min	Max	Mean	Std. Dev	t- value	p -value
1	Age of the respondent	297	28	70	44	9.79	73.8523	0.985
2	Family size	297	2	12	7	2.155	43.8803	0.008
3	number of small ruminants	297	6	20	12	3.158	53.1645	0.013
4	Total cash income	297	3200	23000	9791.65	5344.059	31.5704	0.383
5	expenditure of respondents	297	1250	15000	6012.79	3707.763	27.9384	0.874
6	Experience of production	297	3	11	6	1.932	38.9654	0.016
7	Market Distance	297	0	17	8.73	2.847	39.9792	0.509
8	Size of land	297	0.25	2.5	1.0429	0.56395	-15.955	0.039

Source: own computation from survey data (2021)

The family size of the respondents the study observed shows that the mean (average) family size of the participant was 7, the minimum family size contains 2 family members and the maximum family size contains 12 members. The result of the t-statistical value also reflected that there was a significant mean difference in terms of family size between small family size and large family sizes of households with a t-value of 43.8803 (p = 0.008). This result indicates that the higher the family size the higher the probability of participating in small ruminant livestock production.

Experience of small ruminant production, the mean value of farmers small ruminant production experience was, 6, minimum experience 3 years and maximum experience of 11 years with and, the result of the t-value and (p=0.016), shows that there was a significant mean difference between farmers having long time experience compared to less experienced farmers on the small ruminant production system.

Cultivate Land size of households the average (mean) landholding per household in the study district was (1.0429 hectares), minimum cultivated land size per household (0.25 hectare), and maximum cultivated land size per household was (2.5 hectares). This shows that there is a significant (p=0.039) mean (average) difference in landholding size compared to household members.

The total number of livestock owning the mean (average) and the standard deviation of livestock holding shown in the study area is 12 and 3.158 respectively. There was significant (p<0.05) difference among areas classified by agroecology (highland, midland, and lowland), farmers who live in (highland agroecology) owns a higher number of sheep compared farmer who lives in midland and highland agrology. Also, the result confirms having a (t) value of (53.1645) and statistically significant at(p=0.013) significance level.

Table 3: Categorical (dummy) variables across the decision of farmer's small ruminant livestock production

No	Variable name	Participants on decision	Frequency	Percent	p>/Z/
1	marital statues	Single	**92**	**31%**	
		Married	**201**	**67.7%**	
		Divorced	**4**	**1.3%**	**0.006**
2	educational statues	No Formal Education	**195**	**65.7%**	
		formal education	**102**	**34.3%**	**0.549**
3	Gender	Female	**141**	**47.5%**	
		Male	**156**	**52.5%**	**0.41**
4	extension service	No contact with Extension	**93**	**31.3%**	**0.01**
		Contact with Extension	**204**	**68.7%**	
5	natural hazard	Natural hazard affect	**114**	**38.4%**	
		Natural hazard not affect	**183**	**61.6%**	**0.165**
6	Agroecology	Low land	**63**	**21.2%**	
		Mid land	**111**	**37.4%**	**0.006**
		High land	**123**	**41.4%**	
7	Credit access	Not Having credit service	**188**	**63.3%**	**0.005**
		Having credit service	**109**	**36.7%**	
8					

	Off-farm income	No	100	33.7%	**0.006**
		Yes	197	66.3%	
9	Religion	Muslim	**2**	**0.7%**	**0.029**
		Protestant	149	50.2**%**	
		Orthodox	107	36**%**	
		Catholic	39	13.1**%**	

Source: - Own computation from survey result (2021)

The marital status of the household heads: is an important constituent of the demographic factor and statistically significant at (p=**0.006**) precision level based on table 3 result. The Economic theory and most empirical literature support the notion that the chance of participation in small ruminant production increases as one is married. This is due to when people get married household size will increase as new children are born and expenditures increase which in turn leads to a search for mechanisms of fulfilling additional needs and necessities for the family. The percentage of married households is much higher compared to single, divorced, and widowed respondent households. The percentage distribution of respondents by marital status shows that out of 297 household respondents 201 (67.7%) were married households, 92 (31%) of the respondents were single whereas 4(1.3%) of heads of households are divorced. This indicates that the proportion of married households is high in small ruminant production compared to single and divorced.

Access of Extension contact: it was one of the most important institutional (policy) factors and statistically significant at (p=0.01) significance level. However, 31.3 % of smallholder farmers didn't get access to extension contact service and 68.7% of farmers get access to extension contact. This indicates the inadequate capacity of extension service and it also shows farmers' lack of information regarding veterinary service, market information, and agroecology to select species of ruminant regarding socioeconomic determinants of small ruminant livestock production.

Off-farm income access: it is an important socioeconomic factor and statistically significant at (p=0.006) significance level and, the result of descriptive statistics indicates from the total of 297 respondents about 100 (33.3 %) of households can't get access to have additional income, but 197 (66.3%) of respondents get access to additional income based on table 3. This result implies that most small ruminant farmers have access to get additional income from other sources of income to

smoothen household consumption aside from farming. This finding may have positive or negative implications for small ruminant production. On one hand, farmer‘s income from such secondary sources may be used to invest in small ruminant production. On the other hand, because livestock is a labor-intensive year-round activity, farmers, who are sustained by such non-farm activities, may have little time available for small ruminant production.

Agroecology: Agroecology is one the most important factor that socioeconomic determinant which affects the farmer’s small ruminant production decision. Most of the small ruminant livestock producers 123(41.4 %) arrived in highland, 111(37.4 %) in midland, and the reaming 63 (21.2 %) of the respondents live in lowland agroecology. Where the chi-square value also confirms the result having (p=0.006) this shows that highland agroecology has a high flow of water, and is a very suitable air condition to produce small ruminant livestock’s especially sheep alone. This study result confirms the study result of (Adina and Elizabeth, 2006; Getachew et al., 2008) indicates that agroecology negatively affects the decision of small ruminant livestock production.

The pie chart shows the agroecological distribution of small ruminant livestock’s producers 123(41.4 %) arrived in highland, 111(37.4 %) in midland, and the reaming 63 (21.2 %) lives in low land agroecology.

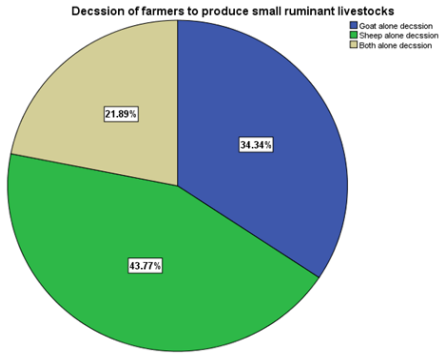


Figure 3: Agroecological distribution of small ruminant livestock producer decision

Gender of Householder: The result of descriptive statistics shown in table 3 indicates that male household heads are dominant 156 (52.25%), whereas 141(47.5%) were females across the three agro-ecological areas. The finding implies that men are the owners of small ruminants in the household, and this is also may be another reason for societal customs and norms in study areas where males control household productive assets. This study result confirms that the study result of Turkson&Naandam (,2006) the large proportion of male household heads are very

crucial for transferring technology since men are mostly the decision-makers in most developing countries.

Religious statutes of respondents: according to descriptive statistics result shows that most of the respondents are 149(50.2%) protestants religious, 107(36%) of the respondents are orthodox and the remaining were catholic religious. This result indicates that most of the small producers are protestant and orthodox religious followers. Also, the value of (p=0.029) confirms that religion has a significant effect on farmer's decisions of small ruminant production.

4.3. Diagnostic test analysis

4.3.1 Diagnostic test analysis for continuous explanatory variables

Before running the variables into a multinomial logistic regression model checking the multicollinearity problems for continuous variables is the mandatory and prioritized problem. According to a rule of thumb, if the variance inflation factor of each continuous explanatory variable is greater than the value of 10, it is said to high collinear (Gujarati, 2004). Based on a rule of thumb which is referred to as in Gujarati, (2004), there are no values of the continuous explanatory variable are multicollinearity problem. But variance inflation factor calculated mathematically as follows $VIF = \frac{1}{1-R^2_j}$ ……..equation (12)

Table 4: Variance Inflation Factor values for continuous explanatory variables

No	continuous explanatory Variable	VIF	1/VIF
1	Expenditure of households	1.06	0.939688
2	Experience in small ruminant production	1.05	0.948593
3	Distance far away from the nearest market	1.05	0.953752
4	Family size of households	1.04	0.96434
5	Land size of the respondents	1.02	0.979718
	Mean-Variance Inflation Factor	1.09	

Source cross-tabulation result of *variance infliction factor value for the continuous explanatory variable*

Table 5: Diagnostic Analysis for dummy (categorical) variables

No	dummy Variable	Chi-square values		Sample size	Contingency coefficient formula $Cc = \sqrt{X^2/N + X^2}$ values	CC value	Sig (0.05)
1	**Agroecology**	Pearson chi2(4)	9.4263	297	$\sqrt{(9.4263/297 + 9.4263)}$	0.01023	0.041
2	**Access of farm**	Pearson chi2(2)	7.4902	297	$\sqrt{(7.4902/297 + 7.4902)}$	0.0091	0.024

3	**Access extension**	**Pearson chi2(2)**	**10.3279**	**297**	$\sqrt{(10.3279/297 + 10.3279)}$	**0.0107**	**0.006**
4	**Religion**	**Pearson chi2(6)**	**12.9083**	**297**	$\sqrt{(12.9083/297 + 12.9083)}$	**0.0119**	**0.045**
5	**Natural hazard**	**Pearson chi2(2)**	**1.0174**	**297**	$\sqrt{(1.0174/297 + 1.0174)}$	**0.00338**	**0.601**
6	**Access to Credit**	**Pearson chi2(2)**	**7.1994**	**297**	$\sqrt{(7.1994/297 + 7.1994)}$	**0.0089**	**0.027**

Source:- computed from the source of, survey data, (2021)

The theory of Healy, (1984) states about the contingency coefficient calculation method are used to detect the degree of association among dummy explanatory variables. Based on a result of the contingency coefficient if the value of the contingency coefficient is zero there is the association, and if it is 1 it shows perfect correlation with the dependent variable. Generally the values of $\mathbf{Cc} = \sqrt{\mathbf{X^2/N + X^2}}$>0.75 we can reject those dummy variables because they are collinear. From the above survey, the p values for natural hazards are not significant at 5% precision.

4.4 Econometric model result analysis

The result of the multinomial logistic regression model result indicates, among 17 explanatory variables, 11 variables are a statistically significant influence on the decision of farmers to produce small ruminant livestock in a study area. Age of household head, the total number of small ruminant livestock, access to have off-farm income, access to have extension service, the experience of small ruminant livestock production, family size and land size affect farmer's decision of small ruminant production positively. Whereas agroecology, religion, and martial statutes of the respondents affect the farmer's decision of small ruminant production negatively.

Table 6: Model fitness result of AIC, BIC, and likelihood ratio values

Model	**Model Fitting Criteria**			**Likelihood Ratio Tests**		
	AIC	BIC	-2 Log Likelihood	Chi-Square(χ^2)	Df	Sig.
Intercept Only	634.353	641.741	630.353			
Final	609.673	742.647	537.673	92.68	34	0.00

Source: computed from the source of, survey data (2021)

However, the model fitness of multinomial logistic regression can be checked by using AIC (Akaike Information Criteria) and BIC (Bayesian Information Criteria).

The values of AIC decrease from intercept model values (634.353) to final model (609.673) and it is significance value is less than (5%) this shows that the model is fit goodness. Also, the model is statistically significant at p=0.000 precision level.

Table 7: Model good of fitness

	Chi-Square	Df	Sig.
Pearson	627.309	558	0.022
Deviance	537.673	558	0.724

Source:- computed from survey data of,(2021)

Based on the table shown abusively on 7 Pearson value is equal to 0.022 which is less than 0.05 (95 %) of confidence interval) the model goodness of fit is accepted statistically.Deviance value also (Chi-square of deviance/degree freedom)=537.673/558 =0.963 statistically shows the model is fitted.

Pseudo R^2 square values of multinomial logistic regression model

Table 8: likelihood ratio test of statistics

Cox and Snell	**0.268**
Nagelkerke	0.305
McFadden	0.147

Source:- computed from the source of; survey data (2021)

The result of table 8 shows that Nagelkerke R square shows that an adjusted version of the cox and Snell R square is that the scale of statistics to cover the full range from 0 to1.

4.4. 1 Likelihood ratio test

The chi-square (χ^2) statistic is the difference in -2 log-likelihoods and the final model and a reduced model.

- The reduced model is formed by omitting an effect from the final model.
- The null hypothesis is that all parameters of that effect are 0.

The reference category is the sheep alone category because the one who used as reference category/ base category has zero coefficient (Maharaja and Kant, 2005, Nourish, 1999). According to my study area sheep is used as a reference category

because of a farmer who alone goat has dominant and high production of sheep for along years ago.

The result in Appendix II table 12 indicates that the log-likelihood of the fitted model was -**268.83635**, and from this value, we can reject the null hypothesis that all the regression coefficients are simultaneously equal to zero. The likelihood ratio on the other hand was 92.68 (degrees of freedom = 34) and the p-value is 0.0000. These two statistics help us to reject the null hypothesis that all regression coefficients across both models are simultaneously equal to zero. Lastly, the pseudo R2 was 0.1470. This is within the highly satisfactory range of 0.2 – 0.4

4.4.2 Marginal Effect for multinomial Logistic regression

The multinomial logistic regression analysis is not linear, and the marginal effect of each independent variable on the dependent variable is not constant but it depends on the value of the explanatory variables. Thus, marginal effects can be a means for summarizing how a change in response is related to a change in a covariate. But in the case of categorical variables, the effects of discrete changes are computed, i.e., the marginal effects for discrete variables show how P (Y = 1) is predicted to change as Xk changes from 0 to 1 holding all other Xs equal. Whereas for continuous independent variables, the marginal effect measures the instantaneous rate of change, while all other explanatory variables are held constant. That means a change in the probability of being farmers decided to produce small ruminant livestock with a unit change in the continuous independent variable (Greene, 1993). However, these are opposed to the linear regression case, but, it is possible to compute the marginal effect values of the significant explanatory variables.

Based on a result shown in table 11, the multinomial logistic regression model result indicates, among 17 explanatory variables, 11 variables are a statistically significant influence on the decision of farmers to produce small ruminant livestock in a study area. Age of household head, the total number of small ruminant livestock, access to have off-farm income, access to have extension service, the experience of small ruminant livestock production, family size of the respondent, and land size affect farmer's decision of small ruminant production positively. However, agroecology, religion, and martial statutes of the respondents negatively affect the farmer's decision of small ruminant production.

Table 9: The marginal effect of multinomial logistic regression model estimation

No	variable	Dy/dx	Stderor	Z	p>z	95% ci		X
						lower	Upper	
1	**Agehhs**	**0.002853**	**0.66**	**0.506**	**0.506**	**-.00556**	**.011266**	**43.8519**
2	**Fmlysze**	**0.046702**	**2.39**	**0.017**	**0.005**	**.008471**	**.084933**	**7.48148**
3	**Mrrtlstatu**	**-0.06924**	**0.8**	**0.424**	**0.004**	**-.1004**	**.238941**	**0.703704**
4	**Education**	**0.118751**	**1.33**	**0.183**	**0.183**	**-.05610**	**.293608**	**0.343434**
5	**Gender**	**-0.06793**	**-0.81**	**0.416**	**0.416**	**-.23155**	**.095699**	**0.525253**
6	**Totlvstock**	**0.03489**	**-2.62**	**0.009**	**0.009**	**-.06104**	**-.00874**	**12.1414**
7	**Ttot cash**	**5.98E-06**	**0.7**	**0.486**	**0.486**	**-.00001**	**.000023**	**9791.65**
8	**Expenditure**	**1.900**	**-1.48**	**0.138**	**0.138**	**-.00004**	**6.0e-06**	**6012.79**
9	**offarmactvty**	**0.09877**	**-0.97**	**0.332**	**0.003**	**-.29829**	**.100765**	**0.6633**
10	**Excprnce**	**0.030524**	**1.39**	**0.165**	**0.010**	**-.01254**	**.073587**	**6.44108**
11	**Extncontct**	**0.327817**	**3.61**	**0.12**	**0.007**	**.150007**	**.505627**	**0.686869**
12	**Natrlhazrd**	**-0.05035**	**-0.51**	**0.61**	**0.610**	**-.24380**	**.143108**	**0.616162**
13	**distncemrket**	**-0.00786**	**-0.53**	**0.598**	**0.598**	**-.03710**	**.02139**	**8.73064**
14	**Agroecology**	**-0.17322**	**3.15**	**0.002**	**0.004**	**.06552**	**.280921**	**1.20202**
15	**land size**	**0.107082**	**1.45**	**0.148**	**0.029**	**-.03801**	**.252179**	**1.04293**
16	**Relgion**	**-0.02034**	**-0.34**	**0.733**	**0.021**	**-.13738**	**.096708**	**1.61616**
17	**credit access**	**0.13332**	**-1.52**	**0.128**	**0.003**	**-.30502**	**.03839**	**1.367**

Source:- computed from source; survey data (2021)

Marital Status:- it was the main socioeconomic factor that affects the probability of households either positively or negatively on the decision of small ruminant livestock production. As hypostasized so far, it was found to be positive and have a significant influence on the probability of farmer's small ruminant livestock production decision at less than 1% significance level. The econometric result of multinomial logistic regression marginal effect is shown in table 12 that the probability of married households increases by 6.92% compared to single and widowed households other things remaining stay. This shows that married couples have greater liquidity needs due to the increased financial needs of more persons in the household. The study result confirms the study result done in northern Benin, Dossa et.al (2008) married household heads are more willing to acquire and raise small ruminants than younger household heads.

The religion of household:- The religion of the household head seems to make a significant effect on the decision of farmer's production of small ruminants. The religious statue was a categorical variable coded 0 for Muslim, 1 for protestant, 2 for orthodox, and 3 for catholic religions. The result of table 12 indicates the coefficient of Islamic religion negatively affects the decision of households. Being Muslim religious follower household-headed decreases the probability of small ruminant production by 2.034 % compared to other religious followers assuming all other things remain constant. The result of this study confirms the study result of Baah et.al (2012), Muslims are noted for slaughtering sheep (ram) to mark Eid-al-Adha celebrations.

Access to have off-farm income (access to off-farm income):- as hypothesized this variable was positively and significantly influencing the probability of participating in small ruminant livestock production decisions at less than 1% probability level. Keeping the influence of other variables constant, the probability of having off-farm income households' participation in the decision to small ruminant production would increase by 9.87 % compared to a farmer who cannot get access to farm income. This implies that households who have access to finance are more likely to participate in small ruminant livestock production decisions. On the other hand, households who haven't access to finance are less likely to participate in small ruminant livestock production decisions. The possible reason would be financing enables the rural households to start Off-farm self-employment. This result is consistent with other findings such as (Woinishet, 2010; Yesuf, 2015; Bekele, 2016; Asfaw et al., 2017; Zewdie & Sivakumar, 2017).

Agroecology had a negative significant effect (at p=0.004) precision level on the decision of farmer's small ruminant livestock production in a study area. The result of marginal effect shown in table 12 that for a farmer who lives in highland agroecology its productivity of small ruminant production increases by 0.4% other things remain constant. These may indicate that highland agroecology is favorable for small ruminant production due to access to feeding. This study result confirms the study of Alilo, et.al (2018) concludes the climate change-related factors were grouped into four categories, namely flood, drought, increased temperature (heat stress), and decreased temperature.

Family Size: family size is one of the explanatory variables hypostasized positively affects the decision of farmer's small ruminant livestock production. As hypostasized so far, it was found to be positive and have a significant influence on the probability of farmer's decision of small ruminant livestock production at a 5% significance level. The marginal effect result shown in table 12 as a member of household increased by one adult equivalent, the probability of participation in small ruminant livestock production decision increased by 4.67% while other things remain constant. This result also indicates that expected because a household with more household members has more of the labor force that tends to produce more compared to small member households. The result of this study confirms the study result of previous findings of Mirie Zemadu (2008) which showed increments in the number of family size increases the probability of farmers participating in livestock production and research study of Offor et al.(2008) shows demographic and socioeconomic factors like age, family size, income, and small animal rearing experience positively determine the farmer's production of small ruminants in Abia State, Nigeria.

Access to Extension contacts: as hypnotized having an access to contact extension had a positive effect on households' decision participate in small ruminant livestock production decision, and the marginal effect from multinomial logistic regression model showed that a farmer having access to extension contact was found statistically significant at 5% precision level. The results meaning increments in the frequency of contact with extension agents by one day would increase the probability of participating in small ruminant livestock production decisions by 3.27% on average, keeping other factors being constant. This result of table 12 implies that the technical advice provided for farmers by extension has a great effect on the decision of farmer's small ruminant livestock production. The result of this study is consistent with the findings of Getahun (2008) which shows that frequency of extension contact has a positive relationship with the decision of farmer's small ruminant livestock production.

Total number of small ruminant Livestock (TNSLU): Livestock holding is positively influenced the household's choice of participating in small ruminant livestock production decisions at less than 1% probability level. The marginal effect shows that an addition of one TLU (which is equivalent to three sheep/goats) to the existing stock of a typical household would increase the probability of participation by 3.489 % keeping all other variables at their mean value. This indicates the farmer

with higher livestock holding would have a higher probability to decide on small ruminant livestock production, since having more small ruminant livestock will increase the possibility to get initial capital. Many smallholder farmers in the kacha birra district, especially in the high land area buy small ruminant livestock during the off-season to fatten and get profit until the harvest season. This study confirms the study result of the previous study Yesuf (2015) found a positive association between farmer's decisions and livestock holding.

Land Size: land allocated for small ruminant grazing was positively and significantly affect the decision of small ruminant livestock production at a 1% significance level. The marginal effect result indicates that allocating one extra hectare of land for small ruminant grazing would increase the probability of participation in small ruminant livestock production by 10.7% on average, keeping other factors constant. This result indicates that those households allocating one more additional hectare of land by any means (self-owned, by lease, from rent) raises the probability of participating in small ruminant livestock production decisions. This result confirms the study result of previous findings of Abera (2015) and GetahunGetahun(2018) revealed that increments in land positively affect the production of livestock.

Credit service access having access to credit service was the main explanatory variable hypostasized to affect the decision of farmer's small ruminant livestock production. As it was hypostasized so far, the econometric result of the multinomial logistic regression marginal effect result showed positive and significant at less than 1 % significance level. The marginal effect showed in table 12 indicates that households that get access to credit service have approximately 0.3% more probability of participating in small ruminant livestock production compared to a farmer who cannot get access to credit service. In other meaning, a household that didn't get access to credit service access started to use access credit service, increase the probability of small ruminant production decision by 0.3% on average keeping all other things constant.The result of this study confirms the result of a previous study conducted by Ademe (2017)which shows the positive relationship between credit service access and household's small ruminant livestock production decision.

4.4.2 Interpreting small ruminant livestock production constraints

Based on result of table 6 result Lack of capital/credit access (1^{st}), lack of access to grazing land (2^{nd}), Problem of pests and diseases (3^{rd}) and Animal feed shortage (4^{th}) are the main constraints that determine the decision of farmer's small ruminant livestock production in a study area based on their rank order result shown in table 6. This study result lined with the study result of (Abayouim 2009) Osun state in Nigeria.

4.4.3 Result interpretation of Negative binomial regression model

Negative Binomial regression modeling is used for modeling count variables, usually for overdispersed count outcome variables. Bouche, (2009) discussed in a paper different methods that exist to solve the problem of underestimating variance in the Poisson regression model when overdispersion is present.

Table 10: likelihood ratio test value

Omnibus Test result of negative Binomial regression

Likelihood Ratio Chi-square	Df	Sign
43.876	17	.ooo

Source:- Computed from the source of, survey data (2021)

Based on table 9 result the likelihood chi-square provides a test of the overall model comparing this model without any predictors (a null hypothesis), and it is statistically significant at a 1% precision level.

Table 11: Negative binomial regression model estimation result

Parameter	B	Std. Error	95% Wald CI		Hypothesis Test			Exp(B)	95% Wald CI for Exp(B)	
			Lower	Upper	Wald Chi-Square	Df	Sig.		Lower	Upper
(Intercept)	0.39	0.215	-0.031	0.812	3.297	1	0.069	1.477	0.969	2.252
Agehhs	0.002	0.002	-0.003	0.006	0.538	1	0.463	1.002	0.997	1.006
Fmsize	0.025	0.011	0.004	0.046	5.651	1	0.017	1.025	1.004	1.047
Mrtlstat	-0.036	0.047	-0.057	0.128	0.576	1	0.448	1.036	0.945	1.137
Edu	0.064	0.048	-0.029	0.158	1.83	1	0.176	1.067	0.971	1.171
Gnder	-0.04	0.045	-0.126	0.051	0.681	1	0.409	0.963	0.882	1.052
Totlvstock	0.02	0.007	-0.034	-0.005	6.764	1	0.009	0.981	0.967	0.995
Offarminc	0.05	0.054	-0.16	0.053	0.978	1	0.323	0.948	0.852	1.054
Exprumpro	0.016	0.012	-0.007	0.039	1.867	1	0.172	1.016	0.993	1.04
Extncontct	0.181	0.05	0.082	0.28	12.935	1	.000	1.199	1.086	1.323
Agroez	-0.095	0.03	0.036	0.154	10.024	1	0.002	1.1	1.037	1.166
Landsz	0.058	0.04	-0.02	0.135	2.145	1	0.143	1.06	0.981	1.145
Relgion	-0.01	0.032	-0.074	0.053	0.11	1	0.74	0.989	0.929	1.054
Creditservce	0.07	0.048	-0.165	0.022	2.273	1	0.132	0.931	0.848	1.022

Source:- Computed from the source of; survey data (2021)

Family Size of household: The estimation result of Negative Binomial model reveals that the family size determines the decision of farmers small ruminant livestock production at 5% level of significance and positive beta value (0.025) by having p=0.017 value of and odds ratio (1.025). This implies that those who have large family member are 1.25 times high likely than those who have low family members on decision of small ruminant livestock production. The result is factual because households with more family member consume more & produces and supplies more to the market. The result of this study is line with result of **(Beza 2019).**

Agroecology: as previously hyphotasaized it has expected to be affect negatively the decision of farmers small ruminant livestock production decision at less than 5% significance level. The result of Negative binomial regression shows that the coefficient of agroecology is negative and statistically significant implying that, a farmer who lives in a highland agroecology expected to produces 1.1 times high than a farmer who lives in low land and midland other things remained constant.(a farmer

who lives in low land agroecology expected as 1.1 times lower to participate in decision of small ruminant livestock production) other things remained constant. This may be due to favorability of feeding and access of water.

Extension service: As shown in table 13 the coefficient for extension service is positive and statistically significant at 1% implying that the expected number of small ruminant production increases in the households was multiplied by 1.19 times for one unit increment of $_{extension}$ contact. In other words, a household with having access to extension contact would likely have large small ruminant production rather than a farmer who can't get access to extension service.

The marital status of households had a positive relationship with farmer's small ruminant livestock production decision and statistically significantly less than 1% significance level. The expected values of married women increase 1.036 times compared to single and divorced to produce small ruminant livestock's other things remained constant.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATION

5.1 Conclusion

The main aim of this study was to analyze socio-economic determinants of small ruminant livestock production decisions in the case of the kacha birra district in the Kambata Tambaro zone southern part of Ethiopia. small livestock production is a very important segment of agriculture and it is referred to as one or more domesticated animals raised in agricultural settings to produce commodities such as food, fiber, manure, and labor.

The study used a multistage sampling (three-stage sampling) procedure. to select districts was selected through purposive sampling based on agroecology and its high potential of small ruminant livestock production. The study also employed a purposive sampling technique to select five kebele and a proportional sampling technique applied to select households from each kebele based on the sample size. Finally, 156 male and 141 female households were selected by using a simple random sampling method. The study used well-structured questionnaires to collect necessary data from 297 households. The selected data were analyzed in a form of descriptive, inferential, and econometrics analysis methods. The study employed multinomial logistic regression and negative binomial regression model to analyze socio-economic determinants of a small ruminant livestock production decision and to express the expected probability of decision of farmers affected by various socio-economic, demographic, and institutional factors respectively

The result of descriptive statistics indicated that sheep production is dominant in study area 130 (43.77%), 102 (34.34%) decided to alone goat and 65 (21.89%) of smallholder farmers both sheep and goat. The study also indicates that 141(47.5%) females, 156 (52.5%) males participated in small ruminant livestock production which shows male dominates the decision of production. From the total of 297 households, 204 (68.7%) has an access to extension service, and 93(31.3%) can not get access to extension contact, however, 197(66.3%) gets access to credit service, and 100 (33.7%) can not get access of credit service, these shows policy/institutional factors crucially determine the decision of households small ruminant livestock production. The examination of farmer‘s decision to own small ruminant livestock reveals that the majority of the farmers are household heads 201(67.7%) married, 92(31%), single,

and 4(1.3%) of the respondents were divorced. This shows most of the households are residence in the study area and also they use the majority of the labor force to produce small ruminant livestock.

The multinomial logistic regression model result shows that Socioeconomic factors like; the number of livestock owned, cultivated land size, policy factors (access of having a credit service and access to extension contact service), access to off-farm income, the experience of small ruminant livestock production affect and family size positively affects the decision of farmers whereas, marital status of the respondent, agroecology, and religion of respondents negatively affect the farmer's decision of small ruminant livestock production at 1% and 5% significance level.

Based on rank order result the lack of capital/credit access, the lack of access to grazing land, the problem of diseases and Animal feed shortage are the main constraints that determine the decision of farmer's small ruminant livestock production in a study area.

The study finding remarkably shows that institutional/policy factors (access of having credit service and access to extension contact) significantly affect the decision of farmer's on small ruminant livestock production in study areas. Also, the study shows that agroecology kindly affects a household's choice of rearing either sheep alone, goat, or both alone. Specifically, the study result confirms farmers from highland (Lein and Eta kebele) prefer to own sheep compared to midland and lowland agroecology. In contrast, farmer's sheep and goat production was less in lowland agroecology compared to highland and midland agroecology.

Based on the household head data, the analysis shows that small ruminant ownership is likely to increase in the study area when older farmers with large household sizes have access to income-generating activities outside the farm. In addition, access to the extension even though has a crucial influence on farmer's decision to own sheep, goat and both alone. It indicates how important farmer's and non-farmers 'characteristics influence the decision to manage small ruminant livestock. Further analysis of the decision of farmers for small ruminant types suggests that male farmers in the highland agro-ecological zone are more inclined to own sheep and the middle agroecology producers also goat livestock. However, smallholder farmers who perceive goat production as riskier and profitable are less likely to raise both sheep and goat together. Perhaps, the reason why farmers who perceive higher profitability

for goat production but are less likely to own both sheep and goat could be linked to higher perceived risk to goat production.

The overall implication of this analysis suggests the importance of the non-market co-products towards sustaining and improving the competitiveness of the traditional small ruminant production systems. Despite based on the study result the share of responsibility between males and females in the family is not equal, and the study shows that men are the sole decision-makers concerning small ruminant management activities. The regression analysis highlights important farmer characteristics (age, marital status, non-farm income source, and household size), and policy factors (access to extension service, and credit service) that contributed to small ruminant productivity. The results show that socio-economic and institutional factors influence farm households 'decision to participate in small ruminant production.

Importantly, off-farm income sources, family size of the respondents. total livestock number, experience on small ruminant livestock production, credit service access, and access to extension service increase the probability of farm families owning sheep, goat, and both livestock production decisions. However, .relgion, marital status, and agroecology influence the decision of smallholder farmers negatively to alone goat, sheep and both alone in the study area. The result generally implies that government intervention programs to improve small ruminant production should not only focus on increasing extension service but also pay attention to farmer's characteristics such as off-farm income sources, credit service, agroecology very important to boost small ruminant producer farmers in the study area.

Based on rank order result shown in table 6 the lack of capital/credit access, the lack of access to grazing land, the problem of diseases and Animal feed shortage are the main constraints that determine the decision of farmer's small ruminant livestock production in a study area

Lastly, the binomial negative result shows that the expected probability farmers decision small ruminant livestock production affected by family size, extension contact, total livestock number, and agroecology in the study area.

Therefore, governmental and non-governmental Organizations can support small ruminant producer farmers with capacity-building training based on ruminant production and facilitating the access of formal credit service.

5.2 Policy Recommendations

Based on the result of the study, the following recommendations are forwarded to the concerned government and none government bodies to increase the productivity of small ruminant livestock production by defending faced socioeconomic, demographic. and institutional factors.

The study result shows that various socio-economic, demographic, and institutional factors affect farmer's decisions to produce small ruminant livestock.

Credit service access significantly affects the decision of farmers small ruminant livestock production in the study area. Therefore, Government and financial institutions should facilitate adequate credit to households to get higher benefits from the production of small ruminant livestock, and also households should be encouraged by cooperatives that help them to mobilize saving and increase access to finance.

Access to extension service has an important institutional factor and have positive impact on farmers decision. This implies that government intervention programs are crucial to improve small ruminant production so the government should focus on increasing extension service to farmers.

Off-farm income source contributes positive and significant effect on households decision of small ruminant livestock production. So that alternative income-generating activities should be expanded to increase the production of small ruminant livestock production.

Agroecology affects negatively the decision farmers small ruminant livestock production in a study area as constraint factor. The government should give attention to encourage the best species which are familiar with farmer's agroecology to boost farmer's small ruminant livestock production and their profitability.

Therefore, the respective zone, and kacha birra woreda livestock and fishery development departments and offices have a great role on the improvement of small ruminant livestock production and oriented small ruminant livestock production. In line with extension serves the promotion of adult education among the farming community in addition to creating experience sharing event to duplicate best practice is also recommended.

Family size of the respondents, the total number of livestock, and experience of production on small ruminant livestock positively, land size and significantly affect the decision of small ruminant livestock production. So that concerned district

government officials should pay attention to encourage farmers to increase their productivity and agroecology, religion affects negatively the decision farmers goat and sheep production in a study area. The government should give attention to encourage the best species which are familiar with farmer's agroecology to boost farmer's small ruminant livestock production.

5.3 Suggestions for Future Research

The study suggests to future researchers it is better to analyze what socio-economic, institutional, and demographic factors determine the decision of farmers small ruminant livestock production at the regional and country-level to design better policy and in order to increase the overall productivity of smallholder by challenging the faced socioeconomic, institutional and demographic factors and other variables which cannot be included in this study.

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Appendix

Appendix- I

Appendix I-B: Household Survey Questionnaire

Survey Questionnaire prepared to Collect Data on

SOCIO-ECONOMIC DETERMINANTS OF SMALL RUMINANT LIVESTOCK PRODUCTION DECISION IN KAMBATA TAMBARO ZONE KACHA BIRRA DISTRICT

The goal of the survey: - The main aim of this questionnaire was to collect primary data to analyze the socioeconomic determinants of a small ruminant livestock production decision. Although the researcher's primary objective is for academic purposes, it was expected to give analytical clues for development and decision-makers. Therefore, the respondents were kindly asked to provide his/her idea for the set of questions as it was organized. Please answer it according to the instructions. Prepared by Zerhun Habte Jimma University 2021 Firstly Thank you for your participation in this study and your great collaboration!!

Please tick inbox

1) **Agro-ecological location of the farmer's**

   lowland agroecology ☐ midland ☐ highland ☐

2) Smallholder **of the farmer's kebeles (location of small holder farm found)**

   Awaye ☐ Buge ☐ Wererama ☐ Lein ☐ Eta ☐

   HOUSEHOLD BACKGROUND INFORMATION

3) Gender of farmer/respondent Male ☐ Female ☐

4) Primary role in household Head ☐ Spouse ☐ Child ☐ Others ☐

5) **Number of individuals in the household male female total**

6) Marital status Single ☐ Married ☐ Divorced ☐ Widow ☐ Separated ☐ Other ☐

7) Religious statues of the farmer Muslim ☐ protestant ☐ orthodox ☐ catholic ☐

8) The primary occupation of the farmer? Full-time crop farmer ☐ Part-time crop farmer ☐

9) What is the highest level of education you completed?

   None ☐ Primary ☐ secondary school ☐ diploma level ☐ University ☐ Others ☐

10) Besides crop farming and small ruminant productions, what other type of economic activity work do you do?

Private own non-farm business ☐ Salaried/paid worker ☐ None ☐ Others ☐

11) Please indicate your total household income earned during 2012 E.C……Birr

12) How did you acquire your cultivated farmland?

Own/Family ☐ Lease ☐ Purchase ☐ Free communal land ☐ Do not have access to land ☐

13) What is your total cultivated farmland size? 0.25 hectare ☐ 0.5 hectare ☐ 1 hectare ☐ 1.25 hectare ☐ 1.5 hectare ☐

'2 hectares ☐ above 2 hectares ☐

14) What type of major crops do you grow when you produce small ruminant livestock?

Cereal crops ☐ tuber crops ☐ legume crops ☐ vegetables ☐

tree crops ☐ forage crops ☐ other species grasses ☐

15) Please indicate the small ruminant livestock type managed to own your farm?

Goat alone ☐ sheep alone ☐ both alone ☐

16) Please rate the reasons for the choice of the small ruminant you manage. Rank its importance by ticking if it is unimportant tick it (1), neither important /unimportant (2), important (3) and very important (4) Please tick inbox

No	Type of importance	goat alone	Sheep alone	Both alone	
1	High prolificacy				
2	Low mortality rate				
3	Disease resistance ability				
4	Environmental adaptability				
5	High profitability				
6	Easier to market				
7	Less expensive to start				
8	Easier to manage/handle				
9	Gift				

10	Diversification of risk				
11	Inheritance				
12	It’s a custom/tradition to keep them				
13	I don't know				

Table 3 Questioner regarding small ruminant importance

17) Please specify if you raise other species of animal(s) on your farm? Please tick inbox

No	Animal type	number	Total number
1	sheep		
2	goat		
3	both		

Table 4 types of animals and their number.

18) Please specify which production system reasonably describes your small ruminant Livestock production/management system? Please tick inbox

No	Production system	Sheep alone	Goat alone	Both alone
1	Free-range (no Shepherd)			
2	Extensive range (with Shepherd)			
3	Semi extensive system (fathering of animals)			
4	Zero grazings (cut and carry out system)			
5	Intensive system(commercial) production			
6	I don’t know			

Table 5 production system of small ruminants

19) Regarding small ruminant socio-economic values

Type of ruminant	*Importance*	*Tick here*
Goat alone decision	Meat(sales)	
	Manure (for farm)	
	Skin (hide)	
	None cash savings purpose	
	Food risk management	
	Food risk management (against crops, and other ruminants filatures)	
	For religious purpose (Christmas, Islamic, traditional, etc)	
	Non-faith based cultural functions (funeral, dowry, etc	
	Others	
Sheep alone decision	Meat(sales)	
	Manure (for farm)	
	Skin (hide)	
	None cash savings purpose	
	Food risk management	
	Food risk management (against crops, and other ruminants filatures)	
	For religious purpose (Christmas, Islamic, traditional, etc)	
	Non-faith based cultural functions (funeral, dowry, etc	
	Others	
Both alone decisions	Meat(sales)	
	Manure (for farm)	
	Skin (hide)	
	None cash savings purpose	
	Food risk management	
	Food risk management (against crops, and other ruminants filatures)	
	For religious purpose (Christmas, Islamic, traditional, etc)	
	Non-faith based cultural functions (funeral, dowry, etc	
	Others	

Table 6 type of small ruminant and socioeconomic values

20) Please indicate who is primarily responsible for managing the household's small ruminant livestock.

No	Household leader responsibility	Sheep	Goat
1	Adult male (Husband)		
2	Adult female(spouse)		
3	Husband and spouse		
4	Others		

Table 7 Responsibly for managing small ruminants

21) Please identify the reasons for the deaths or loss of small ruminants on your farm.

No	Reasons for death or lost small ruminant	Sheep	Goat
1	Sickness (diseases and pest attacks)		
2	Starvation or hunger (feed shortage)		
3	Accidents (car, motorbike, etc)		
4	Predators (snake, etc)		
5	Theft (stolen by humans, etc)		
6	Others (specify)_		

Table 8 Reasons and deaths of small ruminants

22) Please indicate the cost incurred during the past ONE year (2012 E.C) on the following sheep and goat's management services or activities.NB for only listed purpose

No	Cost components	Sheep	Goat
1	Veterinary service		
2	Medicine service		
3	Housing		
4	Fencing		
5	Dipping		
6	Feed supplement		
7	Others(specify)		

Table 9 Cost components to small ruminant's production

22) How often do you provide sheep or goats with supplements?

Daily ☐ once a week ☐ whenever available ☐ others ☐

23) When do you usually offer sheep or goat supplements?

Wet season only ☐ dry season only ☐ all year round ☐ others(specify)☐

24) Why don't you provide sheep and/or goat with a supplement?

Supplements are not available ☐ supplements are expensive/unaware of the importance of supplements ☐ do not want to offer supplements others specify ☐

25) Please indicate the severity of feed shortage for sheep, goat, or both production in the last year on your farm?

Very low severity ☐ low severity ☐ high severity ☐ very high severity☐

26) Do you have veterinary services in your community?

Yes ☐ No ☐

27) If your answer is yes for question 26 how was it is accessible?

Not accessible ☐accessible☐ very accessible ☐

28) If applicable, how often do you vaccinate your animal?

Never once every year ☐ when diseases happen ☐ when it is recommended with veterinary officer ☐ when I get advice from others ☐ other ☐

29) Have you taken credit from any formal institution during the past two (2) years for your farming?

Yes ☐ No ☐

30) If you answered _yes 'to question 29 in what form was the credit?

Cash ☐ In-kind ☐ Both cash and kind ☐ others ☐

31) Do you have a savings account with any formal financial institutions?

Yes ☐ No ☐

32) Do extension agents frequently visit your farm for a discussion on small ruminant livestock production?

Yes ☐ No ☐

33) If yes to question 32 what kind of advice/information does the agent give you concerning the rearing of sheep and/goats?_____

_____

Appendix- II

Likelihood ratio test

Table 12:Likelihood ratio test result

Effect	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC of Reduced Model	BIC of Reduced Model	-2 Log Likelihood of Reduced Model	Chi-Square	Df	Sig.
Intercept	608.389	733.976	540.389	2.716	2	0.257
Ages hhs	606.703	732.29	538.703	1.031	2	0.597
Fmsize	615.016	740.603	547.016	9.343	2	0.009
Mrtlstat	615.447	741.033	547.447	9.774	2	0.008
Edu	606.937	732.524	538.937	1.264	2	0.532
Gnder	606.669	732.256	538.669	0.996	2	0.608
Totlvstock	615.022	740.609	547.022	9.349	2	0.009
Totcash	609.022	734.609	541.022	3.349	2	0.187
Expndtre	608.565	734.152	540.565	2.892	2	0.235
Offarminc	615.16	740.747	547.16	9.487	2	0.009
Exprumpro	612.432	738.019	544.432	6.759	2	0.034
Extncontct	620.691	746.278	552.691	15.018	2	0.001
Nhard	607.899	733.486	539.899	2.227	2	0.328
Dstancemrk	607.204	732.791	539.204	1.531	2	0.465
Agroez	617.445	743.032	549.445	11.773	2	0.003
Land size	610.574	736.16	542.574	4.901	2	0.086
Religion	612.421	738.008	544.421	6.749	2	0.034
Credit service	614.625	740.212	546.625	8.952	2	0.011

- The chi-square (χ^2) statistic is the difference in -2 log-likelihoods and the final model and a reduced model.
- The reduced model is formed by omitting an effect from the final model.
- The null hypothesis is that all parameters of that effect are 0.

The AIC and BIC both values show $_{\text{that}}$ penalized likelihood criteria.AIC is an estimate of constant plus the relative distance between the unknown likelihood function of the data and fitted likelihood of a model, so that lower. Generally, the values of all BIC must be less,to all explanatory variables which shows best model fitness.

The multinomial logistic regression result

Iteration 0: log likelihood = -315.17657

Iteration 1: log likelihood = -269.51153

Iteration 2: log likelihood = -268.8386

Iteration 3: log likelihood = -268.83635

Iteration 4: log likelihood = -268.83635

Multinomial logistic regression

Number of obs = 297 LR chi2 (34) = 92.68

Prob> chi2 = 0.0000 Log likelihood = -268.83635 Pseudo R2 = 0.1470

Table 13: The multiple logistic regression result

Farmers		B	Std.	Wald	Df	Sig.	Exp(B)	95% Confidence	
								Lower	Upper
Goat alone	Intercept	-0.017	1.541	0	1	0.991			
	AGEHHs	-0.015	0.016	0.792	1	0.374	0.985	0.954	1.018
	FMSIZE	0.198	0.075	7.002	1	0.005***	0.82	0.708	0.95
	MRTLSTAT	-0.891	0.327	7.425	1	0.006***	0.41	0.216	0.779
	EDU	-0.203	0.339	0.359	1	0.549	0.816	0.42	1.586
	GNDER	0.259	0.315	0.679	1	0.41	1.296	0.699	2.403
	TOTLVSTOCK	0.128	0.052	6.157	1	0.013***	1.136	1.027	1.257
	TOTCASH	0.111	0.1132	0.761	1	0.383	1	1	1
	EXPNDTRE	0.1321	0.564	0.025	1	0.874	1	1	1
	oFFARMINC	1.104	0.401	7.586	1	0.006***	3.015	1.375	6.612
	EXPRUMPRO	0.071	0.084	0.701	1	0.402	1.073	0.91	1.266
	EXTNCONTCT	0.426	0.333	1.638	1	0.201	0.653	0.34	1.254
	NHARD	-0.283	0.382	0.549	1	0.459	0.754	0.357	1.593
	DSTANCEMrKT	-0.038	0.057	0.437	1	0.509	0.963	0.86	1.077
	AgroEZ	-0.574	0.209	7.565	1	0.006***	0.563	0.374	0.848
	LANDSZ	0.184	0.281	0.427	1	0.514	1.202	0.693	2.085
	RELGION	-0.391	0.224	3.052	1	0.081	0.676	0.436	1.049
	CREDITServce	0.932	0.335	7.742	1	0.005***	2.539	1.317	4.895
Both alone	Intercept	-2.387	1.679	2.021	1	0.155			
	AGEHHs	0	0.018	0	1	0.985	1	0.965	1.036
	FMSIZE	0.008	0.085	0.009	1	0.925	0.992	0.84	1.171
	MRTLSTAT	-0.765	0.375	4.153	1	0.042**	0.466	0.223	0.971
	EDU	0.215	0.375	0.329	1	0.566	1.24	0.594	2.588
	GNDER	-0.034	0.356	0.009	1	0.924	0.967	0.481	1.941
	TOTLVSTOCK	0.015	0.061	0.064	1	0.8	0.985	0.873	1.11
	TOTCASH	0.111	0.3124	2.919	1	0.088	1	1	1
	EXPNDTRE	0.131	0.213	1.923	1	0.165	1	1	1
	oFFARMINC	0.73	0.428	2.903	1	0.088	2.074	0.896	4.802
	EXPRUMPRO	0.226	0.093	5.833	1	0.016***	1.253	1.043	1.505
	EXTNCONTCT	1.147	0.448	6.563	1	0.01***	3.15	1.309	7.576
	NHARD	-0.574	0.413	1.929	1	0.165	0.564	0.251	1.266
	DSTANCEMrKT	-0.074	0.065	1.305	1	0.253	0.929	0.818	1.054
	AgroEZ	0.104	0.243	0.182	1	0.67	1.109	0.689	1.787
	LANDSZ	0.637	0.309	4.256	1	0.039**	1.891	1.032	3.463
	RELGION	-0.576	0.264	4.773	1	0.029**	0.562	0.335	0.942
	CREDITServce	0.419	0.378	1.231	1	0.267	1.521	0.725	3.188

Source STATA output computation from survey data of(2021)

*Note: *****, **** and ***** denotes level of significance at 1%, 5% and 10% respectively.*

The marginal effect result of multinomial logistic regression model

mfx

Marginal effects after regress

y = Fitted values (predict) = 1.8754209

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Table 14: The marginal effect of multinomial logistic regression model estimation

No	variable	Dy/dx	Stderor	Z	p>z	95% ci		X
1	**Agehhs**	**0.002853**	**0.66**	**0.506**	**0.506**	**-.00556**	**.011266**	**43.8519**
2	**Fmlysze**	**0.046702**	**2.39**	**0.017**	**0.005**	**.008471**	**.084933**	**7.48148**
3	**Mrrtlstatu**	**0.069247**	**0.8**	**0.424**	**0.004**	**-.1004**	**.238941**	**0.703704**
4	**Education**	**0.118751**	**1.33**	**0.183**	**0.183**	**-.05610**	**.293608**	**0.343434**
5	**Gender**	**-0.06793**	**-0.81**	**0.416**	**0.416**	**-.23155**	**.095699**	**0.525253**
6	**Totlvstock**	**0.03489**	**-2.62**	**0.009**	**0.009**	**-.06104**	**-.00874**	**12.1414**
7	**tot cash**	**5.98E-06**	**0.7**	**0.486**	**0.486**	**-.00001**	**.000023**	**9791.65**
8	**Expenditure**	**1.9E-05**	**-1.48**	**0.138**	**0.138**	**-.00004**	**6.0e-06**	**6012.79**
9	**Offarmactvty**	**0.09877**	**-0.97**	**0.332**	**0.003**	**-.29829**	**.100765**	**0.6633**
10	**Excprnce**	**0.030524**	**1.39**	**0.165**	**0.010**	**-.01254**	**.073587**	**6.44108**
11	**Extncontct**	**0.327817**	**3.61**	**0**	**0.007**	**.150007**	**.505627**	**0.686869**
12	**Natrlhazrd**	**-0.05035**	**-0.51**	**0.61**	**0.610**	**-.24380**	**.143108**	**0.616162**
13	**Distncemrket**	**-0.00786**	**-0.53**	**0.598**	**0.598**	**-.03710**	**.02139**	**8.73064**
14	**Agroecology**	**-0.17322**	**3.15**	**0.002**	**0.004**	**.06552**	**.280921**	**1.20202**
15	**land size**	**0.107082**	**1.45**	**0.148**	**0.029**	**-.03801**	**.252179**	**1.04293**
16	**Relgion**	**-0.02034**	**-0.34**	**0.733**	**0.021**	**-.13738**	**.096708**	**1.61616**
17	**credit access**	**0.13332**	**-1.52**	**0.128**	**0.003**	**-.30502**	**.03839**	**1.367**

Source: marginal effect output, computed from the source of; survey data, (2021)

Result of Negative binomial regression model

Table 15: Negative binomial regression model estimation

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			Exp(B)	95% Wald Confidence Interval for Exp(B)	
			Lower	Upper	Wald Chi-Square	Df	Sig.		Lower	Upper
(Intercept)	0.39	0.215	-0.031	0.812	3.297	1	0.069	1.477	0.969	2.252
Agehhs	0.002	0.002	-0.003	0.006	0.538	1	0.463	1.002	0.997	1.006
Fmsize	0.025	0.011	0.004	0.046	5.651	1	0.017	1.025	1.004	1.047
Mrtlstat	0.036	0.047	-0.057	0.128	0.576	1	0.448	1.036	0.945	1.137
Edu	0.064	0.048	-0.029	0.158	1.83	1	0.176	1.067	0.971	1.171
Gnder	-0.04	0.045	-0.126	0.051	0.681	1	0.409	0.963	0.882	1.052
Totlvstock	0.02	0.007	-0.034	-0.005	6.764	1	0.009	0.981	0.967	0.995
Offarminc	-0.05	0.054	-0.16	0.053	0.978	1	0.323	0.948	0.852	1.054
Exprumpro	0.016	0.012	-0.007	0.039	1.867	1	0.172	1.016	0.993	1.04
Extncontct	0.181	0.05	0.082	0.28	12.935	1	.000	1.199	1.086	1.323
Agroez	0.095	0.03	0.036	0.154	10.024	1	0.002	1.1	1.037	1.166
Landsz	0.058	0.04	-0.02	0.135	2.145	1	0.143	1.06	0.981	1.145
Relgion	-0.01	0.032	-0.074	0.053	0.11	1	0.74	0.989	0.929	1.054
Creditservce	-0.07	0.048	-0.165	0.022	2.273	1	0.132	0.931	0.848	1.022

Source:- Computed from the source of; survey data,(2021)

Negative binomial regression Number of obs = 297

LR chi2(17) = 12.01

Dispersion = mean Prob > chi2 = 0.7996

Log likelihood = -407.30873 Pseudo R2 = 0.0145